Regents Physics Problem Workbook Pack & Handout Supplements

CONTENTS

Kinematics Problems

#1) Stewie pushes Lois down the stairs and she slides 4 m at an average speed of 3 m/s. Determine the time of her stair fall.

#2) The evil monkey chases Chris down the road at a speed of 5 km/hr over 50 m. How long in seconds was the chase.

#3) Peter travels to work 5 km north, then turns around and heads 3 km south to arrive at the bar. The trip took him 10 minutes. (a) What was his average velocity over the whole trip, (b) what was his average speed over the whole trip.

#4) A torpedo fired from a submerged submarine is propelled through the water with a speed of 20 m/s and explodes upon impact with a target 2000 m away. If the sound of the impact is heard 101.4 seconds after the torpedo was initially fired, what is the speed of sound in water? (Because the torpedo is held at a constant speed by its propeller, the effect of water resistance can be neglected)

#5) – Bart Simpson is skateboarding on the sidewalk for 10m with an average velocity of 5 m/s East and then he hits wet cement and travels 5 m at an average velocity of 4 m/s East. What is the average velocity for the entire trip.

#6) – You are in the guidance office desperately trying to drop physics and you realize you are late for class. You run for 5 seconds from guidance to the auditorium at an average speed of 5 m/s. Mr. Ross sees you running so he trips you and you slide for 10 seconds at an average speed of 1 m/s. You finally get up and pick your nose for 5 seconds and then run for 7 seconds at a speed of 3 m/s to reach class.
a) sketch this situation b) find the average speed for the entire motion.

#7) – One time, at band camp, you were running a go cart race on a straight track and rode the first 250 m at a velocity of 12 m/s East. You then stopped for 1.5 minutes to play your flute. You continued the race and finished the last 150 m at a constant speed East. Your average velocity for the entire trip was 3.33 m/s East, what was your average velocity in only the last 150 m stretch.

Hint: (This problem is similar to the multi-step problem we have done before but is slightly different. You can not follow the steps the exact same way, but the procedure is very similar … set up the problem the same way, list all the things you have, and find everything you need in order to solve. You will do all of the same things you did before when doing this problem type, you just need to do them in a different order)

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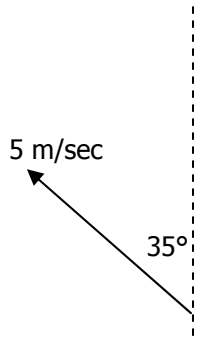
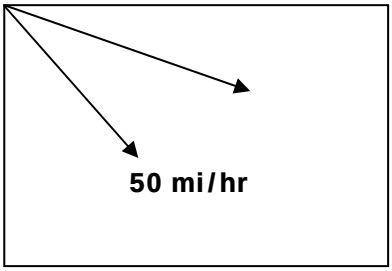
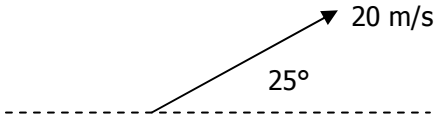
Vectors Student Sheet #1 - Assume North is upwards on the page. The vectors shown below can be described two different ways to produce the same thing. Write down the two descriptions of the vector shown



Follow the steps given in class for determining the direction of a vector, and use a protractor to describe the 50 mi/hr vector shown below

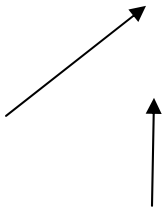


A plane is taking off from a runway heading upwards.

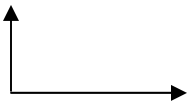


Add the vectors below by using a quick rough sketch to show your answer.

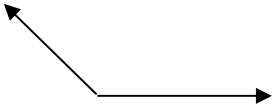
(a)



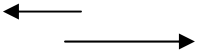
(b)



(c)



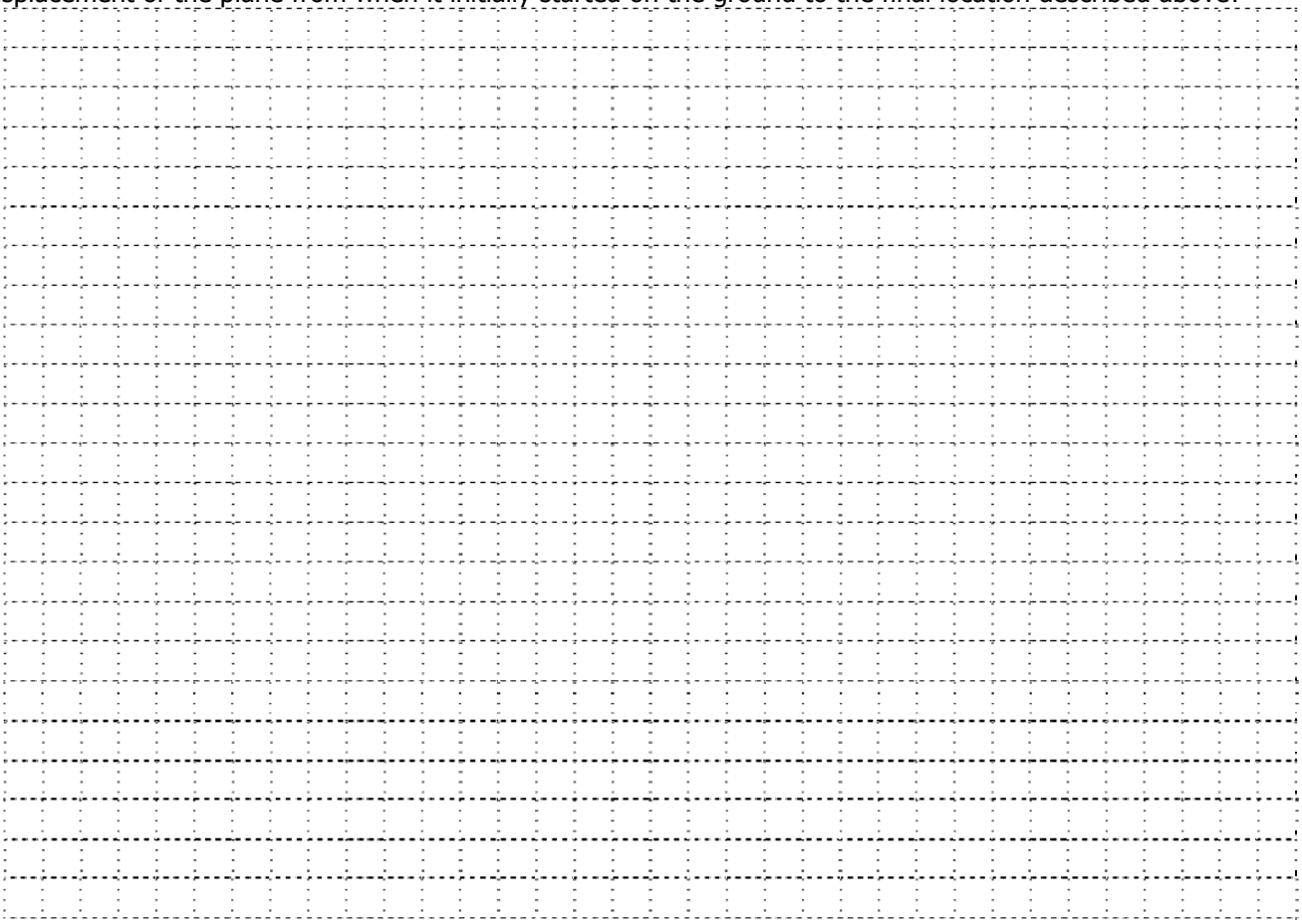
(d)



Vector Student Sheet #2 – Solve the vector problems below. Use a mathematical solution if possible, if not use a graphical solution.

1.) – Vector **x** = 15 m/s west. Vector **y** = 40 m/s south Find **x** + **y**

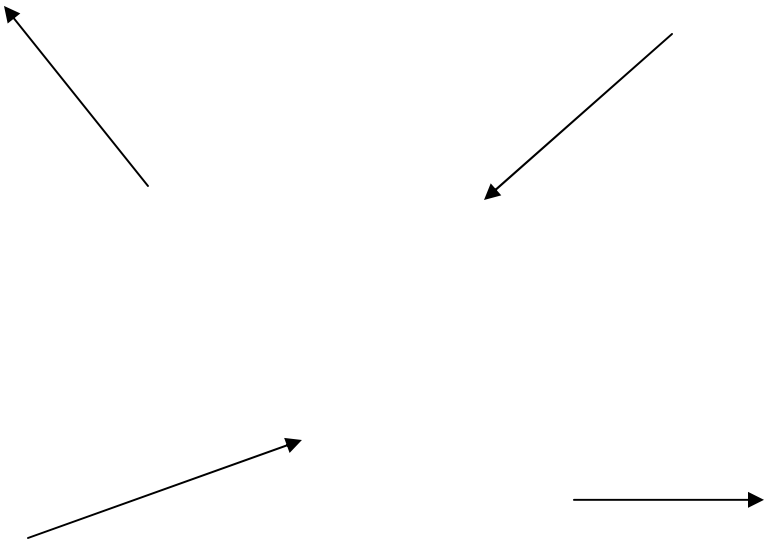
2.) - A plane starts on the ground and heads upwards at an angle of 60 degrees above the horizontal. It travels a distance of 100 m when it is hit by a missile and drops vertically downward a distance of 40 m. What is the displacement of the plane from when it initially started on the ground to the final location described above?



3.) A cat walks 12 m north in 10 seconds. Turns and runs 20 m east in 5 seconds, Determine the cats velocity (a vector quantity)

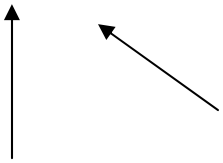
Vector Student Sheet #3 –

Draw sketches of the components of the vectors shown below

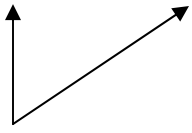


Draw a sketch of the resultant of the following vectors.

(a)



(b)



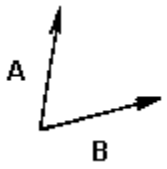
Regents Practice 1

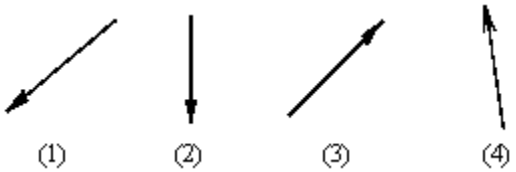
1) Which measurement of an average classroom door is closest to 1 meter?
1) thickness 2) width 3) height 4) surface area

2) Which two terms represent a vector quantity and the scalar quantity of the vector's magnitude, respectively?

1. acceleration and velocity
2. weight and force
3. speed and time
4. displacement and distance

3) Which vector below represents the resultant of the concurrent vectors *A* and *B* in the diagram?





4) A student walks 1.0 kilometer due east and 1.0 kilometer due south. Then she runs 2.0 kilometers due west. The magnitude of the student's resultant displacement is closest to
1) 0 km 2) 1.4 km 3) 3.4 km 4) 4.0 km

5) What is the approximate mass of a chicken egg?

1) 1×10^{1} kg 2) 1×10^{2} kg
3) 1×10^{-1} kg 4) 1×10^{-4} kg

6) A force of 6.0 newtons north and a force of 8.0 newtons east act concurrently on an object. The magnitude of the resultant of the two forces is

1) 1.3 N 2) 2.0 N
3) 10. N 4) 14 N

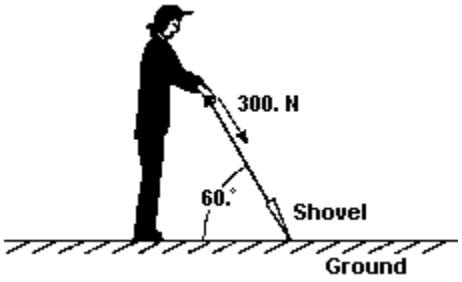
7) As the angle between a force and level ground decreases from 60° to 30°, the vertical component of the force

1. decreases
2. increases
3. remains the same

8) Which pair of concurrent forces could produce a resultant force having a magnitude of 10. newtons?

1) 10. N, 10. N 2) 10. N, 30. N
3) 4.7 N, 4.7 N 4) 4.7 N, 50. N

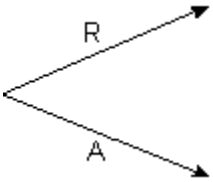
9) The diagram shows a person exerting a 300.-newton force on the handle of a shovel that makes an angle of 60.° with the horizontal ground.



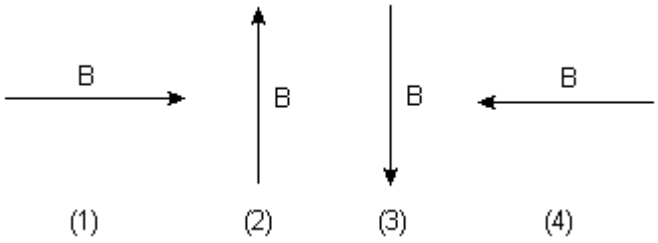
The component of the 300.-newton force that acts perpendicular to the ground is approximately

1) 150. N 2) 260. N 3) 300. N 4) 350. N

10) Forces *A* and *B* have a resultant *R*. Force *A* and resultant *R* are represented in the diagram below.



Which vector best represents force *B*?



11) A 5.0-newton force could have perpendicular components of

1. 1.0 N and 4.0 N
2. 2.0 N and 3.0 N
3. 3.0 N and 4.0 N
4. 5.0 N and 5.0 N

#1) Superman is flying horizontally at 25 m/s and accelerated in a straight line to 50 m/s in 2 seconds order to catch a falling lois lane. (a) What is superman's acceleration (b) What is superman's average speed in these 2 seconds (c) How far did superman travel in these 2 seconds.

#2) Santa claus is sliding down the chimney at 10 m/s and needs to slow his decent. He sticks out his fat gut against the chimney to cause an average acceleration of 5 m/s^2 upward over a 4m distance. (a) How fast is he traveling after the 2 m decent, and (b) How long did it take him to reach this new speed.

#3) A car accelerates from rest at -3 m/s^2. (a) What is the velocity at the end of 5.0 s? (b) What is the displacement after 5.0 sec

#4) A ball initially at rest rolls down a hill with an acceleration of 3.3 m/s^2. If it accelerates for 7.5 s, how far does it travel?

#5) A jet plane lands with a speed of 100 m/s and can accelerate uniformly at a maximum rate of -5.0 m/s^2 as it comes to rest on the landing strip. Can this plane land at an airport where the runway is 0.80 km long (Hint, the 0.80 km is not necessarily the distance actually traveled, it is simply the total length of the runway which can be used as a comparison)?

#6) The Easter Bunny and the Tooth Fairy are running a race together. They start from rest and accelerate at 5 m/s^2 for 10 seconds. The Easter bunny then has a heart attack (too much chocolate) and falls over. The tooth fairy stops accelerating at this point and he maintains his speed at a constant rate until he finishes the race 20 seconds later.

(a) What is the total distance traveled by the tooth fairy?
(b) What is the Easter Bunny's average velocity while he was running?
(c) What is the tooth fairy's average velocity for the whole trip?

#7) The school bully stuffs you in an oil barrel and kicks it. You roll on a horizontal surface with an initial velocity of 20 m/s. You slow down at a rate of 2 m/s^2 for 5 seconds until you reach a hill (note you are slowing so the acceleration would be negative). At this point you roll down a hill and accelerate at 3.5 m/s^2 down the hill for 10 seconds. What is the total distance you traveled on your mystical journey and what final speed do you achieve at the base of the hill.

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Regents Practice 2

1) A girl leaves a history classroom and walks 10 meters north to a drinking fountain. Then she turns and walks 30 meters south to an art classroom. What is the girl's total displacement from the history classroom to the art classroom?

(1) 20. m south (3) 40. m south
(2) 20. m north (4) 40. m north

2) A boat initially traveling at 10. meters per second accelerates uniformly at the rate of 5.0 meters per second squared for 10. seconds. How far does the boat travel during this time?

1. 50. m
2. 250 m
3. 350 m
4. 500 m

3) What is the total distance traveled by an object that moves with an average speed of 6.0 meters per second for 8.0 seconds?

1. 0.75 m
2. 1.3 m
3. 14 m
4. 48 m

4) A car moving at a speed of 8.0 meters per second enters a highway and accelerates at 3.0 meters per second squared. How fast will the car be moving after it has accelerated for 56 meters?

1. 24 m/s
2. 20. m/s
3. 18 m/s
4. 4.0 m/s

5) The speed of a wagon increases from 2.5 meters per second to 9.0 meters per second in 3.0 seconds as it accelerates uniformly down a hill. What is the magnitude of the acceleration of the wagon during this 3.0-second interval?

(1) 0.83 m/s^2 (3) 3.0 m/s^2
(2) 2.2 m/s^2 (4) 3.8 m/s^2

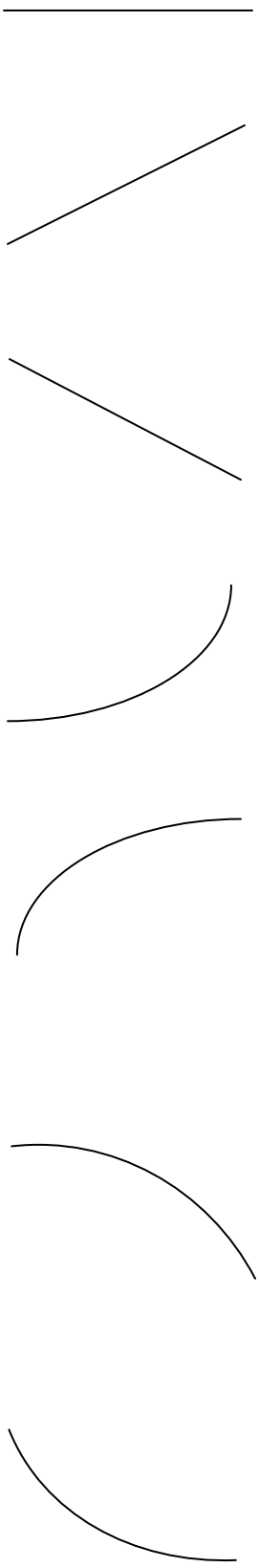
6) In a 4.0-kilometer race, a runner completes the first kilometer in 5.9 minutes, the second kilometer in 6.2 minutes, the third kilometer in 6.3 minutes, and the final kilometer in 6.0 minutes. The average speed of the runner for the race is approximately

(1) 0.16 km/min (3) 12 km/min
(2) 0.33 km/min (4) 24 km/min

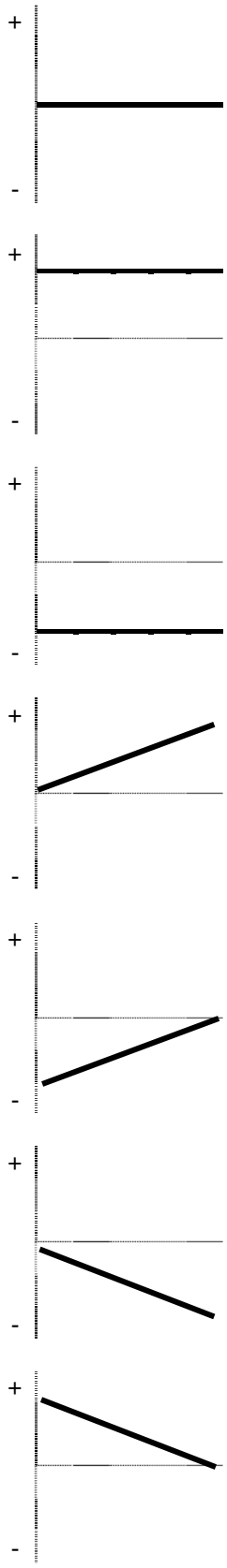
7) As a car is driven south in a straight line with *decreasing* speed, the acceleration of the car must be

(1) directed northward
(2) directed southward
(3) zero
(4) constant, but not zero

Student Handout - “d vs t” segments



Student Handout – “V vs T” segments



Any curved line =

Motion Curves Summary Sheet

D vs T Curves – The key thing to remember in this graph is that the slope is the velocity. Whatever the slope is doing, that's what the velocity is doing.

D vs T curves - Describing Motion Behavior

- To find the sign of the velocity +/- look at the slope direction …

upwards slope +v	downwards slope - v	Flat slope v = 0

- To find the direction of motion (forward/backward), look at the sign of the velocity …

+ v = forward	- v = backward

- To find what's happening to velocity (increasing/decreasing/constant/stop) look at how the slope is changing

slope gets flatter = less slope = less v (slow down)	slope get steeper = more slope = more v (speed up)	Slope w/ no change=constant v
Any horizontal line = Stopped, V = 0		

- To find the sign of the acceleration +/- think of the combination that works

+V and Increase V (speed up) = + a	+V and Decrease V (slow down) = - a

- V and Increase V (speed up) = - a	- V and Decrease V (slow down) = +a

All other cases have a = 0

D vs T curves – Analyzing Motion

- Velocity at a certain time (that is an instantaneous velocity),
  find the slope of the line at that point. DO NOT use v = d/t

- Displacement at a certain time (implies from when you started until that time),
  just read off the y axis where you are and include a direction

- Displacement in between two times (such as from 10 to 20 seconds),
  find the difference in the displacements at each time. If at 10 sec you were at 5 m and at 20 sec you were at -3 m your displacement between the two times is -8 m. ($d_{final} - d_{initial}$)

- Distance traveled at a certain time (implies from when you started until then),
  add up the absolute value of each displacement from all segments (ignore the negative signs)

- AVERAGE **velocity** at a given time or between two times
  use v = d / t (d=displacement), get the **displacement** as described above, include a direction.

- AVERAGE **speed** at a given time or between two times
  use v = d / t (d=distance), get the **distance** as described above

- Acceleration - Actual Values of acceleration are not usually asked for in this type of analysis .. you should know when it is zero or when you have + a or – a though

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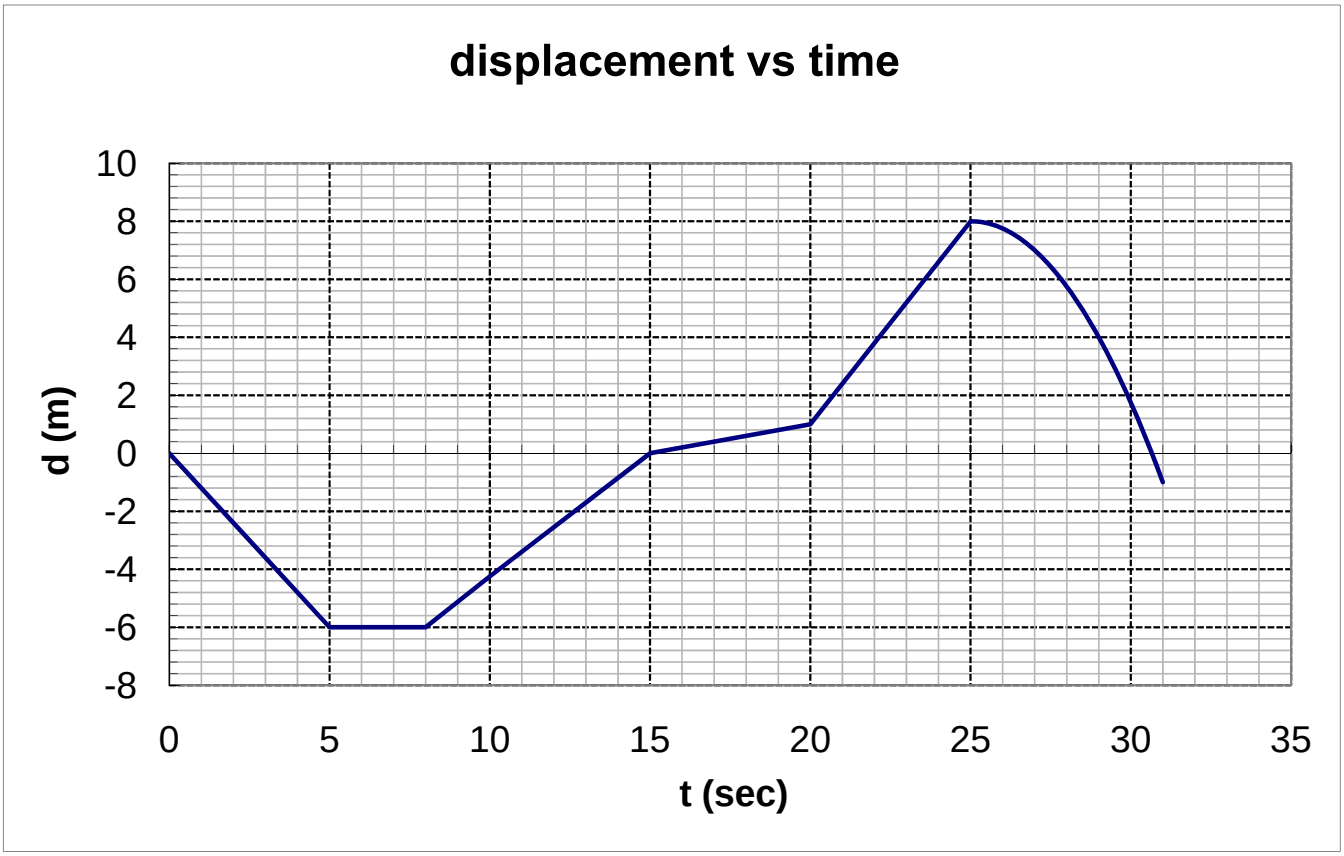
#10) – D-T Curve 1

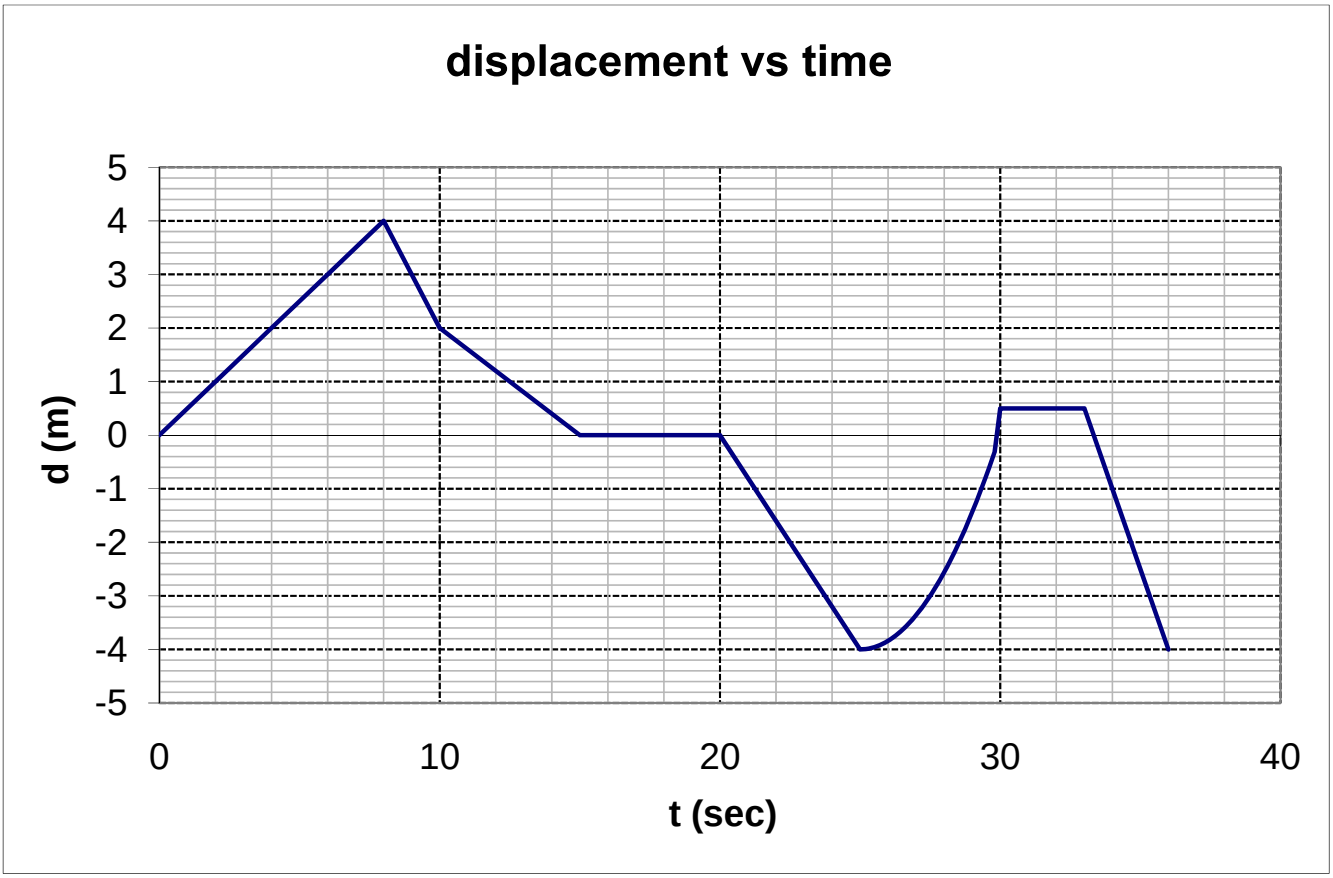
The following graphs represent straight line motion of a car initially heading west.



1 - At what times is the car accelerating
2 - Describe the behavior of the car from 6 to 8 seconds
3 - How much distance is covered over the whole trip
4 - What is the displacement at 22 seconds
5 - What is the average velocity from 0-15 seconds
6 - What is the average speed from 0-15 seconds
7 - What is the velocity at 27 seconds
8 - What is the velocity at 12 seconds

#11) – D-T Curve 2

The following graphs represent straight line motion of a car initially heading North



1 - At what times is the car stopped
2 - Describe the behavior of the car from 26 to 29 seconds
3 - How much distance is covered over the whole trip
4 - What is the displacement between 10 and 25 seconds
5 - What is the average velocity from 0-10 seconds
6 - What is the average speed from 5-15 seconds
7 - What is the velocity at 12 seconds
8 - What is the velocity at 30 seconds

Motion Curves Summary Sheet

V vs T Curves – Key idea = The slope is the acceleration, The velocities are on the y axis.

V vs T curves – Describing Motion

- To find the sign of velocity +/- look at the y axis …

When above 0 (+y) → + V	When below 0 (-y) → - V	When on 0 line → v=0

- To find the direction of motion (forward/backward) …

+ v = forward	- v = backward

- To find what's happening to velocity (increasing/decreasing/constant/stiop) look at the y axis

Moving towards 0, decreasing V	Moving away from 0, increase V	Straight line not on zero = constant V
Straight line on 0 only = stopped		

- To find the sign of the acceleration +/- look at the slope

upwards slope +a	downwards slope -a	Flat slope a=0

V vs T curves – Analyzing Motion

- Velocity at a certain time (that is an instantaneous velocity),
  Just look at the y axis and read off the axis what the velocity is, include a direction with the answer.

- Displacement at a certain time (implies from when you started until that time),
  Find the areas **between the motion line and the x axis** for each section from start to the point in question. If you are below the x axis it is a negative area, if above it is a positive area. Add them all up and keep signs (+/-) when adding. Don't forget to include a direction on the answer

- Displacement in between two times (such as from 10 to 20 seconds),
  Same as above, find the Areas of the sections between the times you are looking at.

- Distance traveled at a certain time (implies from when you started until then),
  Almost the same as displacement: find the areas between the motion line and the x axis for each section from start to the point in question and add the absolute values of the areas (ignore negatives).

- AVERAGE **velocity or speed** over 1 individual segment only
  use $v(bar) = (V_i + V_f) / 2$ (velocity would have a direction, speed would not)
  or $v(bar) = d / t$ (d = displacement for velocity, d = distance for speed)

- Acceleration over a single segment – Find the slope of the line at the location where you are trying to find the acceleration, which is the same as doing $a = (V_f - V_i) / t$

- Acceleration over multiple segments (you would rarely see this) – you can't find the slope because you have multiple segments, you can use $a = (V_f - V_i) / t$ to get an average acceleration over the whole period.

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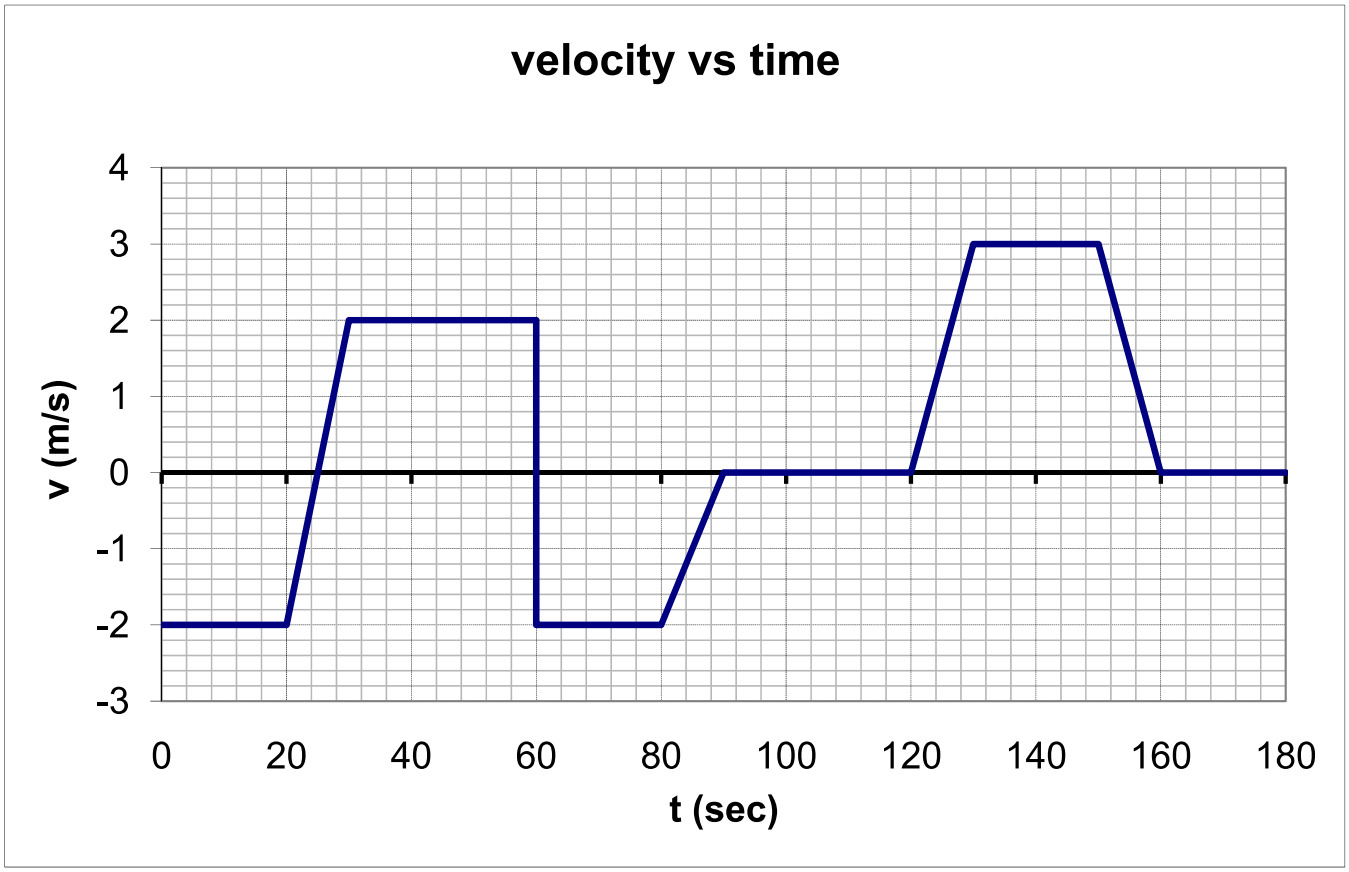
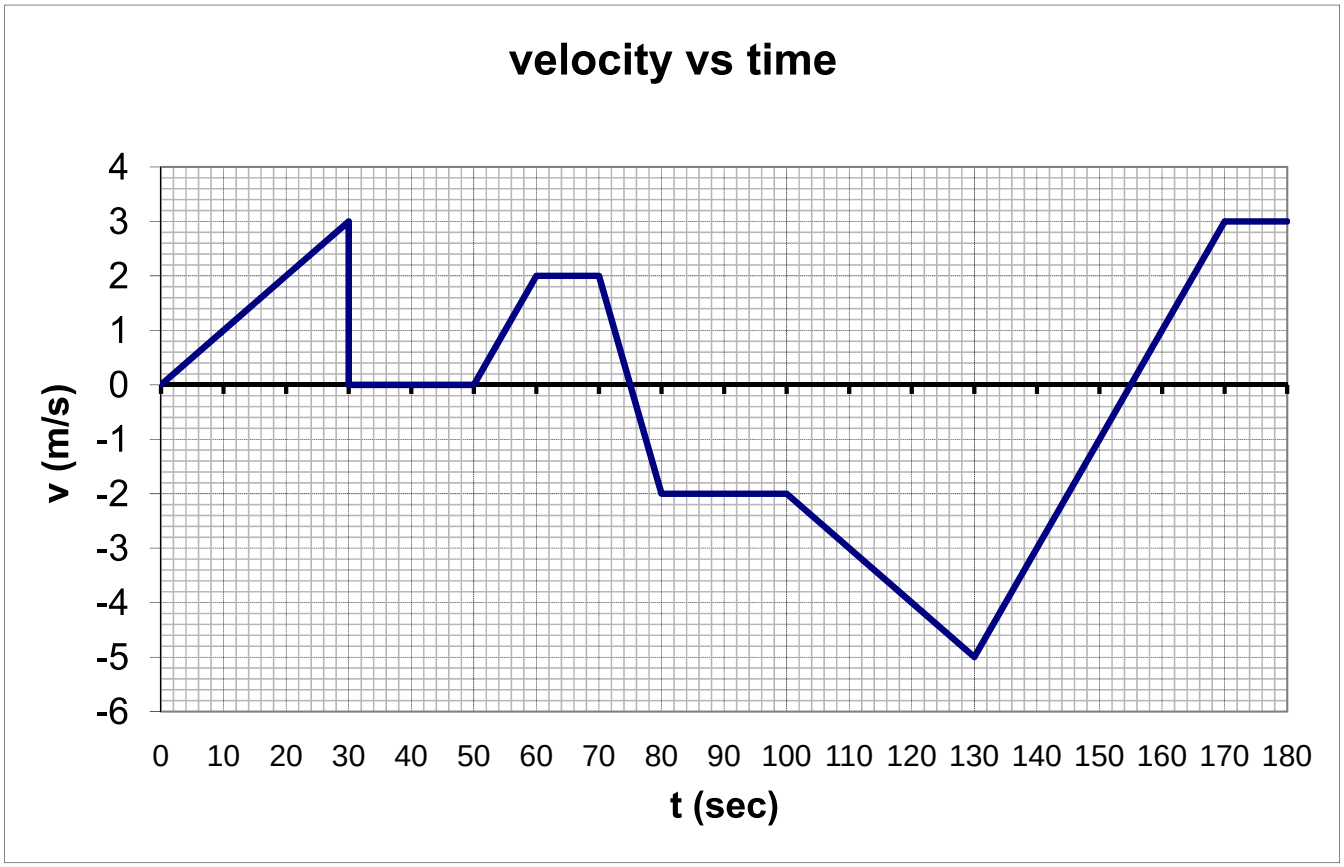
#12) – V-T Curve 1 (Assume the + direction represents east)



1 - How much distance is covered in the first 30 seconds
2 - In what time intervals is the car moving west
3 - What is the acceleration of the car from 40-60 seconds
4 - During what intervals does the car have constant non-zero velocity
5 - Find the displacement of the car from 50 to 90 seconds
6 - What is the average velocity of the car from 80-90 seconds
7 - What is the velocity and acceleration of the car at 125 seconds

#13) – V-T curve 2 (Assume the + direction represents east)

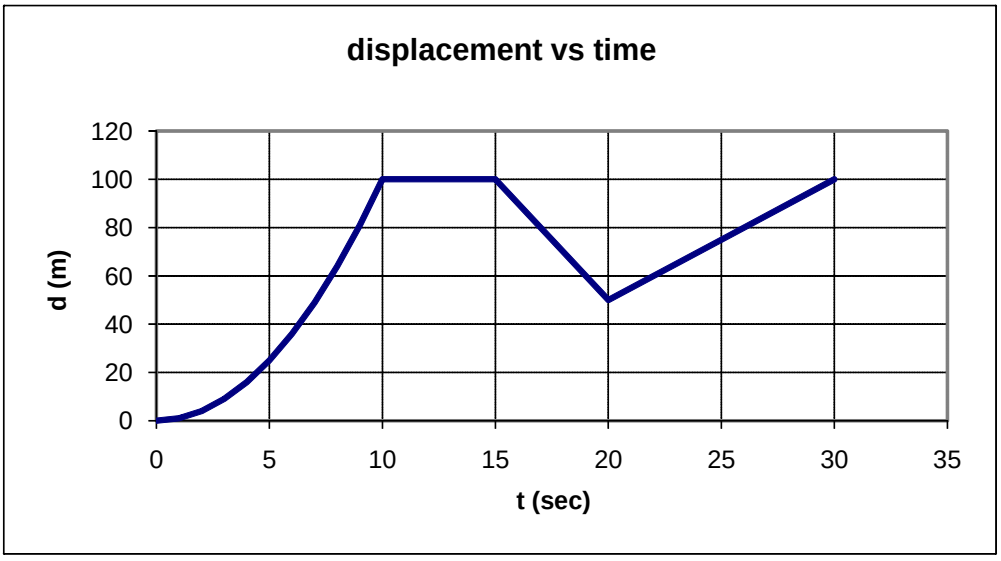


1 - How much distance is covered in the first 30 seconds
2 - In what time intervals is the car speeding up
3 - What is the acceleration of the car from 100-130 seconds
4 - What is the maximum acceleration of the car
5 - Find the displacement of the car from 130 to 180 seconds
6 - What is the average velocity of the car from 100-120 seconds
7 - What is the velocity and acceleration of the car at 140 seconds

#14) – Motion Curves

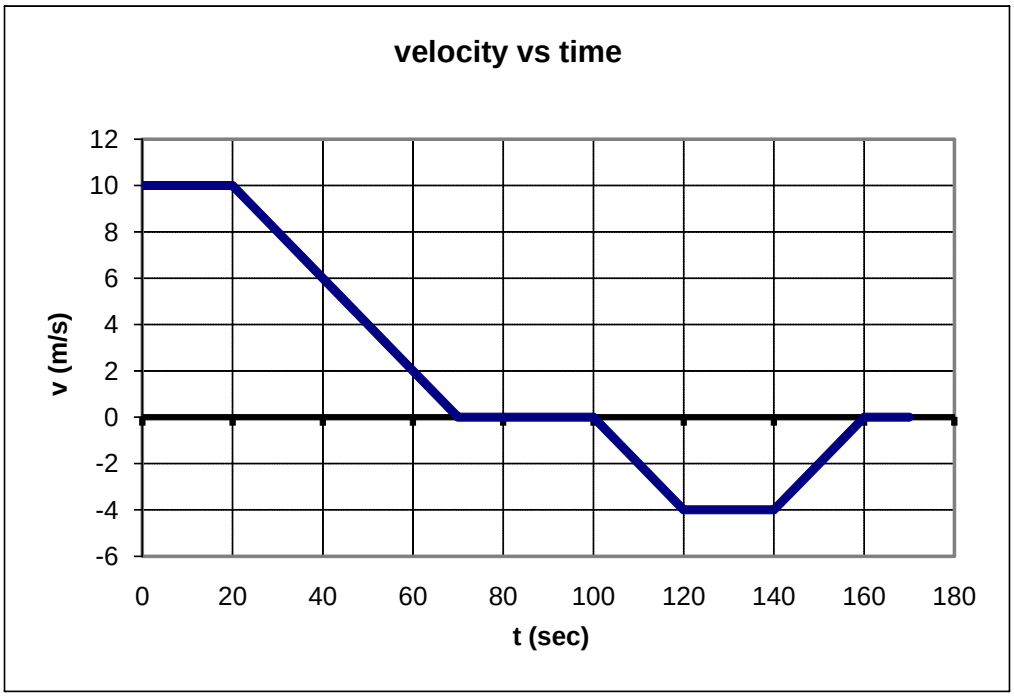
The following graphs represent straight line motion of a car initially heading east.

1



1 - At what times is the car stopped
2 - Describe the behavior of the car from 15 to 20 seconds
3 - How much **distance** is covered over the whole trip
4 - What is the **displacement** at the end of the trip
5 - What is the average velocity from 0-15 seconds
6 - Find the velocity at t = 5 seconds
7 - What is the acceleration from 25 to 40 seconds

2



1 - How much distance is covered in the first 40 seconds
2 - In what time intervals is the car moving backwards
3 - What is the acceleration of the car from 100-120 seconds
4 - During what intervals does the car have constant non-zero velocity
5 - Find the displacement of the car from 40 to 120 seconds
6 - What is the average velocity of the car from 40-70 seconds
7 - What is the velocity and acceleration of the car at 130 seconds

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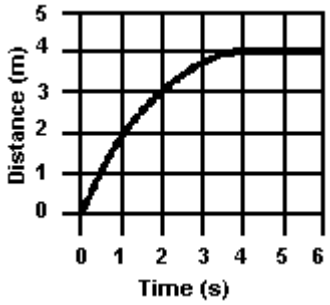
REGENTS PRACTICE 3

1) The graph represents the relationship between distance and time for an object.

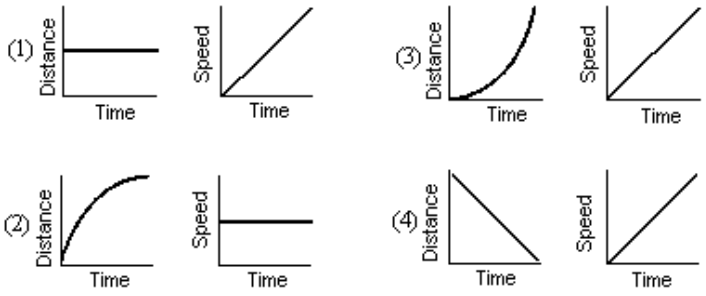


What is the instantaneous speed of the object at t = 5.0 seconds?
1) 0 m/s
2) 2.0 m/s
3) 5.0 m/s
4) 4.0 m/s

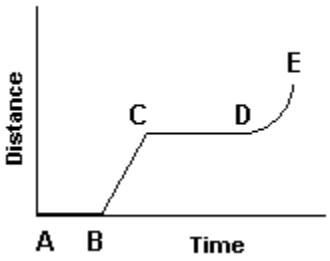
2) The graph represents the motion of a body moving along a straight line.

According to the graph, which quantity related to the motion of the body is constant?
1) speed
2) velocity
3) acceleration
4) displacement

3) Which pair of graphs represent the same motion?

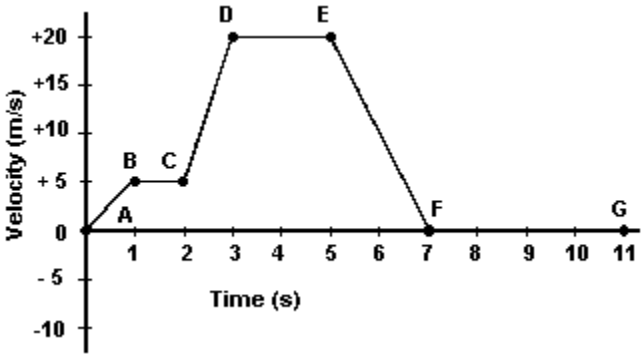


4) The graph represents the relationship between distance and time for an object in motion.



During which interval is the speed of the object changing?
1) AB
2) BC
3) CD
4) DE

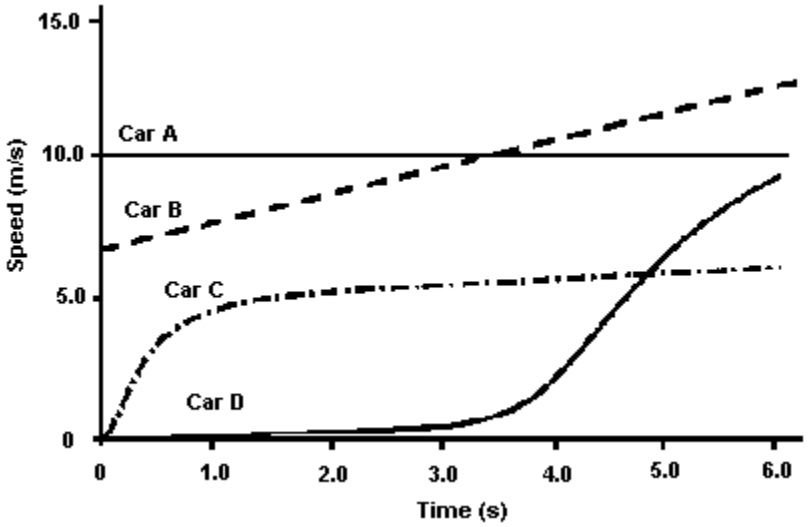
5) The graph represents the linear motion of a car.



5a) The acceleration of the car at t = 6.0 seconds is
1) -20. m/s2
2) -10. m/s2
3) 5.0 m/s2
4) 10. m/s2

5b) The car has the largest displacement during interval
1) FG
2) BD
3) EF
4) DE

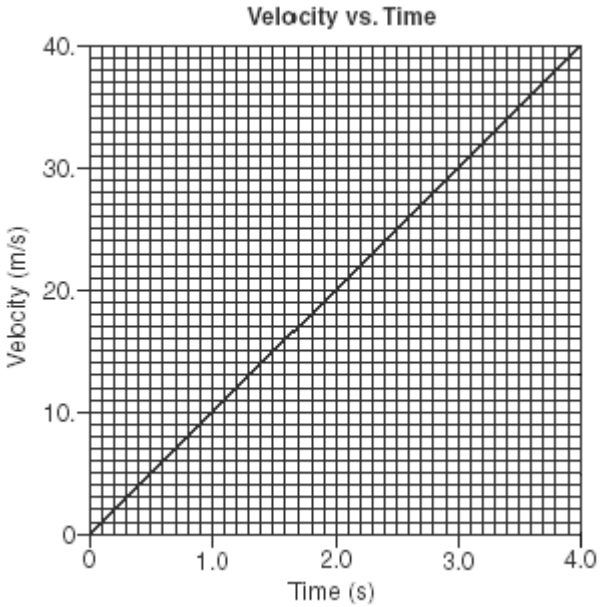
6) The graph shows speed as a function of time for four cars, A, B, C, and D , in straight-line motion.



Which car experienced the greatest average acceleration during this 6.0-second interval?

1) car A
2) car B
3) car C
4) car D

7) The graph below shows the velocity of a race car moving along a straight line as a function of time.



What is the magnitude of the displacement of the car from t = 2.0 seconds to t = 4.0 seconds?

1) 20. m
2) 40. m
3) 60. m
4) 80. m

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#1) A worker drops a wrench from the top of a tower. It falls on his grandma's head 80 m below him. What is the velocity when the wrench strikes his grandma?

#2) While on the roof of the school, you see your best friend sitting directly below you up against the wall. You take off your shoe and whip it at him straight downward at 8 m/s. It hits him 0.75 seconds later. (a) With what velocity does it hit your friend? (b) How far below you was your friend?

#3) A tennis ball is thrown vertically upward with an initial velocity of +8 m/s (a) What will the ball's velocity be when it returns to its start point. (b) What is the total time the ball is in the air for?

#4) A rat jumps in your lap and you scream like a baby and toss is straight upwards into the air. 3 seconds later, it lands back in your lap again. (a) At what speed did you throw the rat (b) What is the maximum height reached by the rat.

#5) You fell into a 10 m deep well. You use a slingshot to fire your shoe upwards at 18 m/s and it rises out of the well and lands on the ground next to it. (a) What was the velocity of the shoe when it hit the ground above. (b) How long was the shoe in the air for. (c) What was the maximum height reached by the shoe above the ground

#6) A BB gun is held at a height of 1.2 m above the ground and a BB is fired upwards at 8 m/s towards a squirrel sitting in a tree. The squirrel is 4 m above the ground at the location of the shooter. (a) Will the BB reach the squirrel? (b) Assuming that the squirrel does not get hit, how much time will the BB be in the air since it was launched?

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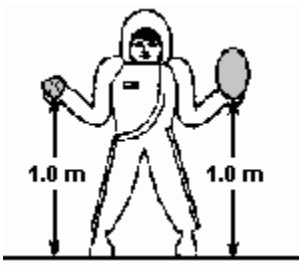
Regents Practice 4

1) A ball dropped from a bridge takes 3.0 seconds to reach the water below. How far is the bridge above the water? (1) 15 m (2) 29 m (3) 44 m (4) 88 m

2) An object near the surface of planet *X* falls freely from rest and reaches a speed of 12.0 meters per second after it has fallen 14.4 meters. What is the acceleration due to gravity on planet *X*?
(1) 2.50 m/s^2 (2) 5.00 m/s^2 (3) 9.8 m/s^2 (4) 10.0 m/s^2

3) As shown in the diagram, an astronaut on the Moon is holding a baseball and a balloon. The astronaut releases both objects at the same time. What does the astronaut observe? [Note: The Moon has no atmosphere.]



1. The baseball falls slower than the balloon.
2. The baseball falls faster than the balloon.
3. The baseball and balloon fall at the same rate.
4. The baseball and balloon remain suspended and do not fall.

4) A rock falls freely from rest near the surface of a planet where acceleration due to gravity is 4.0 meters per second per second. What is the speed of this rock after it falls 32 meters?
(1) 8.0 m/s (2) 16 m/s (3) 25 m/s (4) 32 m/s

5) A stone is dropped from a bridge approximately 45 meters above the surface of a river. Approximately how many seconds does the stone take to reach the water's surface?
(1) 1.0 s (2) 10. s (3) 3.0 s (4) 22 s

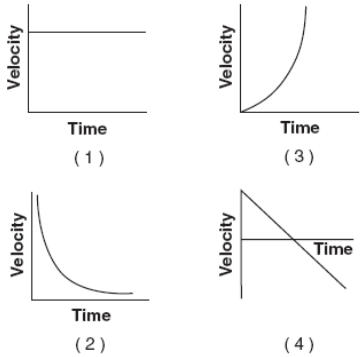
6) Objects *A* and *B* are dropped from rest near Earth's surface. Object *A* has mass *m* and object *B* has mass 2*m*. After 2 seconds of free fall, object *A* has a speed *v* and has fallen a distance *d*. What are the speed and distance of fall of object *B* after 2 seconds of free fall?
(1) speed = v/2 ; distance = d/2 (2) speed = *v*; distance = *d*
(3) speed = v/2 ; distance = 2*d* (4) speed = 2*v*; distance = 2*d*

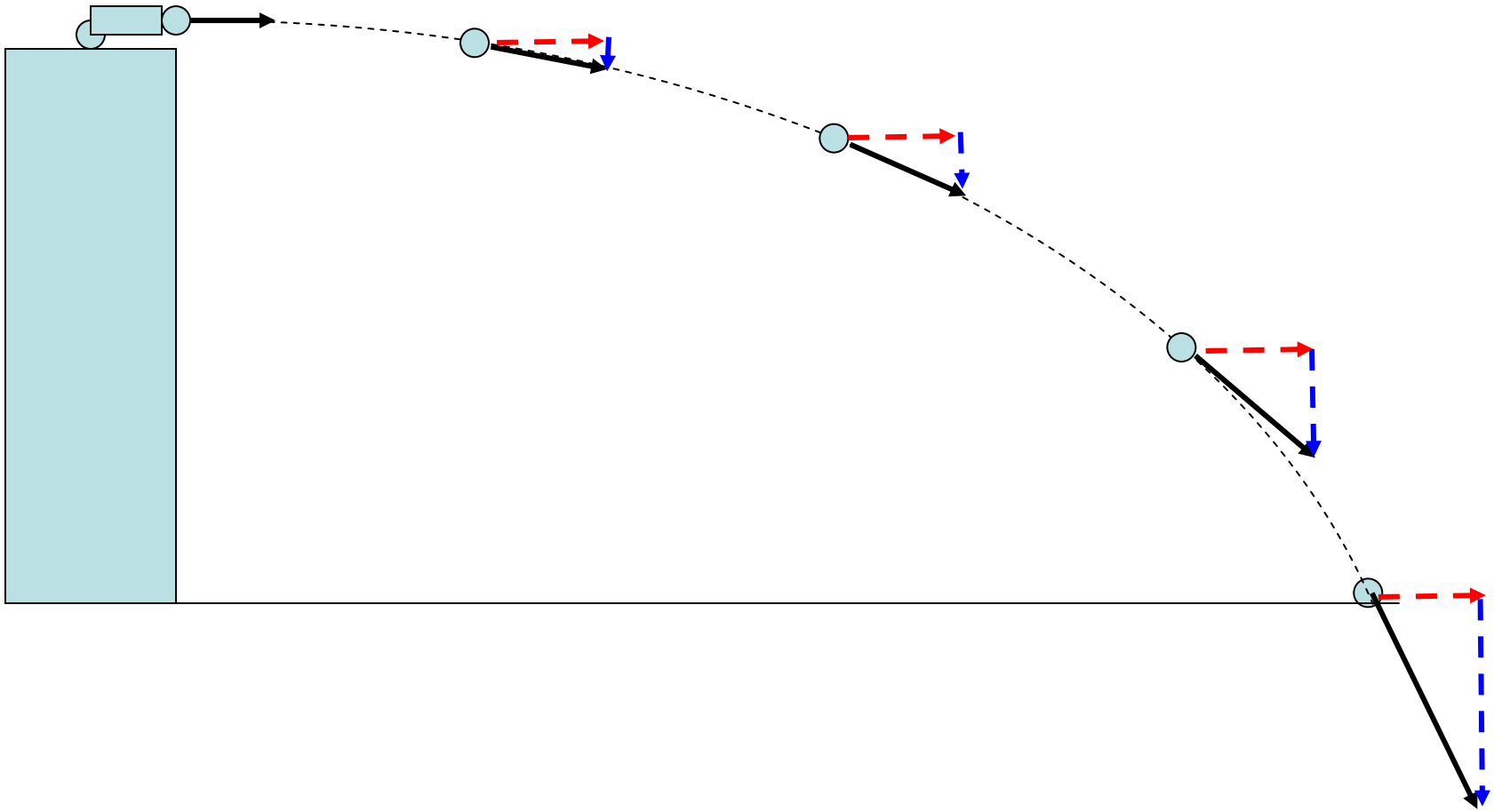
7) A ball thrown vertically upward reaches a maximum height of 30 meters above the surface of Earth. At its maximum height, the speed of the ball is (1) 0.0 m/s (2) 3.1 m/s (3) 9.8 m/s (4) 24 m/s

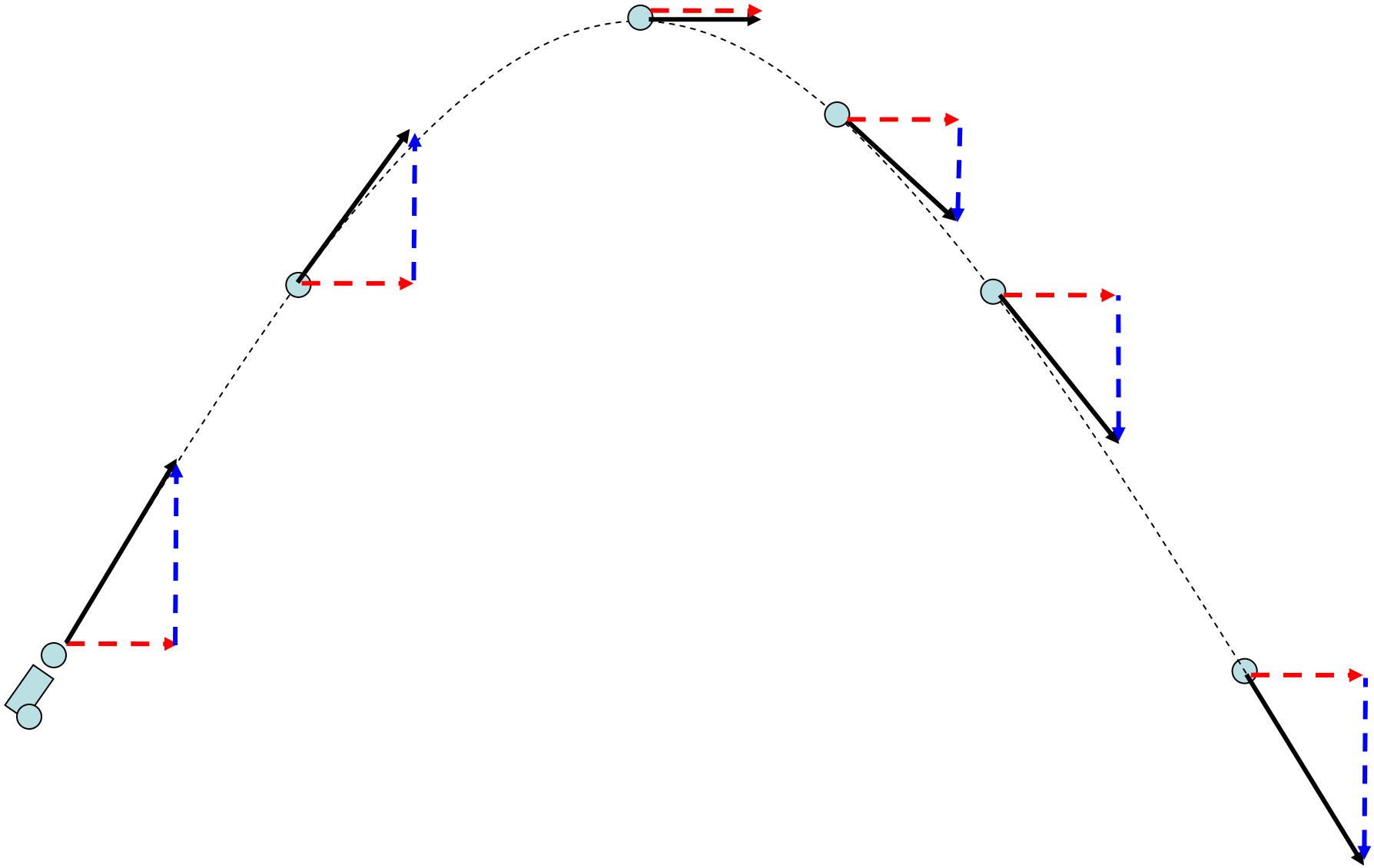
8) A basketball player jumped straight up to grab a rebound. If she was in the air for 0.80 second, how high did she jump? (1) 0.50 m (2) 0.78 m (3) 1.2 m (4) 3.1 m

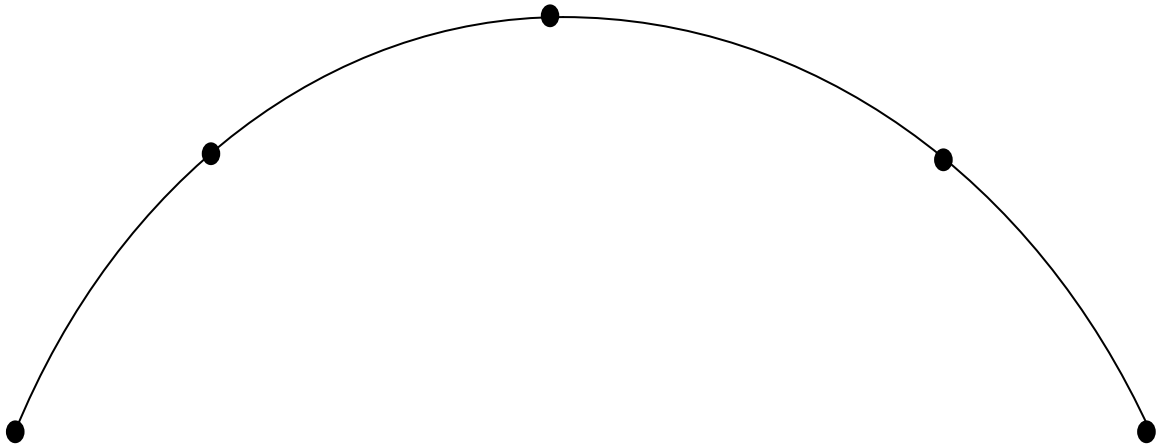
9) An object is dropped from rest and falls freely 20. meters to Earth. When is the speed of the object 9.8 meters per second?
(1) during the entire first second of its fall (2) at the end of its first second of fall
(3) during its entire time of fall (4) after it has fallen 9.8 meters

10) Which graph best represents the relationship between the velocity of an object thrown straight upward from Earth's surface and the time that elapses while it is in the air? [Neglect friction.]

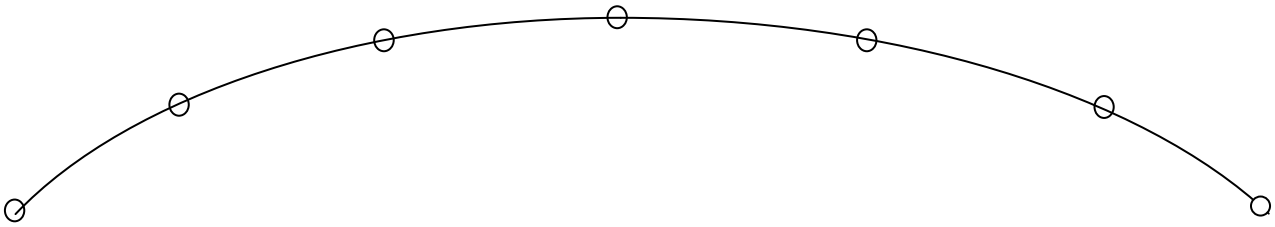








1 - In the figure above draw vectors and vector components to represent the **velocity** of the ball at each spot



2 – In figure above draw vectors and vector components to represent the **acceleration** of the ball at each spot.

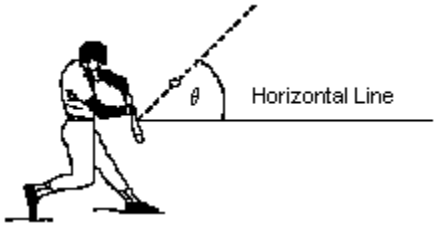
3 – In question #1 which of the components remain constant and which change and why?

REGENTS PRACTICE 5

1) A ball is thrown horizontally at a speed of 20. meters per second from the top of a cliff. How long does the ball take to fall 19.6 meters to the ground?
1) 1.0 s
2) 2.0 s
3) 9.8 s
4) 4.0 s

2) A book is pushed with an initial horizontal velocity of 5.0 meters per second off the top of a desk. What is the initial vertical velocity of the book?
1) 0 m/s
2) 2.5 m/s
3) 5.0 m/s
4) 10. m/s

3) The diagram shows a baseball being hit with a bat. Angle θ represents the angle between the horizontal and the ball's initial direction of motion.

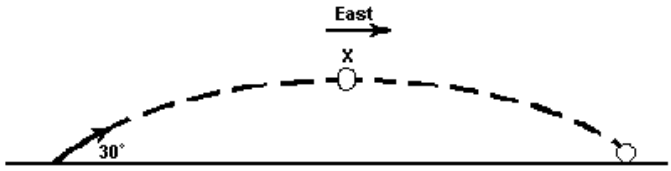


Which value of θ would result in the ball traveling the longest distance? [Neglect air resistance.]
1) 25° 2) 45° 3) 60° 4) 90°

4) An object is thrown horizontally off a cliff with an initial velocity of 5.0 meters per second. The object strikes the ground 3.0 seconds later. What is the vertical speed of the object as it reaches the ground? [Neglect friction.]
1) 130 m/s
2) 29 m/s
3) 15 m/s
4) 5.0 m/s

5) Four cannonballs, each with mass M and initial velocity V, are fired from a cannon at different angles relative to the Earth. Neglecting air friction, which angular direction of the cannon produces the greatest projectile height?
1) 90°
2) 70°
3) 45°
4) 20°

6) The diagram shows a ball thrown toward the east and upward at an angle of 30° to the horizontal. Point X represents the ball's highest point.

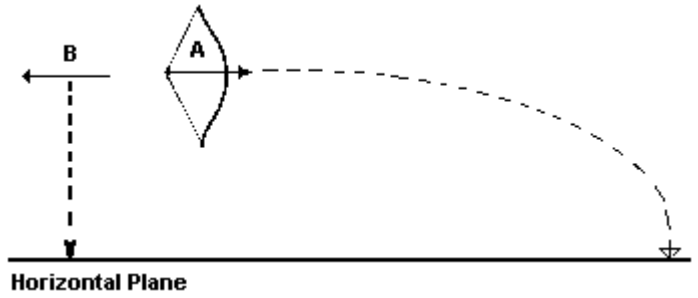


6a) What is the direction of the ball's velocity at point X? [Neglect friction.]
1) down 2) up 3) west 4) east

6b) What is the direction of the ball's acceleration at point X? [Neglect friction.]
1) down 2) up 3) west 4) east

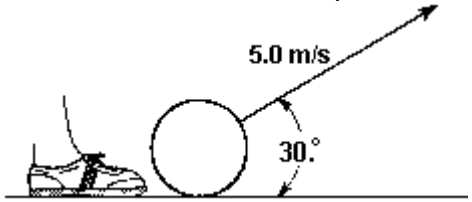
7) A batted softball leaves the bat with an initial velocity of 44 meters per second at an angle of 37° above the horizontal. What is the magnitude of the initial vertical component of the softball's velocity?
1) 0 m/s
2) 26 m/s
3) 35 m/s
4) 44 m/s

8) Above a flat horizontal plane, an arrow, A, is shot horizontally from a bow at a speed of 50 meters per second as shown in the diagram. A second arrow, B, is dropped from the same height and at the same instant as arrow A is fired



Neglecting air friction, compared to the amount of time A takes to strike the plane, the amount of time B takes to strike the plane is
1) less
2) greater
3) the same

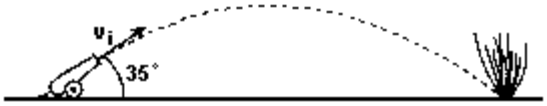
9) The diagram represents a ball being kicked by a foot and rising at an angle of 30.° from the horizontal. The ball has an initial velocity of 5.0 meters per second. [Neglect friction.]



If the angle between the horizontal and the direction of the 5.0-meters-per-second velocity decreases from 30.° to 20.°, the horizontal distance the ball travels will

1) decrease
2) increase
3) remain the same

10) A cannon elevated at an angle of 35° to the horizontal fires a cannonball, which travels the path shown in the diagram. [Neglect air resistance and assume the ball lands at the same height above the ground from which it was launched.]



If the ball lands 7.0×10^2 meters from the cannon 10. seconds after it was fired, what is the vertical component of its initial velocity?

1) 9.8 m/s
2) 49 m/s
3) 70. m/s
4) 98 m/s

11) An archer uses a bow to fire two similar arrows with the same string force. One arrow is fired at an angle of 60.° with the horizontal, and the other is fired at an angle of 45° with the horizontal. Compared to the arrow fired at 60.°, the arrow fired at 45° has a

1) longer flight time and longer horizontal range
2) longer flight time and shorter horizontal range
3) shorter flight time and longer horizontal range
4) shorter flight time and shorter horizontal range

Newtons Laws Student Sheet 1

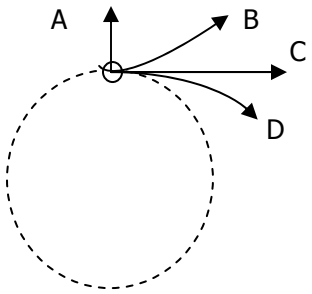
1 – An astronaut in outer space away from any gravitational or frictional forces throws a rock. The rock will

(a) gradually slow to a stop
(b) Continue to move at a constant speed
(c) gradually speed up

2 – The rocks tendency to behave as described above is called

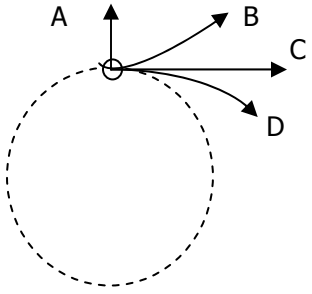
(a) acceleration
(b) weight
(c) inertia

3. The sketch shown here is a top view of a rock being whirled at the end of a string. Is the string breaks, the path of the rock is



A B C D

4. The sketch shown here is a side view of a rock being whirled at the end of a string. Is the string breaks, the path of the rock is



A B C D

5. Which person has the greatest inertia?
(1) a 110-kg wrestler resting on a mat
(2) a 90-kg man walking at 2 m/s
(3) a 70-kg long-distance runner traveling at 5 m/s
(4) a 50-kg girl sprinting at 10 m/s

Newtons Laws Student Sheet 2 – True/False questions – explain answer

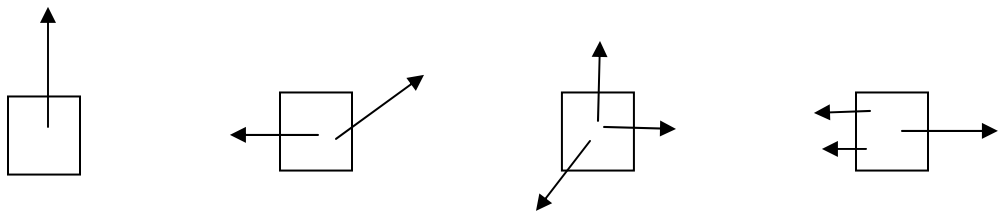
1 – When the net force = 0, no forces are acting on the object

2 – A moving object must have forces acting on it

3 – When the net force is not zero you must accelerate

4 – An object moving at constant velocity has a net force = 0

Which examples shown below are situations where equilibrium could exist



Newtons Laws Student Sheet 3 – multiple choice

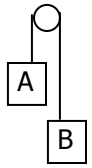
(1-3) A man and his son are on a frictionless pond, each holding an end of a taught(tight) rope facing each other. The man is twice as massive as the son and the father pulls with a constant force.

1 – Which of the following best describes the motion of the boy?
(a) constant speed
(b) constant velocity
(c) constant acceleration
(d) at rest

2 – What is the force on the boy
(a) half the force on the father, directed towards the father
(b) equal to the force on the father, directed towards the father
(c) Twice the force on the father, directed towards the father
(d) Twice the force on the father, directed away from the father

3 – What is the acceleration of the boy
(a) twice the acceleration of the father, directed towards the father
(b) half the acceleration of the father, directed towards the father
(c) equal to the acceleration of the father, directed away from the father
(d) zero, since the boy moves with a constant speed

4 – Two objects, object A and Object B, are connected by a string over a frictionless pulley as shown. Object A is accelerating downward. Which of the following statements is true
(a) Object A is more massive than object B
(b) Object A is less massive than object B
(c) The magnitude of the acceleration of object B is greater than that of A
(d) The magnitude of the acceleration of object B is less than that of A



5 – Two children are playing catch. The ball follows a parabolic trajectory. Which of the following best represents the direction of the force on the ball, the ball's acceleration, and its velocity at the top of its trajectory.

	Force	Acceleration	Velocity
(a)	→	0	→
(b)	↓	↓	→
(c)	→	→	→
(d)	0	0	0

6 – A sheet of paper can be withdrawn from under a bottle of cola without toppling it if the paper is jerked quickly. This can be done because of the property of
(a) weight
(b) inertia
(c) acceleration
(d) newtons third law of motion

7 – An automobile that is pulling a trailer is accelerating on a level highway. The force that the automobile exerts on the trailer is
(a) equal to the force the trailer exerts on the automobile
(b) equal to the force the road exerts on the trailer
(c) greater than the force the trailer exerts on the automobile
(d) equal to the force the trailer exerts on the road

8 – When the mass of an object is halved and the net force on it doubled, then the acceleration is
(a) ¼ as much
(b) ½ as much
(c) 2 times as much
(d) 4 times as much

9 – A bug splatters on the windshield of a moving car. Compared to the magnitude of the force acting on the car, the magnitude of the force acting on the bug is
(a) larger
(b) smaller
(c) equal
(d) not able to be determined

10 – A ball is thrown into the air at some angle. Neglecting air resistance, the horizontal velocity
(a) increases
(b) decreases
(c) decreases, is zero at the top, then increases
(d) remains constant

11 – Action and reaction pairs
(a) always occur together on the same object
(b) must be equal in magnitude
(c) cancel each other out
(d) all of the above

Explain

1 – Why does the acceleration of a rocket increase as it rises into the air

2 – A golf club hits a golf ball and each object applies and equal amount of force on each other. Why do they accelerate differently

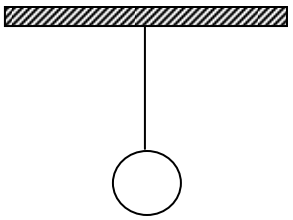
3 – An object has multiple forces acting on it and moves at a constant speed. Is it in equilibrium? Explain the conditions that exist in this situation.

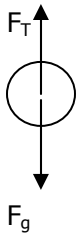
4 – In terms of velocity, what does is mean when an object moving forward has a decreasing positive acceleration.

Newtons Laws Student Sheet 4

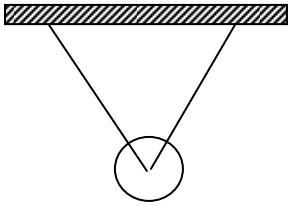
Draw FBD's for the examples shown below. The first one has been done for you.

1

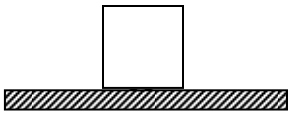




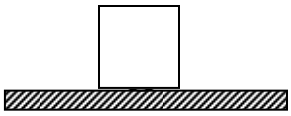
2



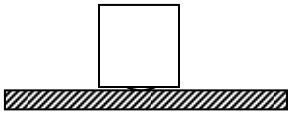
3. Static (meaning not moving)



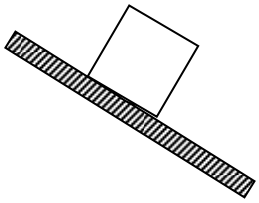
4. Sliding right without friction



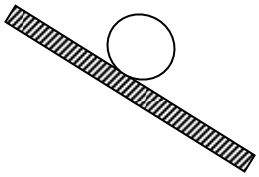
5. Moving right, decelerating due to friction



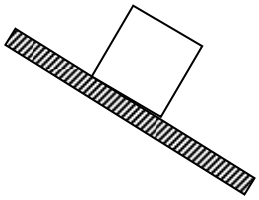
6. Static



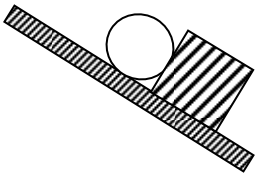
7. Rock "rolls" down the hill



8. Slides up the hill decelerating



9. Static



10. Rock in free fall

Newtons Laws Student Sheet 5

1. A crate filled with junk food rests on a horizontal floor. Draw a FBD of the crate.

(a) The net force on the crate is (zero) (greater than zero)

(b) Evidence for this is _____

2. A slight pull **F** is exerted on the crate, not enough to move it. Draw the FBD of the crate.

(a) The friction force that exists now is (less than) (equal to) (greater than) **F**

(b) The net force acting on the crate is (zero) (greater than zero)

3. Pull **F** is increased until the crate begins to move. It is pulled so that it moves with constant velocity across the floor. Draw the FBD of the crate.

(a) The friction force is (less than) (equal to) (greater than) **F**

(b) Constant velocity means acceleration is (zero) (greater than zero)

(c) The net force on the crate is (less than) (equal to) (greater than) zero

4. Pull **F** is increased again.

(a) The net force on the crate is (less than) (equal to) (greater than) zero.

(b) The net force is directed left, and the acceleration is directed (left) (right)

5. If the pulling force **F** is 150 N and the crate doesn't move, what is the magnitude of the friction force?

6. If the pulling force **F** is 200 N and the crate doesn't move, what is the magnitude of the friction force?

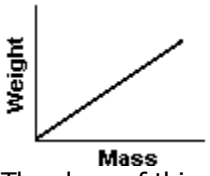
7. If the force of sliding friction is 250 N, what force is needed to keep the crate moving at constant velocity?

8. If the mass of the crate is 50 kg and sliding friction is 250N, what is the acceleration of the crate when the pulling force is

(a) 250 N
(b) 300 N
(c) 500 N

Regents Practice 6

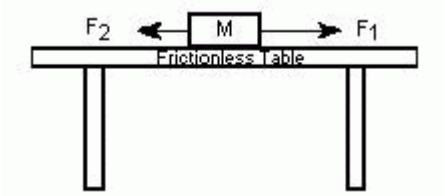
1) The graph shows the relationship between weight and mass for a series of objects.



The slope of this graph represents
1) change of position
2) normal force
3) momentum
4) acceleration due to gravity

2) Two concurrent forces have a maximum resultant of 45 newtons and a minimum resultant of 5.0 newtons. What is the magnitude of each of these forces?
1) 0.0 N and 45 N
2) 5.0 N and 9.0 N
3) 20. N and 25 N
4) 0.0 N and 50.N

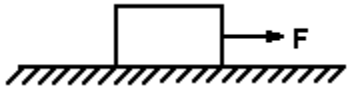
3) Box M is on a frictionless table with forces F1 and F2 acting as shown below.



If the magnitude of F1 is greater than the magnitude of F2, then the box is
1) moving with a constant speed in the direction of F1
2) moving with a constant speed in the direction of F2
3) accelerating in the direction of F1
4) accelerating in the direction of F2

4) What is the gravitational force of attraction between a planet and a 17-kilogram mass that is falling freely toward the surface of the planet at 8.8 meters per second squared?
1) 150 N
2) 8.8 N
3) 1.9 N
4) 0.52 N

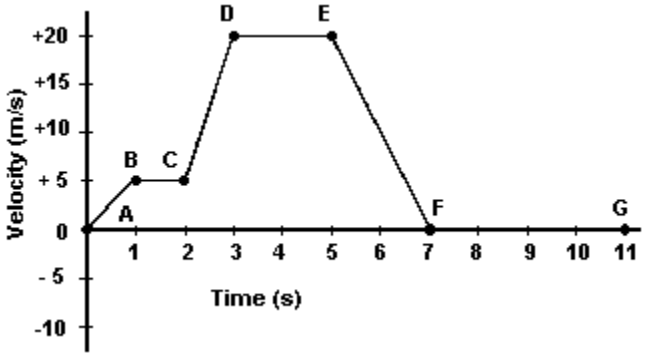
5) A box initially at rest on a level floor is being acted on by a variable horizontal force, as shown in the diagram.



Compared to the force required to start the box moving, the force required to keep it moving is
1) less
2) greater
3) the same

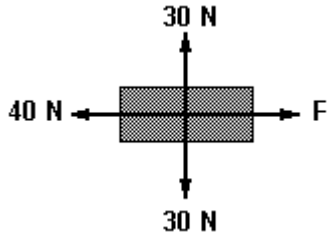
6) Compared to the inertia of a 1-kilogram mass, the inertia of a 4-kilogram mass is
1) 1/4 as great
2) 1/16 as great
3) 16 times as great
4) 4 times as great

7) The graph represents the linear motion of a car.



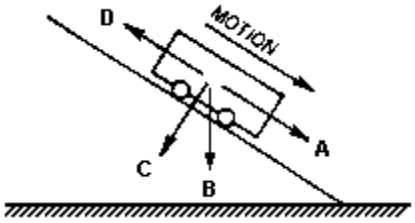
During which interval is the net force on the car zero?
1) AB
2) BC
3) CD
4) EF

8) Four forces are acting on an object as shown in the diagram.



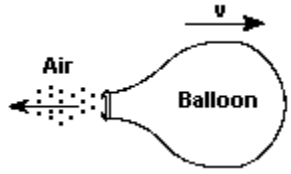
If the object is moving with a constant velocity, the magnitude of force F must be
1) 0 N
2) 20 N
3) 100 N
4) 40 N

9) A cart rolls down an inclined place with constant speed as shown in the diagram.



Which arrow represents the direction of the frictional force?
1) A
2) B
3) C
4) D

10) As shown in the diagram, an inflated balloon released from rest moves horizontally with velocity v .



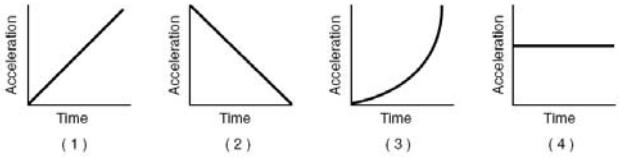
The velocity of the balloon is most likely caused by
1) action-reaction force
2) centripetal force
3) gravitational attraction
4) rolling friction

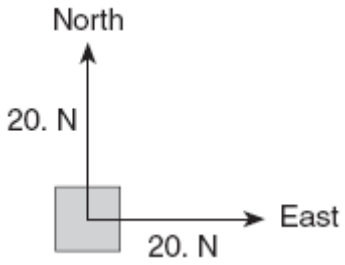
11) A tennis ball is hit with a tennis racket. Compared to the force of the racket on the ball, the force of the ball on the racket is
1) smaller
2) larger
3) the same

12) If the sum of all the forces acting on a moving object is zero, the object will
1) slow down and stop
2) change the direction of its motion
3) accelerate uniformly
4) continue moving with constant velocity

13) When a 12-newton horizontal force is applied to a box on a horizontal tabletop, the box remains at rest. The force of static friction acting on the box is
1) 0 N
2) between 0 N and 12 N
3) 12 N
4) greater than 12 N

14) A constant unbalanced force is applied to an object for a period of time. Which graph best represents the acceleration of the object as a function of elapsed time?





15) The additional force necessary to bring the object into a state of equilibrium is
(1) 20. N, northeast (3) 28 N, northeast
(2) 20. N, southwest (4) 28 N, southwest

16) A 3-newton force and a 4-newton force are acting concurrently on a point. Which force could *not* produce equilibrium with these two forces?
(1) 1 N (3) 9 N
(2) 7 N (4) 4 N

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Newtons Problems

#1) – Can an object be in equilibrium if only one force acts on it.

#2) – If an 800 kg car is traveling westward with a constant velocity of 20 m/s, what is the net external force acting on it?

#3) A 190 gram dart is launched horizontally from a dart-gun and has 2.1 N of friction acting on it while moving in the gun barrel. The acceleration of the dart is 3.2 m/s^2. Determine the average force of the gun pushing the dart out of the barrel.

#4) A 5 kg sack of potatoes slides across a flat floor with an initial velocity of 10 m/s right. It comes to a stop in 2 seconds.

(a) Determine the acceleration of the sack
(b) Determine the normal force
(c) How much friction force acts on the sack

#5) A 490 N box is pushed constantly by a force of 100 N at 25 degrees below the horizontal and moves towards the right on a flat surface. It moves at a constant speed of 2 m/s.

(a) Determine the normal force
(b) How much friction force acts on the box

#6) A 1000 kg elevator is lifted by a force of 12000 N. 1000 N of friction impede the motion of the elevator. What is the acceleration of the elevator?

#7) A 245.25 N sled is pulled by a force of 75 N @ 40 degrees above the horizontal and slides across the snow with 20 N of friction acting on it. (a) Determine the acceleration of the sled (b) Determine the normal force acting on the sled (c) How much force in a horizontal direction would need to be applied to make the sled move at a constant speed.

Challenge Problem

A 25 kg box is pulled with an unknown force F directed at 60 degrees measured from the vertical and towards the right. 25 N of friction force impede the blocks motion as it accelerates at 2 m/s^2 to the right on a flat surface.

(a) What force is the box pulled with
(b) What is the magnitude of the normal force

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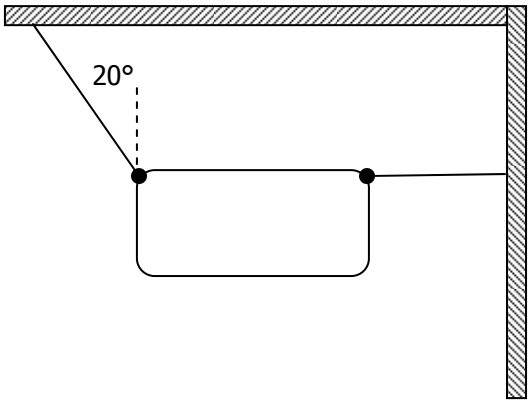
#8) – A 675 N box is pulled with a 250 N force directed 30 deg above horizontal. The box moves at a constant speed. What is the coefficient of kinetic friction of these surfaces.

#9.) A 49 N box is pushed with a horizontal force of 30 N east on a surface with a coefficient of kinetic friction = 0.25. What is the acceleration of the box?

#10.) A 250 kg wood bed is on a wood floor. (a) How much horizontal force would need to be applied to start moving it? (b) How much force would need to be applied to move it at a constant speed?

#11.) A 500 N box is on a horizontal floor with 220 N of horizontal force applied to it. The coefficient of kinetic friction is 0.20 and the coefficient of static friction is 0.40. How much friction force acts on the box.

#12.) Find the Tension in the ropes shown below that support a 1000 kg sign



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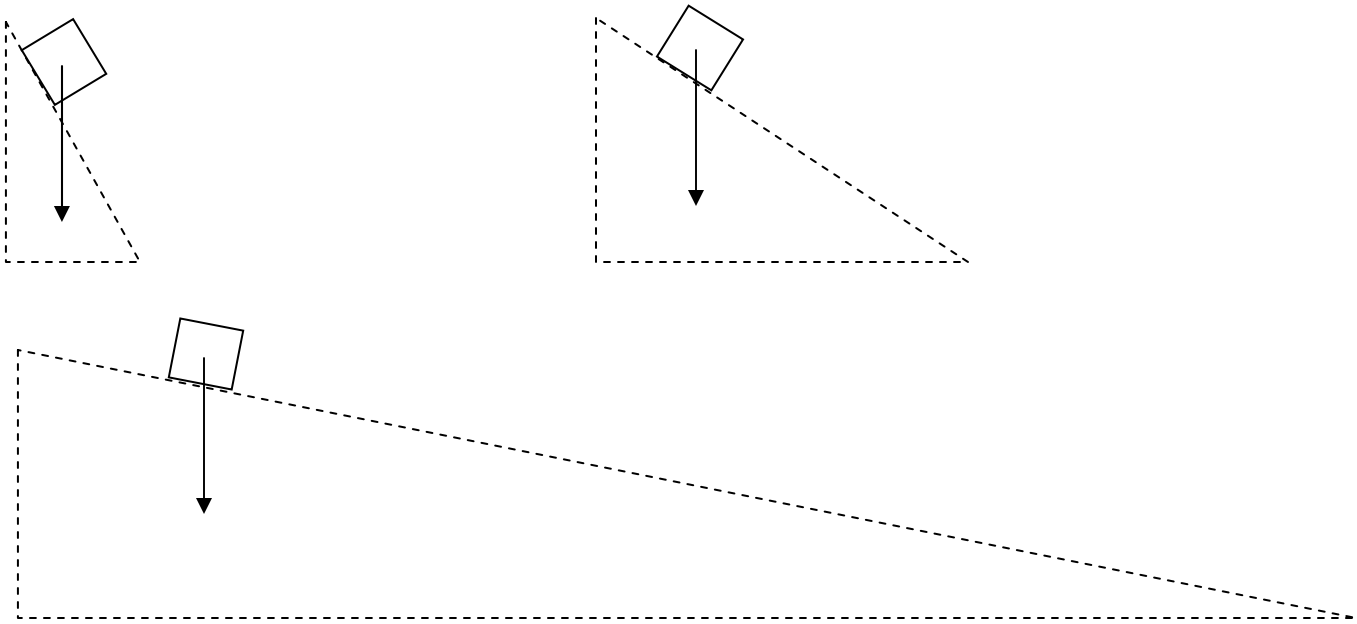
Newtons Laws Student Sheet 7

1.) Draw the x and y components of the weight for the inclines below



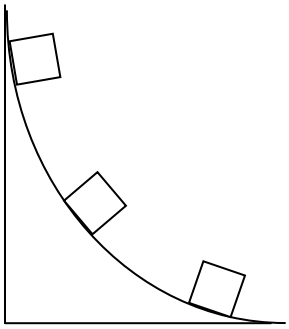
2.) Based on your drawings above, answer the following

- What happens to the Normal Force acting on a box when you increase the incline?

- Assuming that the box does not move, what happens to the friction force when you increase the incline?

- Which component of the weight causes the box to accelerate?

Based on this picture below, answer the following



(a) At which location is the component parallel to the ramp the largest

(b) At which location is the acceleration the greatest

(c) At which location is the acceleration the least

(d) Is the speed of the block the greatest where the acceleration is the greatest

You just learned something … now don't forget it !!

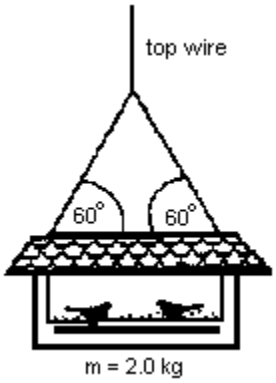
#1) A 20 kg box rests on a 15 degree incline and does not move but is on the brink of slipping. What is the coefficient of static friction on the incline?

#2) A 1 kg box slides down a 30 degree incline and accelerates at 1.2 m/s^2. What is the coefficient of kinetic friction on this incline?

#3) A 98.1 N box is pushed up a 60 degree incline with a force of 159.37 N directed parallel to the incline surface. The coefficient of kinetic friction between the box and the ramp is 0.5. If the box starts from rest, how fast will it be moving when it reaches the top of the 5 m long incline?

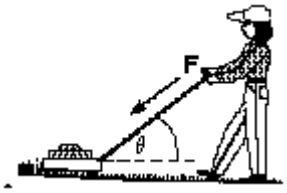
REGENTS PRACTICE 7

1.) A bird feeder with two birds has a total mass of 2.0 kilograms and is supported by wire as shown in the diagram.



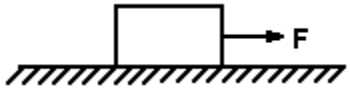
The force in the top wire is approximately
1) 10. N
2) 14 N
3) 20. N
4) 39 N

2.) A 50.-kilogram woman wearing a seatbelt is traveling in a car that is moving with a velocity of +10. meters per second. In an emergency, the car is brought to a stop in 0.50 second. What force does the seatbelt exert on the woman so that she remains in her seat?
1) 1.0 ´ 103 N
2) 5.0 ´ 102 N
3) 5.0 ´ 101 N
4) 2.5 ´ 101 N



3.) In the diagram, as angle θbetween the lawnmower handle and the horizontal increases, the horizontal component of F
1) decreases
2) increases
3) remains the same

4) A box initially at rest on a level floor is being acted on by a variable horizontal force, as shown in the diagram.



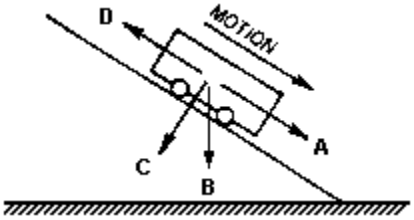
Compared to the force required to start the box moving, the force required to keep it moving is
1) less
2) greater
3) the same

5) The table lists the coefficients of kinetic friction for four materials sliding over steel.

Material	μ_k
Aluminum	0.47
Brass	0.44
Copper	0.36
Steel	0.57

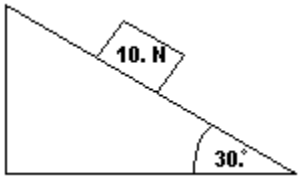
A 10.-kilogram block of each of the materials in the table is pulled horizontally across a steel floor at constant velocity. Which block would require the smallest applied force to keep it moving at constant velocity?
1) aluminum
2) brass
3) copper
4) steel

6) A cart rolls down an inclined place with constant speed as shown in the diagram.



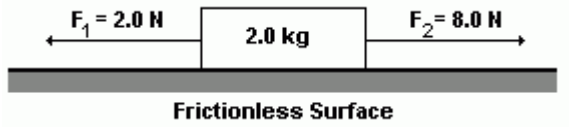
Which arrow represents the direction of the frictional force?
1) A
2) B
3) C
4) D

7) The diagram represents a 10.-newton block sliding down a 30.° incline at a constant speed.



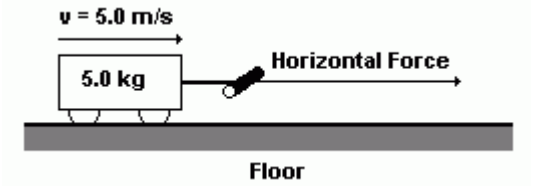
The force of friction on the block is approximately
1) 5.0 N
2) 10. N
3) 49 N
4) 98 N

8) Two forces are applied to a 2.0-kilogram block on a frictionless, horizontal surface, as shown in the diagram.

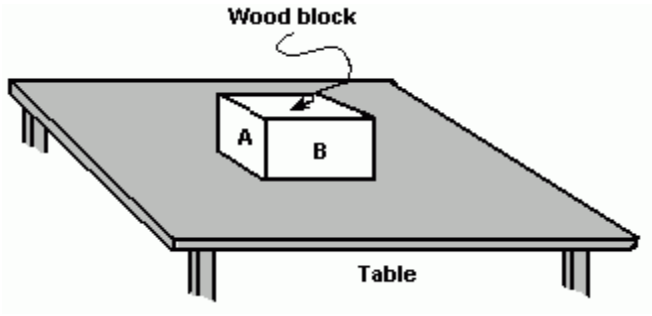


The acceleration of the block is
1) 5.0 m/s2 to the right
2) 5.0 m/s2 to the left
3) 3.0 m/s2 to the right
4) 3.0 m/s2 to the left

9) A horizontal force is used to pull a 5.0-kilogram cart at a constant speed of 5.0 meters per second across the floor, as shown in the diagram.

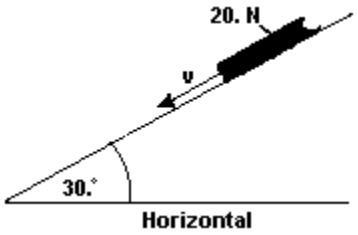


If the force of friction between the cart and the floor is 10. newtons, the magnitude of the horizontal force along the handle of the cart is
1) 5.0 N
2) 10. N
3) 25 N
4) 50. N



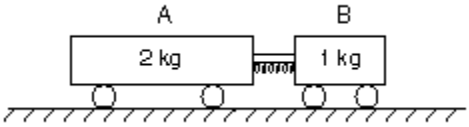
10.) In the diagram, surface B of the wooden block has the same texture as surface A, but twice the area of surface A. If force F is required to slide the block at constant speed across the table on surface A, approximately what force is required to slide the block at constant speed across the table on surface B?
1) F
2) 2F
3) ½ F
4) 4F

11.) A man weighs 900 newtons standing on a scale in a stationary elevator. If some time later the reading on the scale is 1200 newtons, the elevator must be moving with
1) constant acceleration downward
2) constant speed downward
3) constant acceleration upward
4) constant speed upward



12.) A book weighing 20. newtons slides at a constant velocity down a ramp inclined at 30.° to the horizontal as shown in the diagram. What is the force of friction between the book and the ramp?
1) 10. N up the ramp
2) 17 N up the ramp
3) 10. N down the ramp
4) 17 N down the ramp

13.) The diagram shows a compressed spring between two carts initially at rest on a horizontal frictionless surface. Cart A has a mass of 2 kilograms and cart B has a mass of 1 kilogram. A string holds the carts together.



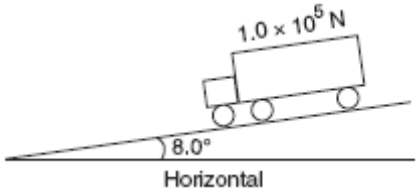
What occurs when the string is cut and the carts move apart?

1) The magnitude of the acceleration of cart A is one-half the magnitude of the acceleration of cart B.
2) The length of time that the force acts on cart A is twice the length of time the force acts on cart B.
3) The magnitude of the force exerted on cart A is one-half the magnitude of the force exerted on cart B.
4) The magnitude of the impulse applied to cart A is twice the magnitude of the impulse applied to cart B.

14.) When a 12-newton horizontal force is applied to a box on a horizontal tabletop, the box remains at rest. The force of static friction acting on the box is

1) 0 N
2) between 0 N and 12 N
3) 12 N
4) greater than 12 N

15.) The diagram below shows a 1.0×10^5-newton truck at rest on a hill that makes an angle of 8.0° with the horizontal.

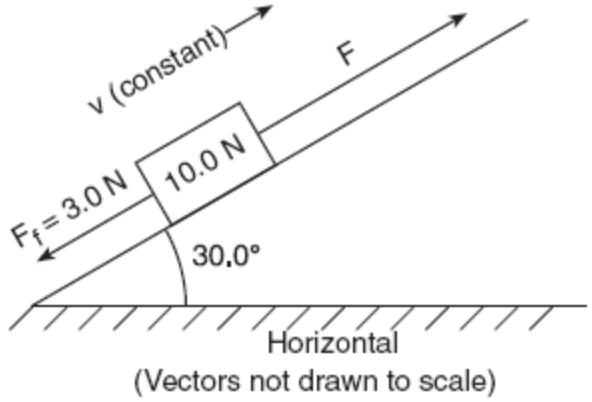


What is the component of the truck's weight parallel to the hill?

(1) 1.4×10^3 N (3) 1.4×10^4 N
(2) 1.0×10^4 N (4) 9.9×10^4 N

16.) A block weighing 10.0 newtons is on a ramp inclined at 30.0° to the horizontal. A 3.0-newton force of friction, F_f, acts on the block as it is pulled up the ramp at constant velocity with force F, which is parallel to the ramp, as shown in the diagram below. What is the magnitude of force F?

(1) 7.0 N (3) 10. N
(2) 8.0 N (4) 13 N



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Centripetal Force and Acceleration

#1) A 60 kg girl rides on a merry-go-round with a 5 m radius. She stands on the outside edges where she has a speed of 3 m/s (a) What is the magnitude of the friction force on her feet at this location (The friction is the centripetal force in this case) (b) what is the magnitude of the girls centripetal acceleration (c) If the girl walks 2 m in towards the center, and the ride changes speed so that she has the same centripetal force acting on her, What would the new speed be?

#2) A 2 kg ball is tied to a 3m long string and whirled in a horizontal circle at a speed of 5 m/s. (a) What is the magnitude of the centripetal force acting on the ball. (b) What force provides the centripetal force

#3) A truck tire has a circumference of 8m. A 50 kg boy jumps in the tire rim and rolls at a constant speed of 4 m/s. (a) How much centripetal force acts on him (b) What is the magnitude of his acceleration?

#4) A 150 kg bicyclist races around a circular track of 18 m radius at a constant speed and makes 3 revolutions in 1.5 minutes. (a) Determine the speed of the cyclist as she rounds the track. (b) Determine the acceleration of the cyclist

---

#5) A stone tied to a string is whirled around a students head in a horizontal circle.

a) If the stone moves faster its direction changes (faster) (slower)

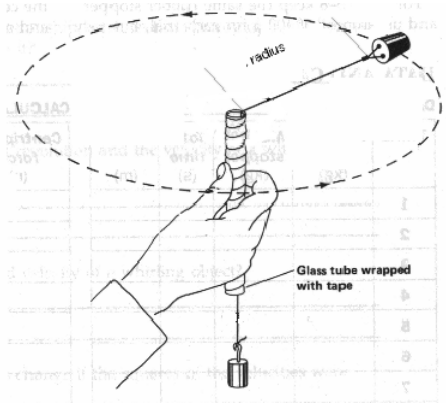
b) This indicates that as speed increases, centripetal acceleration (increases) (decreases) (stays same)

c) If the stone is whirled on a shorter string but at the same speed, the rate at which the direction changes is (less) (more) (the same)

d) This indicates that if the speed remains the same and the radius decreases, the centripetal acceleration (increases) (decreases) (remains the same)

#6) A 1000 kg car rounds a circle of radius 30 m at a constant speed in 20 seconds. What is the velocity of the car and the coefficient of static friction of the tires on the road?

#7) A string is passed through a tube and a 1 kg mass is tied to the bottom while a 200 g mass is tied to the top. The 200 g mass is spun in a 25 cm radius horizontal circle and the 1 kg mass below remains motionless. (a) What is the magnitude of the Tension in the string (look at the 1 kg mass) (b) What is the speed of the 200 g mass?



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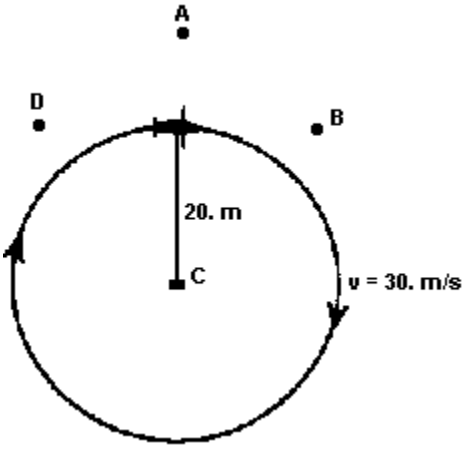
REGENTS PRACTICE 8

1) The diagram shows a 2.0-kilogram model airplane attached to a wire. The airplane is flying clockwise in a horizontal circle of radius 20. meters at 30. meters per second.



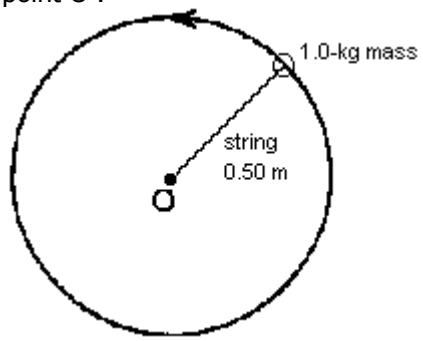
The centripetal force acting on the airplane at the position shown is directed toward point
1) A
2) B
3) C
4) D

2) What is the magnitude of the centripetal acceleration of the airplane?
1) 0 m/s^2
2) 1.5 m/s^2
3) 45 m/s^2
4) 90. m/s^2

3) If the wire breaks when the airplane is at the position shown, the airplane will move toward point
1) A
2) B
3) C
4) D

4) A car going around a curve is acted upon by a centripetal force, F. If the speed of the car were twice as great, the centripetal force necessary to keep it moving in the same path would be
1) F 2) 2F 3) F/2 4) 4F

5) The diagram shows an object with a mass of 1.0 kg attached to a string 0.50 meter long. The object is moving at a constant speed of 5.0 meters per second in a horizontal circular path with center at point O .

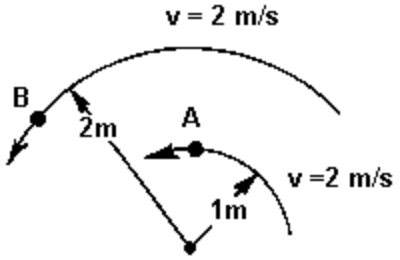


What is the magnitude of the centripetal force acting on the object?
1) 2.5 N
2) 10. N
3) 25 N
4) 50. N

6) While the object is undergoing uniform circular motion, its acceleration
1) has a magnitude of zero
2) increases in magnitude
3) is directed toward the center of the circle
4) is directed away from the center of the circle

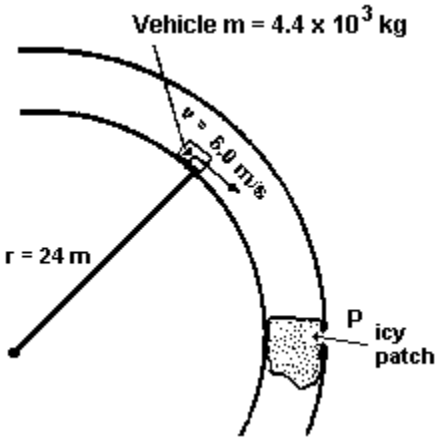
7) If the string is lengthened while the speed of the object remains constant, the centripetal acceleration of the object will
1) decrease
2) increase
3) remain the same

8) Two masses, A and B, move in circular paths as shown in the diagram.



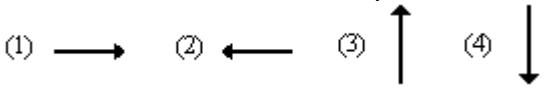
The centripetal acceleration of mass A, compared to that of mass B, is
1) the same
2) twice as great
3) one-half as great
4) four times as great

9) A vehicle travels at a constant speed of 6.0 meters per second around a horizontal circular curve with a radius of 24 meters. The mass of the vehicle is 4.4×10^3 kilograms. An icy patch is located at P on the curve.



What is the magnitude of the frictional force that keeps the vehicle on its circular path?
1) 1.1×10^3 N
2) 6.6×10^3 N
3) 4.3×10^4 N
4) 6.5×10^4 N

10) On the icy patch of pavement, the frictional force of the vehicle is zero. Which arrow best represents the direction of the vehicle's velocity when it reaches icy patch P?



11) In which situation is the net force on the object equal to zero?
1) a satellite moving at constant speed around Earth in a circular orbit
2) an automobile braking to a stop
3) a bicycle moving at constant speed on a straight, level road
4) a pitched baseball being hit by a bat

#1) What is the magnitude of the gravity force between the earth and the sun

#2) You have a mass of 80 kg and are standing on the earths surface. Use the universal law of gravity to find your weight (gravity force between you and earth)

#3) (a) Calculate the gravitational force between the earth and the moon. (b) The period of the moons revolution around the earth is 27 days, 7 hours, and 43 minutes. Use this period and the given data about the moon to determine the speed of the moon in orbit. (c) Use the answer from part b and the given data about the moon to calculate the centripetal force acting on the moon. (d) Compare the answers to parts a and c, comment.

#4) When a satellite is at a distance d from the center of the Earth, the force due to gravity on the satellite is F. What would be the force due to gravity on the satellite be when its distance from the center of the earth is 3d?

#5) Compared to the mass of an object at the surface of the earth, the mass of the object a distance of two Earth radii from the center of the Earth is?

#6) What is the gravitational force of attraction between a planet and a 17 kg mass that is freely falling toward the surface at 8.8 m/s^2?

#7.) If the Earth were twice as massive as it is now, (a) then how would the force with which the sun pulls on it be effected? (b) How would the force with which the earth pulls on the sun change?

#8) Two masses are located a distance, D, apart. The gravitation force of attraction between them can be quadrupled by changing the distance by what factor?

#9) Two masses are kept at a constant distance apart. Mass 1 is tripled and mass 2 is halved. How does the gravitational force of attraction change

#10) An astronaut weighs 8.00×10^2 newtons on the surface of Earth. What is the weight of the astronaut 6.37×10^6 meters above the surface of Earth? (You must recognize what 6.37×10^6 m represents to solve this question)

#11) Two masses are a distance d apart. One of the masses is quadruped and the distance between them is also changed making the gravitational force 36 times larger that it originally was. By what factor was the distance changed.

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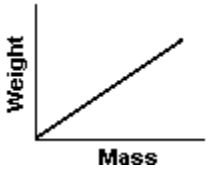
REGENTS PRACTICE 9

1) The graph shows the relationship between weight and mass for a series of objects.



The slope of this graph represents

1. change of position
2. normal force
3. momentum
4. acceleration due to gravity

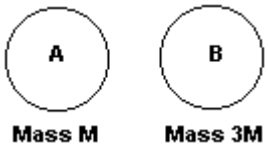
2) Gravitational force of attraction *F* exists between two point masses *A* and *B* when they are separated by a fixed distance. After mass *A* is tripled and mass *B* is halved, the gravitational attraction between the two masses is

1. $\frac{1}{6}F$
2. $\frac{2}{3}F$
3. $\frac{3}{2}F$
4. $6F$

3) Two point masses are located a distance, *D*, apart. The gravitational force of attraction between them can be quadrupled by changing the distance to

1. *D*/2
2. 2*D*
3. *D*/4
4. 4*D*

4) The diagram shows spheres *A* and *B* with masses of *M* and 3*M*, respectively.



If the gravitational force of attraction of sphere *A* on sphere *B* is 2 newtons, then the gravitational force of attraction of sphere *B* on sphere *A* is

1. 9 N
2. 2 N
3. 3 N
4. 4 N.

5) A 60.-kilogram astronaut weighs 96 newtons on the surface of the Moon. The acceleration due to gravity on the Moon is

1. 0.0 m/s^2
2. 1.6 m/s^2
3. 4.9 m/s^2
4. 9.8 m/s^2

6) What is the magnitude of the gravitational force between an electron and a proton separated by a distance of 1.0×10^{-10} meter?

1. 1.0×10^{-47} N
2. 1.5×10^{-46} N
3. 1.0×10^{-37} N
4. 1.5×10^{-36} N

7) An astronaut weighs 8.00×10^2 newtons on the surface of Earth. What is the weight of the astronaut 6.37×10^6 meters above the surface of Earth?

1. 0.00 N
2. 2.00×10^2 N
3. 1.60×10^3 N
4. 3.20×10^3 N

8) The weight of an object was determined at five different distances from the center of Earth. The results are shown in the table below. Position *A* represents results for the object at the surface of Earth.

Position	Distance from Earth's Center (m)	Weight (N)
A	6.37×10^6	1.0×10^3
B	1.27×10^7	2.5×10^2
C	1.91×10^7	1.1×10^2
D	2.55×10^7	6.3×10^1
E	3.19×10^7	4.0×10^1

The approximate mass of the object is

1. 0.01 kg
2. 10 kg
3. 100 kg
4. 1,000 kg

9) At what distance from the center of Earth is the weight of the object approximately 28 newtons?

1. 3.5×10^7 m
2. 3.8×10^7 m
3. 4.1×10^7 m
4. 4.5×10^7 m

10) A container of rocks with a mass of 65.0 kilograms is brought back from the Moon's surface where the acceleration due to gravity is 1.62 meters per second^2. What is the weight of the container of rocks on Earth's surface?

1. 638 N
2. 394 N
3. 105 N
4. 65.0 N

#1) A boy pulls on a toy wagon with a force of 40 N @ 30° above horizontal. The wagon moves horizontally a distance of 30 m at a constant speed. (a) How much work does the boy do, (b) What is the net work, (c) How much work does friction do?

#2) A 5 kg wood box slides 3m down a 75° wood incline. (a) How much work is done by gravity (b) How much work is done by friction?

#3) A 50 kg treasure chest is lifted 20 m out of the water by a crane pulling up with a force. The chest accelerates at 2 m/s^2. 100 N of resistive force acts against the motion of the chest.
Determine: (a) The work done by gravity (b) The work done by friction (c) The net work (d) The work done by the crane (e) The force the crane pulls with?

#4) A 1500 W engine lifts a 200 kg box in 30 seconds. (a) How much work is done on the box by the engine (b) What is the average speed of the box.

#5) A 10 kg bucket is filled with 5 kg of water and is hoisted up a well at a constant speed by a person pulling a rope over a pulley. The pulley provides 28 N of friction force retarding the motion. The bucket moves 10 m up the well in 2.5 seconds. (a) What power of the puller is required to do this. (b) What is the net work done

#6) Two bullets having masses of 3 g and 6 g are both fired with a speed of 40 m/s. What is the ratio of the kinetic energy of the smaller to the larger bullet.

#7) A 50 kg mass falls from a height of 100 cm to a height of 50 cm. (a) How much does the PE change? (b) If the mass is moving at 3.1 m/s at the 50 cm height, what is the total mechanical energy at that point.

#8) A 3 kg ball rolls down a 5 m board inclined at 36.9°. What is the change in its potential energy.

#9) A 1000 kg car speeds up from rest for 10 seconds. The engine provides 500 N of force which acts against 100 N of friction. (a) find the acceleration of the car (b) find the final velocity of the car (c) Find the change in the KE of the car

#10) A horizontal spring with a length of 20 cm rests on a table. The spring is compressed to a new length of 12 cm and is held in place by a 15 N force. What is the stiffness coefficient of the spring?

#11) A vertical spring rests at its equilibrium position with a relaxed length of 1m. A 2 kg box is placed on top of the spring so the spring compresses 0.25 m. How much energy is stored in the spring?

#12) A 30 cm long vertical spring is attached to the ceiling. A 1 kg weight is attached to it and it is also pulled down to a final length of 85 cm. It is held in place with a 10 N force (In addition to the weight). What is the force constant of the spring? (Draw the FBD to see all forces acting on the spring).

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A – rock falls (conservative)
A 10 kg rock is dropped from a 5 m high roof and hits the ground below. How fast is it moving when it hits

B – Box slides on rough surface (non conservative)
A 50 kg box moving at 10 m/s hits a rough patch with a coefficient of kinetic friction of 0.80. After sliding 6 m, how fast would the box be moving?

C – Toy dart gun (conservative)
A 20 gram dart is loaded into a toy dart gun and the spring loader is compressed 14 cm. The dart is launched along the frictionless barrel of the gun and exits with a muzzle velocity of 5 m/s. What is the spring constant of the spring loader.

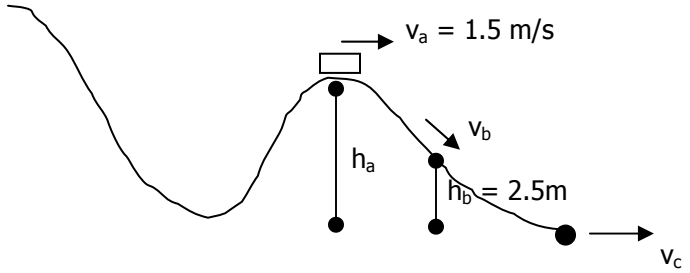
D – Rocket Launch (non conservative)
A 10000 kg rocket starts from rest and is accelerated off the launch pad to a speed of 5 m/s over 25m. What is the thrust force of the rocket engine.

E - Projectile Problem (conservative)
A projectile is launched off a 20 m high cliff at 10 m/s @ 30 degrees above horizontal. What velocity does the projectile hit the ground with.

#13) A 4 kg box is sliding right at 9 m/s on frictionless ground and hits a relaxed spring compressing it 75 cm, until the box is momentarily brought to rest. What is the spring constant of the spring.

#14) A 10 g bullet hits a tree. A 213.33 N friction force acts over 15 cm to stop the bullet. What was the initial speed of the bullet

#15) A 3kg toy cart is on a friction free rollercoaster set shown below with the appropriate labeled quantities. Given that the KE at point B = 25 J, determine v_b, v_c and h_a



#16) A 75 kg box moving with an initial speed of 5 m/s is pushed with a force and accelerates over a frictionless surface a distance of 8m. The box gains 205 J of kinetic energy over the 8m. (a) How much force is applied to the box? (b) what is the final speed of the box

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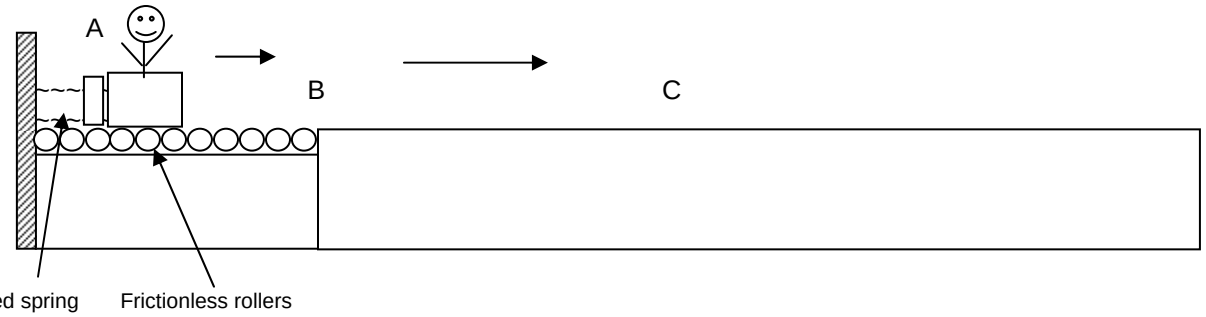
#17)



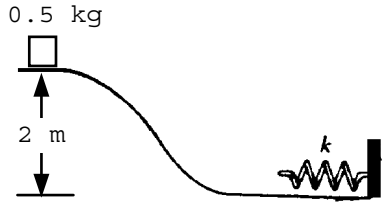
Happy man is sitting at rest at point A in the cart shown above on a friction free roller surface. The total mass of happy man and the cart is 200 kg. A spring launching mechanism using a 50 N/m spring is compressed 2m and released. Happy man is launched along the rollers until he reaches point B (2 m away from point A). At point B the spring no longer makes contact with happy man. Happy man then slides across a rough surface and comes to rest at point C.

(a) Is mechanical energy conserved between points AB? Is mechanical energy conserved between points BC? USE YOUR ANSWERS TO PART (a) to guide you in solving the rest of the problem
(b) Find the energy at points A, B and C
(c) Find the work done by friction between points BC
(d) Find the velocity at point B
(e) If the cart travels 10 m between points B and C, find the friction force acting on the box
(f) How much work does the spring do between points A and B

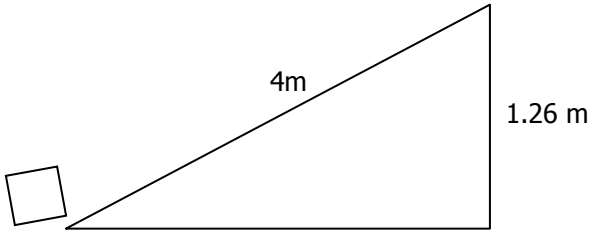
#18) The spring of a toy car is wound by pushing the car backward with an average force of 15 newtons through a distance of 0.50 meter. How much elastic potential energy is stored in the car's spring during this process?

#19) A 10-newton force is required to hold a stretched spring 0.20 meter from its rest position. What is the potential energy stored in the stretched spring?

#20) A block of mass 0.5 kg is released from rest and slides down a frictionless track of height 2 m above the horizontal. At the bottom of the track, where the surface is horizontal, the block strikes and sticks to a spring (k = 80 N/m). (a) Find the maximum distance of compression. (b) Determine the amount of work done by the spring to stop to box



#21) A 8.09 kg box is moving at an unknown initial speed at the bottom of a 1.26 m high incline and has kinetic energy of 500J. It slides 4 m to the top of the incline and comes to rest. How much friction force acts on the box as it slides up the incline.



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Regents Practice 10

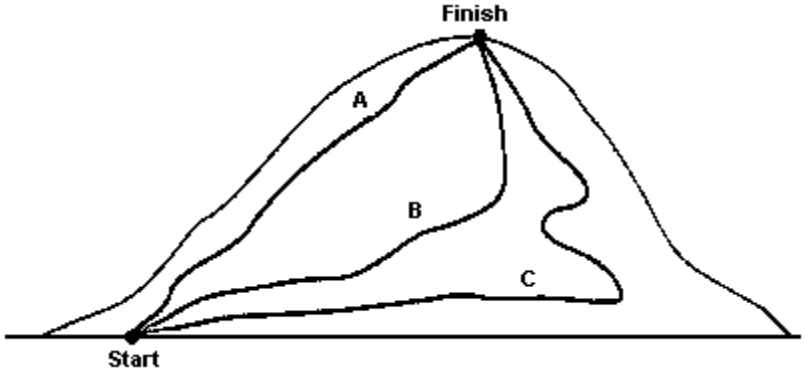
1.) A net force of 5.0 newtons moves a 2.0-kilogram object a distance of 3.0 meters in 3.0 seconds. How much work is done on the object?
1) 1.0 J
2) 10. J
3) 15 J
4) 30. J

2.) A 0.10-kilogram ball dropped vertically from a height of 1.0 meter above the floor bounces back to a height of 0.80 meter. The mechanical energy lost by the ball as it bounces is approximately
1) 0.080 J
2) 0.20 J
3) 0.30 J
4) 0.78 J

3.) A 6.0×10^2 newton man climbing a rope at a speed of 2.0 meters per second develops power at the rate of
1) 1.2×10^1 W
2) 6.0×10^2 W
3) 3.0×10^2 W
4) 1.2×10^3 W

4.) A 20.-kilogram object strikes the ground with 1960 joules of kinetic energy after falling freely from rest. How far above the ground was the object when it was released?
1) 10. m
2) 14 m
3) 98 m
4) 200 m

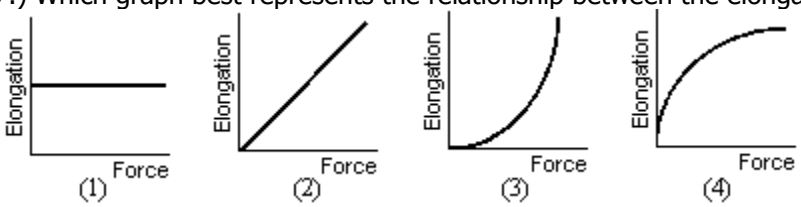
5.) Three people of equal mass climb a mountain using paths A, B, and C shown in the diagram.



Along which path(s) does a person gain the greatest amount of gravitational potential energy?
1) A, only
2) B, only
3) C, only
4) The gain is the same along all paths.

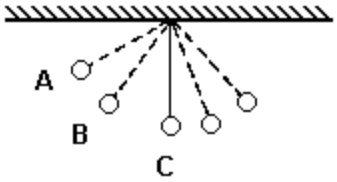
6.) A person does 100 joules of work in pulling back the string of a bow. What will be the initial speed of a 0.5-kilogram arrow when it is fired from the bow?
1) 20 m/s
2) 50 m/s
3) 200 m/s
4) 400 m/s

7.) Which graph best represents the relationship between the elongation of an ideal spring and the applied force?



8.) A motor has an output of 1,000 watts. When the motor is working at full capacity, how much time will it require to lift a 50-newton weight 100 meters?
1) 5 s
2) 10 s
3) 50 s
4) 100 s

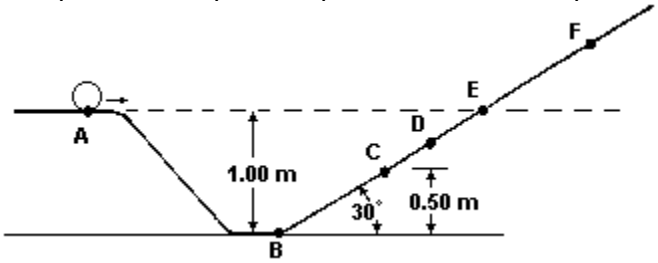
9.) If the speed of an object is doubled, its kinetic energy will be
1) halved
2) doubled
3) quartered
4) quadrupled



10.) As the pendulum swings from position A to position C as shown in the diagram, what is the relationship of kinetic energy to potential energy? [Neglect friction.]
1) The kinetic energy decreases more than the potential energy increases.
2) The kinetic energy increases more than the potential energy decreases.
3) The kinetic energy decrease is equal to the potential energy increase.
4) The kinetic energy increase is equal to the potential energy decrease

11.) An average force of 0.2 newton is needed to compress a spring a distance of 0.02 meter. The potential energy stored in this compressed spring is
1) 8×10^{-5} J
2) 2×10^{-3} J
3) 2×10^{-5} J
4) 4×10^{-3} J

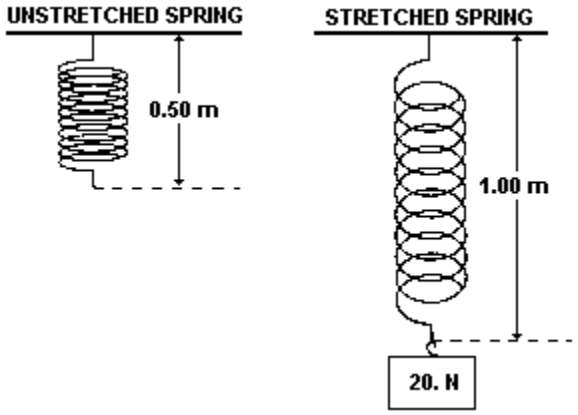
12.) The diagram represents a 0.20-kilogram sphere moving to the right along a section of a frictionless surface. The speed of the sphere at point A is 3.0 meters per second.



Approximately how much kinetic energy does the sphere gain as it goes from point A to point B?

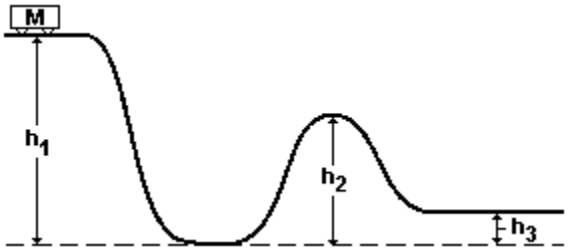
1) 1.0 J
2) 2.0 J
3) 3.9 J
4) 0.98 J

13.) A 20.-newton weight is attached to a spring, causing it to stretch, as shown in the diagram.



What is the spring constant of this spring?

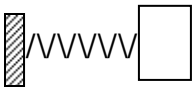
1) 0.050 N/m
2) 0.25 N/m
3) 20. N/m
4) 40. N/m



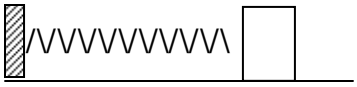
14.) A cart of mass M on a frictionless track starts from rest at the top of a hill having height h1, as shown in the diagram. What is the kinetic energy of the cart when it reaches the top of the next hill, having height h2?

1) Mgh1
2) Mg(h1-h2)
3) Mg(h2-h3)
4) 0

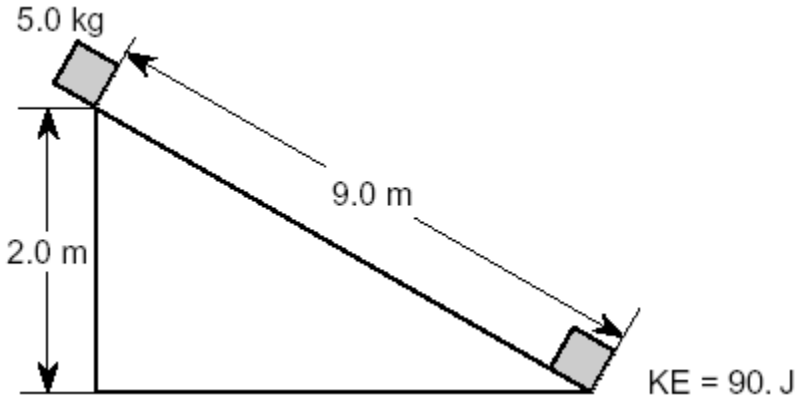
15.) A box is held at rest against a compressed spring with a spring constant of 100 N/m. The compressed length of the spring is 40 cm and the relaxed length of the spring is 75 cm. When released, the box moves right and leaves the spring with a kinetic energy of 4 J when the spring returns to its relaxed length. How much work is done against friction while the spring is pushing the box?



1) 0 J
2) 2.125 J
3) 4 J
4) 6.125 J



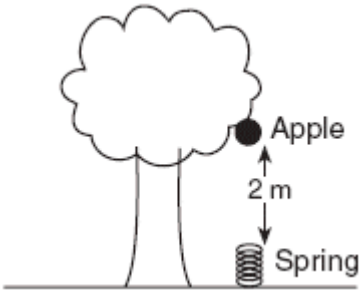
16.) The diagram below shows a 5.0-kilogram mass sliding 9.0 meters down an incline from a height of 2.0 meters in 3.0 seconds. The object gains 90. joules of kinetic energy while sliding.



How much work is done against friction as the mass slides the 9 m

1) 0 J
2) 8 J
3) 45 J
4) 90 J

17.) The diagram shows a 0.1-kilogram apple attached to a branch of a tree 2 meters above a spring on the ground below.



The apple falls and hits the spring, compressing it 0.1 meter from its rest position. If all of the gravitational potential energy of the apple on the tree is transferred to the spring when it is compressed, what is the spring constant of this spring?

1) 10 N/m
2) 40 N/m
3) 100 N/m
4) 400 N/m

Impulse-Momentum

#1) A 2250 kg car traveling west slows down uniformly from 20 m/s to 5 m/s in 4 seconds. How much braking force is applied to the car

#2) A 10 g bullet moving at 60 m/s hits a tree and imbeds itself into the trunk until it comes to rest. If the tree applies 2000 N of resistive force to stop the bullet, how long does it take the bullet to stop?

#3) A 1.5 kg soccer ball moving downfield at 4 m/s is kicked up field by a Force of 12 N. If the players foot is in contact with the ball for .8125 seconds, what is the new speed of the ball

#4) A 0.4 kg soccer ball rolls right at 8.5 m/s and rolls into a 0.15 kg bucket at rest. What is the speed of the combined objects after the collision?

#5) An astronaut in space is at rest 20 m away from his space station. Seeing no way to return to the station, he removes his oxygen tank and hurls in the direction away from the ship at a speed of 12 m/s. (a) If the astronaut has a mass of 65 kg and the tank has a mass of 10 kg, how fast will the astronaut be moving after he throws the tank. (b) How long we he have to hold his breath before he reaches the space station.

#6) A 15 g ball rolls right at 0.225 m/s and a 30 g ball rolls left towards it at 0.180 m/s. The balls collide and the 15 g ball moves left at 0.315 m/s. (a) What is the velocity of the 30 g ball. (b) What type of collision is this, prove your answer mathematically?

#7) In a physics experiment with two toy cars colliding, the data shown below was recorded. Use this information to determine what type of collision was investigated … explain and prove how you get your conclusion.

m_1 = 1.5 kg m_2 = 2.25 kg
v_{1i} = 3.6 m/s v_{2i} = -1.4 m/s v_{1f} = -2.25 m/s v_{2f} = 2.5 m/s

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Regents Practice 11

1) A force of 20. newtons is exerted on a cart for 10. seconds. How long must a 50. newton force act to produce the same impulse?

1. 10 s
2. 2.0 s
3. 5.0 s
4. 4.0 s

2) If a net force of 10. newtons acts on a 6.0-kilogram mass for 8.0 seconds, the total change of momentum of the mass is

1. 48 kg·m/s
2. 60. kg·m/s
3. 80. kg·m/s
4. 480 kg·m/s

3) A 0.10-kilogram model rocket's engine is designed to deliver an impulse of 6.0 newton-seconds. If the rocket engine burns for 0.75 second, what average force does it produce?

1. 4.5 N
2. 8.0 N
3. 45 N
4. 80. N

4) A 1,000-kilogram car traveling due east at 15 meters per second is hit from behind and receives a forward impulse of 6,000 newton-seconds. Determine the magnitude of the car's change in momentum due to this impulse.

Answer: _____ kg·m/s

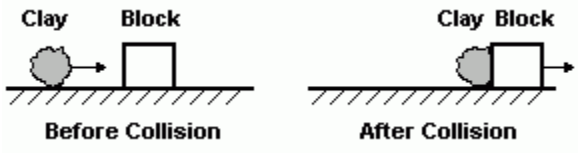
5) A student drops two eggs of equal mass simultaneously from the same height. Egg *A* lands on the tile floor and breaks. Egg *B* lands intact, without bouncing, on a foam pad lying on the floor. Compared to the magnitude of the impulse on egg *A* as it lands, the magnitude of the impulse on egg *B* as it lands is

1. less
2. greater
3. the same

6) A 2.0-kilogram ball traveling north at 4.0 meters per second collides head-on with a 1.0 kilogram ball traveling south at 8.0 meters per second. What is the magnitude of the total momentum of the two balls after collision?

1. 0 kg·m/s
2. 8.0 kg·m/s
3. 16 kg·m/s
4. 32 kg·m/s

7)



As shown in the diagrams, a lump of clay travels horizontally to the right toward a block at rest on a frictionless surface. Upon collision, the clay and the block stick together and move to the right. Compared to the total momentum of the clay and the block before the collision, the momentum of the clay-block system after the collision is

1. less
2. greater
3. the same

8) A 2.0-kilogram body is initially traveling at a velocity of 40. meters per second east. If a constant force of 10. newtons due east is applied to the body for 5.0 seconds, the final speed of the body is

1. 15 m/s
2. 25 m/s
3. 65 m/s
4. 130 m/s

9) A 2.0-kilogram cart moving due east at 6.0 meters per second collides with a 3.0-kilogram cart moving due west. The carts stick together and come to rest after the collision. What was the initial speed of the 3.0-kilogram cart?

1. 1.0 m/s
2. 6.0 m/s
3. 9.0 m/s
4. 4.0 m/s

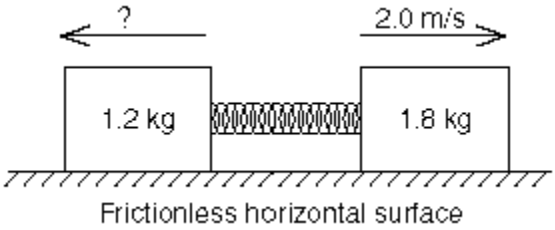
10) A 0.025-kilogram bullet is fired from a rifle by an unbalanced force of 200. newtons. If the force acts on the bullet for 0.1 second, what is the maximum speed attained by the bullet?

1. 5 m/s
2. 20 m/s
3. 400 m/s
4. 800 m/s

11) A 50.-kilogram student threw a 0.40-kilogram ball with a speed of 20. meters per second. What was the magnitude of the impulse that the student exerted on the ball?

1. 8.0 N·s
2. 78 N·s
3. 4.0×10^2 N·s
4. 1.0×10^3 N·s

12) A 1.2-kilogram block and a 1.8-kilogram block are initially at rest on a frictionless, horizontal surface. When a compressed spring between the blocks is released, the 1.8-kilogram block moves to the right at 2.0 meters per second, as shown.



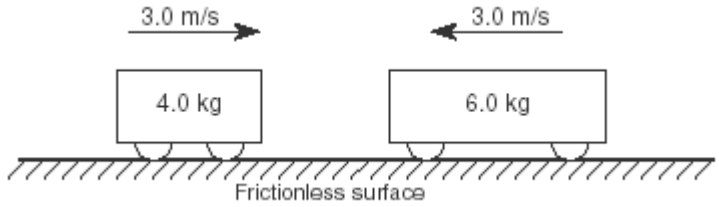
What is the speed of the 1.2-kilogram block after the spring is released?

1. 1.4 m/s
2. 2.0 m/s
3. 3.0 m/s
4. 3.6 m/s

13) A 2.0-kilogram laboratory cart is sliding across a horizontal frictionless surface at a constant velocity of 4.0 meters per second east. What will be the cart's velocity after a 6.0-newton westward force acts on it for 2.0 seconds?

1. 2.0 m/s east
2. 2.0 m/s west
3. 10. m/s east
4. 10. m/s west

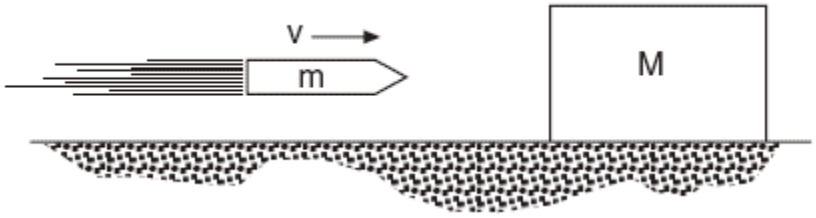
14) The diagram below shows a 4.0-kilogram cart moving to the right and a 6.0-kilogram cart moving to the left on a horizontal frictionless surface.



When the two carts collide they lock together. The magnitude of the total momentum of the two-cart system after the collision is

1. 0.0 kg·m/s
2. 6.0 kg·m/s
3. 15 kg·m/s
4. 30. kg·m/s

15) In the diagram below, a block of mass *M* initially at rest on a frictionless horizontal surface is struck by a bullet of mass *m* moving with horizontal velocity *v*.



What is the velocity of the bullet-block system after the bullet embeds itself in the block?

1. $\left(\frac{M+v}{M}\right)m$
2. $\left(\frac{m+M}{m}\right)v$
3. $\left(\frac{m+v}{M}\right)m$
4. $\left(\frac{m}{m+M}\right)v$

Student Sheet – Electrostatics 1

1. The charge on a rubber rod rubbed with fur is designated as _____

2. When you comb your hair, why does the comb acquire a negative charge?

3. Since electric charges move well through metals, they are classified as good _____

4. The unit of electric charge is _____

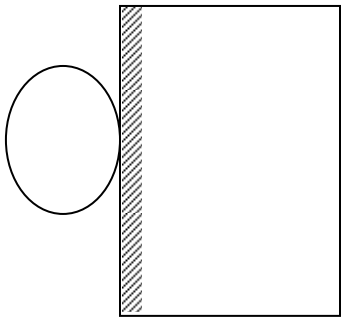
5. An important difference between gravitational and electrical forces is that the gravitational force is always
(1) stronger (2) attractive (3) repulsive (4) positive (5) removable

6. Stroking a rubber balloon with a wool mitten will put a charge on the balloon, if the mitten is then brought near the balloon, what should occur?

7. A glass rod stroked with silk becomes positively charged because
(1) the silk removes electrons from the rod
(2) the rod removes electrons from the silk
(3) friction creates a positive charge
(4) the silk gains protons
(5) the silk loses electrons

8. Materials in which the outer electrons are bound tightly to the nucleus and not free to roam in the material are classified as _____

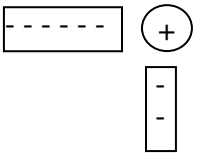
9. A positively charged balloon is placed against a wall and is stuck there. The particles in the wooden wall rearrange themselves to help allow the balloon to stick.
(a) This process it called _____
(b) Draw a sketch of the charges on the balloon and the wall below

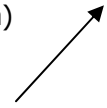


10. Which atom pictured below is electrically neutral

(a) 3P 3N ◯ 2e (b) 9P 10N ◯ 9e (c) 16P 16N ◯ 17e (d) 1P 1N ◯

11. In which direction will the positively charge ball shown below move? The rods are equally charged

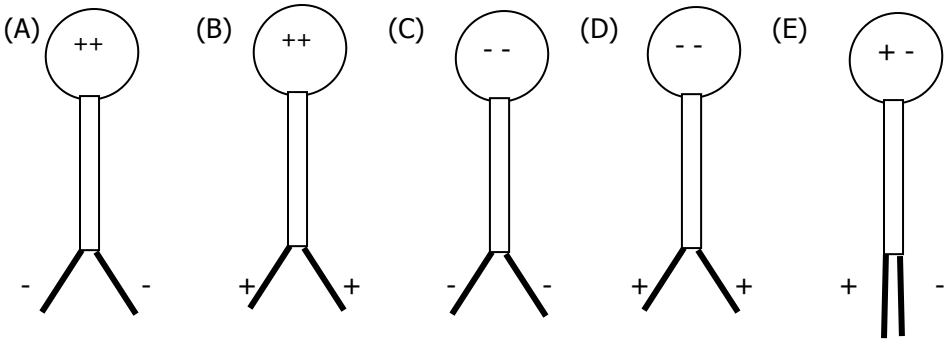


(a)  (b)  (c)  (d) 

12.) Two equal metal spheres are on insulating stands. Sphere A has a charge of + 3 μC and sphere B has a charge of – 7 μC. The spheres are touched together, and then removed.
(a) What is the charge on each sphere in the end
(b) How much charge is transferred and where does it move to and from
(c) How many electrons are transferred and where do they move to and from

Student Sheet – Electrostatics 2

For each numbered example below, choose the diagram that best represents the charge on an electroscope during each of the procedures described.



1. A positively charged rod is brought near, but not touching an uncharged electroscope.

2. A glass rod is charged positively by rubbing it with silk. The silk is touched to a neutral electroscope.

3. A positive rod is brought near a neutral electroscope, and the electroscope is charged by induction.

4. An electroscope is charged by conduction by a positive rod

5. A negatively charged rod is brought near a neutral electroscope.

6. A positively charged rod is brought near a positively charged electroscope.

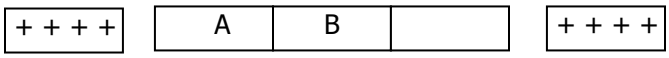
7. A metal rod is brought in contact with the positively charged electroscope.

8. A 1 g pith ball is sitting suspended above a table and a charged rod is above the pith ball. Explain how this is possible from a force point of view

9. How much electric force acts on the pith ball described in #8 above.

Student Sheet – Electrostatics 3

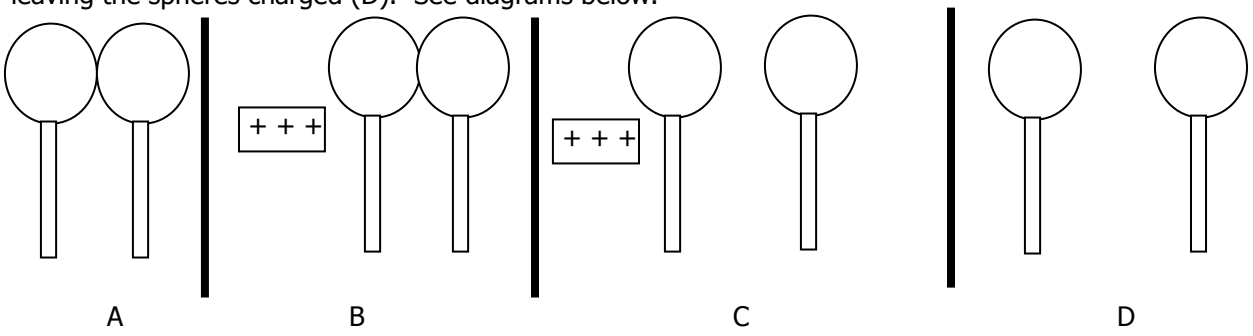
Three pieces of metal are insulated from ground and directly touching each other. Positively charged rods are brought near both ends.



1. The charge on piece A is (a) + (b) - (c) neutral

2. The charge on piece B is (a) + (b) - (c) neutral

3. Two neutral metal spheres are insulated from ground and touching (A). A positively charged rod is brought near the two spheres (B). While the rod is still near the sphere, they are separated (C). The rod is then removed leaving the spheres charged (D). See diagrams below.



(a) fill in the spheres above with "+" and "-" signs to represent the charge on each in all 4 steps.

(b) This process of charging is referred to as _____

4. 25 electrons are transferred from one atom to another. How much charge was transferred?

5. A metal sphere has a charge of 20 μC. Express this charge in the standard SI unit.

6. In an experiment, electrons are transferred to a neutral atom three times in a row and the charge is measured each time. Which of the following sets of results contains errors and why?

A

Measurement	Charge (C)
1	1.60E-19
2	3.20E-19
3	9.00E-19

B

Measurement	Charge (C)
1	3.20E-19
2	1.60E-18
3	1.76E-18

C

Measurement	Charge (C)
1	1.60E-19
2	2.00E-19
3	3.20E-19

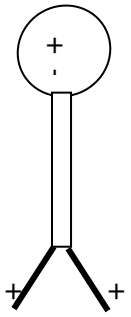
7. For the data in choice "A" above, determine how many electrons were transferred in measurements that are correct.

Student Sheet – Electrostatics 4 Name: _____

1.) What does it mean for an object to be charged?

2.) A positively charged metal sphere is attached to the ground. Then a second metal sphere that is neutral and insulated from ground is touched to the first one and removed. The first sphere is then removed from the ground. What type of net charge does each sphere have on it (positive, negative, neutral), explain your answer.

3.) A leaf type electroscope is positively charged, as shown below. A glass rod is rubbed with silk and the rod is brought near the ball of the electroscope. What will happen to the leaves of the electroscope when the rod is brought near the ball on top. Explain.



4.) A small neutral pith ball hangs on a string. A charged rod is brought near the ball. The ball moves towards the rod and touches it, then goes flying away from the rod. Explain these observations in terms of charges and electron transfer.

5.) A conductor is charged to - 8 nC. How many extra electrons are in the conductor

6.) If possible, explain how the following net charges could be produced. If not possible, explain why.
(a) -1.36×10^{-18} C (b) 3.2×10^{-20} C (c) 2.56×10^{-18} C

Electric Force Sample Problem

1.) A - 50 nC charge is placed 5 cm to the left of a 20 nC charge. A 35 nC charge is placed in the same line 15 cm to the right of the 20 nC charge. What is the force acting on the 35 nC charge.

Student Sheet – Electric Fields

1. Several electric field line patterns are shown in the diagrams below. Which of these patterns are incorrect? _____ Explain what is wrong with all incorrect diagrams.

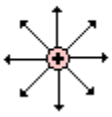
Diagram A 

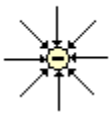
Diagram B 

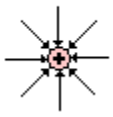
Diagram C 

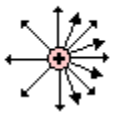
Diagram D 

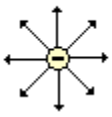
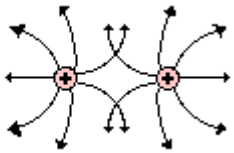
Diagram E 

Diagram F 

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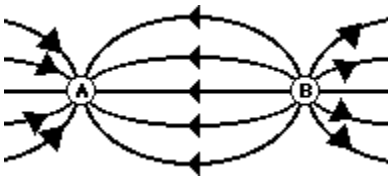
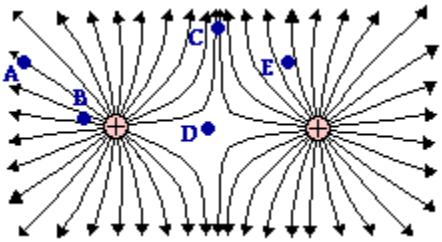
2. Consider the electric field lines shown in the diagram below. From the diagram, it is apparent that object A is ____ and object B is ____.

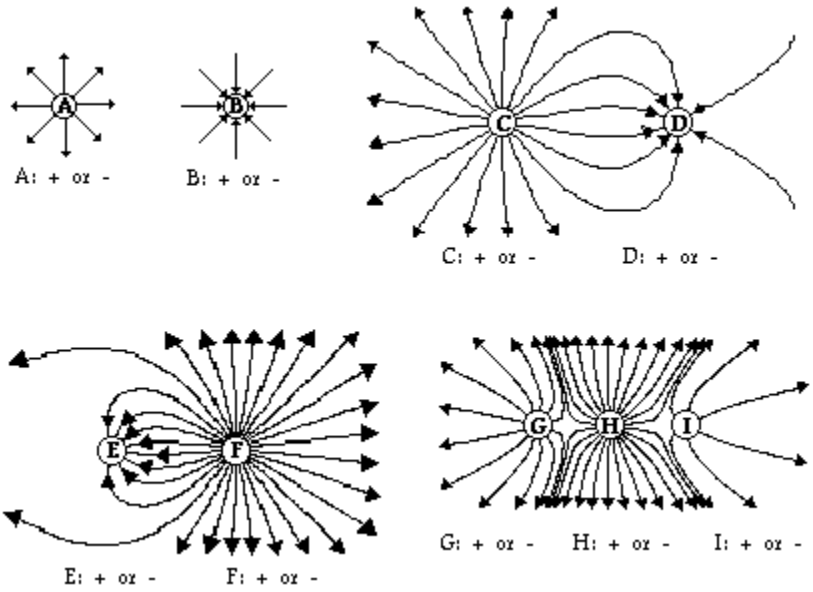


a. +, + b. -, - c. +, - d. -, + e. insufficient info

3. Consider the electric field lines drawn at the right for a configuration of two charges. Several locations are labeled on the diagram. Rank these locations in order of the electric field strength - from smallest to largest.



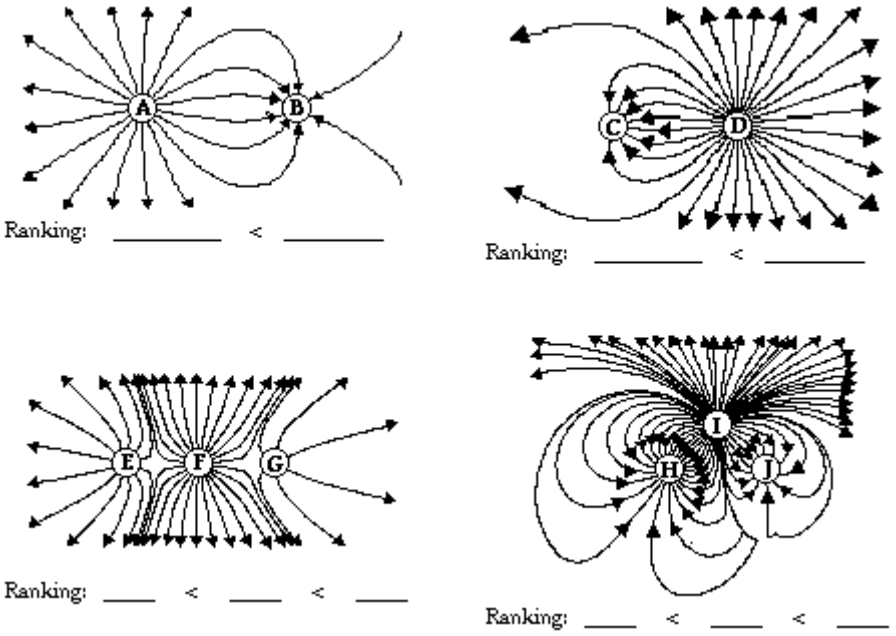
4. Use your understanding of electric field lines to identify the charges on the objects in the following configurations.



A: + or - B: + or - C: + or - D: + or -

E: + or - F: + or - G: + or - H: + or - I: + or -

5. Observe the electric field lines below for various configurations. Rank the objects according to which has the greatest magnitude of electric charge, beginning with the smallest charge.



Ranking: _____ < _____

Ranking: _____ < _____

Ranking: ____ < ____ < ____

Ranking: ____ < ____ < ____

Electrostatic Sheet 5 Name: _____

1. A metal sphere has a deficiency of 1.0×10^{12} electrons. What is the charge on the sphere?

2. List one of the rules discussed in class for drawing electric field lines.

The following statements (1-3) are false. Explain what is wrong with the statements.

1. Object A is positively charged. Object B is an electrically neutral insulator. If Object A is brought near Object B, the electrons in Object B travel to the surface which is nearest to Object A.

2. The leaves of a positively charged electroscope are separated. If a physics student, standing on the ground, touches the electroscope with a plastic baseball bat, then the electroscope will be discharged and the leaves will relax to their original rest position.

3. The leaves of a positively charged electroscope are separated. When the electroscope is touched by a person standing upon the ground, the positive charges within the electroscope will be transmitted through the person and into the earth.

1.) A 7C charge is on the x axis located at x = 0m. (a) Determine the electric field at x = 4.5 m (b) A -3C charge is placed at x = 4.5 m, determine the magnitude and direction of the force acting on this charge (c) Sketch two E field vectors to represent the E field from each charge at the x=6m location. (d) Determine the magnitude and direction of the net E field at X=6m

2.) A group of electrons placed in a $5x10^{5}$ N/C electric field experience an electric force of $3.84x10^{-12}$ N. How many electrons were grouped together.

3.) Two oppositely charged horizontal plates have an electric field between them. +4e worth of charge bunched together is placed at rest in the field (e = elementary charge). The charge floats suspended between the plates. (a) Draw a sketch of the plates with the charge in-between them. Draw a FBD of the charge and label which plate is + and which plate is -. (b) Redraw the plates and draw the E field between the plates. Then find the magnitude of the field.

4.) How much charge is required to produce an electric field of 500 N/C at a location 5 cm away from the charge center?

5.) Two charged spheres are placed 25 cm apart. Sphere A on the left has a charge of +20 μC and sphere B on the right has a charge of – 50 μC.
(a) Sketch the spheres and draw field lines around them
(b) Determine the force each sphere exerts on the other
(c) The spheres are touched together. Explain in terms of the # of electrons or protons what occurs
(d) The spheres are separated again to 25 cm. Draw the field lines
(e) Determine the force each sphere exerts on the other

<u>Challenge problem</u>
Prior to being touched, determine the following for spheres A and B above
(a) Find the magnitude and direction of the net electric field 10 cm to the right of A
(b) Find the magnitude and direction of the force that would act on an electron placed 10 cm to the right of A

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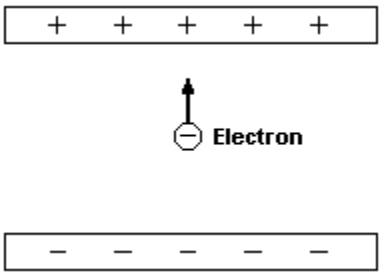
Regents Practice 12

1) If a positively charged rod is brought near the knob of a positively charged electroscope, the leaves of the electroscope will

1. converge, only
2. diverge, only
3. first diverge, then converge
4. first converge, then diverge



2) An electron is located between two oppositely charged parallel plates as shown in the diagram. As the electron moves toward the positive plate, the magnitude of the electric force acting on the electron

1. decreases
2. increases
3. remains the same

3) Sphere *A* carries a charge of +2 coulombs and an identical sphere *B* is neutral. If the spheres touch one another and then are separated, the charge on sphere *B* would be

1. +1 C
2. +2 C
3. 0 C
4. +4 C

4) A negatively charged plastic comb is brought close to, but does not touch, a small piece of paper. If the comb and the paper are attracted to each other, the charge on the paper

1. may be negative or neutral
2. may be positive or neutral
3. must be negative
4. must be positive

5) A lightweight sphere hangs by an insulating thread. A student wishes to determine if the sphere is neutral or electrostatically charged. She has a negatively charged hard rubber rod and a positively charged glass rod. She does not touch the sphere with the rods, but runs tests by bringing them near the sphere one at a time. The student notes that the sphere is attracted to both rods. This test result shows that the charge on the sphere is

1. positive
2. negative
3. neutral

6) A metallic sphere is positively charged. The field at the center of the sphere due to this positive charge is

1. positive
2. negative
3. zero
4. dependent on the magnitude of the charge

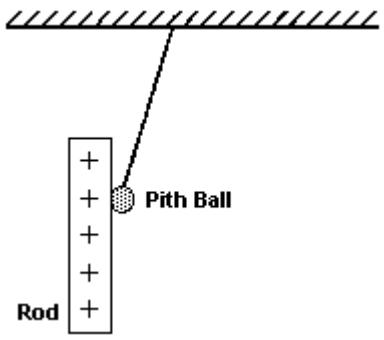
7) Oil droplets may gain electrical charges as they are projected through a nozzle. Which quantity of charge is *not* possible on an oil droplet?

1. 8.0×10^{-19} C
2. 4.8×10^{-19} C
3. 3.2×10^{-19}C
4. 2.6×10^{-19} C

8) An object possessing an excess of 6.0×10^{6} electrons has a net charge of

1. 2.7×10^{-26} C
2. 5.5×10^{-24} C
3. 3.8×10^{-13} C
4. 9.6×10^{-13} C

9) As shown in the diagram, a neutral pith ball suspended on a string is attracted to a positively charged rod.



During contact with the rod, the pith ball

1. loses electrons
2. gains electrons
3. loses protons
4. gains protons

10) What is the approximate electrostatic force between two protons separated by a distance of 1.0×10^{-6} meter?

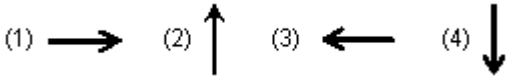
1. 2.3×10^{-16} N and repulsive
2. 2.3×10^{-16} N and attractive
3. 9.0×10^{21} N and repulsive
4. 9.0×10^{21} N and attractive

11) Three identical metal spheres are mounted on insulating stands. Initially, sphere *A* has a net charge of *q* and spheres *B* and *C* are uncharged. Sphere *A* is touched to sphere *B* and removed. Then sphere *A* is touched to sphere *C* and removed. What is the final charge on sphere *A*?

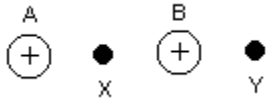
1. *q*
2. *q*/2
3. *q*/3
4. *q*/4

12) In the diagram below, *A* is a point near a positively charged sphere.

Which vector best represents the direction of the electric field at point A?



13) The diagram shows the positions of two positive point charges, *A* and *B* .



At which location is the electric field intensity due to these two charges equal to zero?

1. *A*
2. *B*
3. *X*
4. *Y*

14) Which procedure will double the force between two point charges?

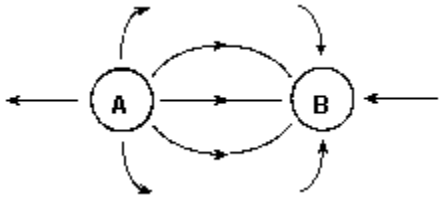
1. doubling the distance between the charges
2. doubling the magnitude of one charge
3. halving the distance between the charges
4. halving the magnitude of one charge

15) In the diagram, a positive test charge is located between two charged spheres, *A* and *B*. Sphere *A* has a charge of +2*q* and is located 0.2 meter from the test charge. Sphere *B* has a charge of -2*q* and is located 0.1 meter from the test charge.

If the magnitude of the force on the test charge due to sphere *A* is *F*, what is the magnitude of the force on the test charge due to sphere *B*?

1. $\frac{F}{4}$
2. $2F$
3. $\frac{F}{2}$
4. $4F$

16) The diagram shows the electric field in the vicinity of two charged conducting spheres, *A* and *B*.



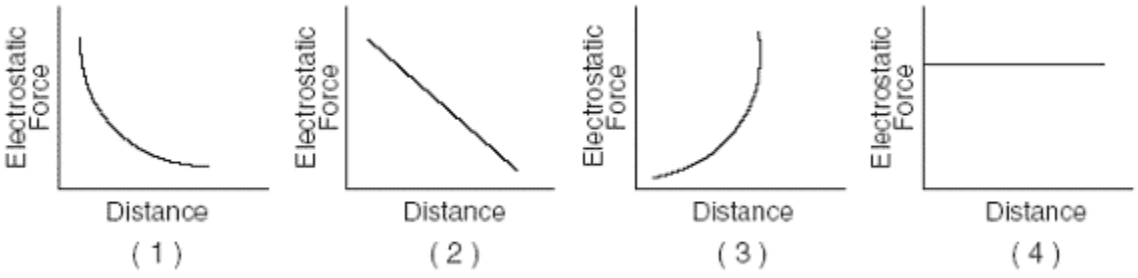
What is the static electric charge on each of the conducting spheres?

1. *A* is negative and *B* is positive.
2. *A* is positive and *B* is negative.
3. Both *A* and *B* are positive.
4. Both *A* and *B* are negative.

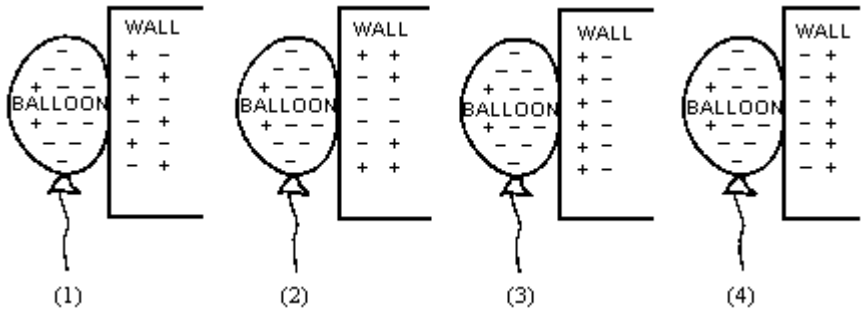
17) What is the magnitude of an electrostatic force experienced by one elementary charge at a point in an electric field where the electric field intensity is 3.0×10^3 newtons per coulomb?

1. 1.0×10^3 N
2. 1.6×10^{-19} N
3. 3.0×10^3 N
4. 4.8×10^{-16} N

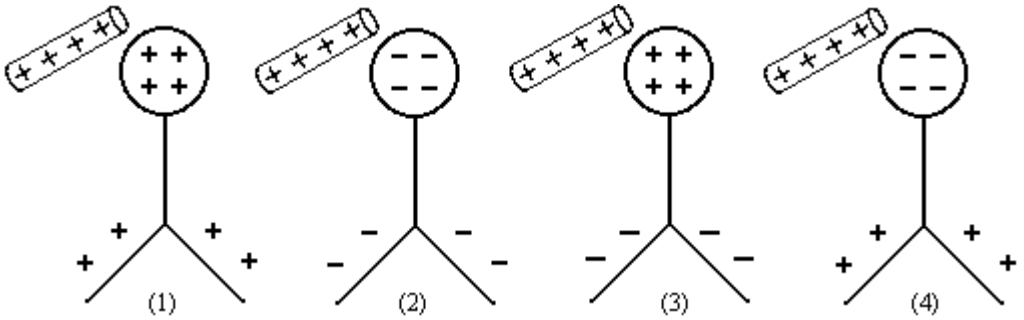
18) Which graph best represents the electrostatic force between an alpha particle with a charge of +2 elementary charges and a positively charged nucleus as a function of their distance of separation?



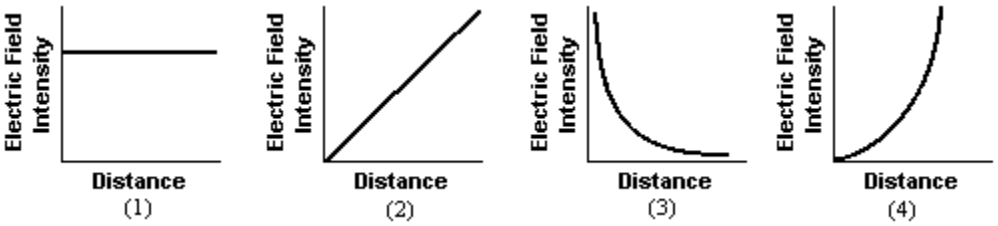
19) An inflated balloon which has been rubbed against a person's hair is touched to a neutral wall and remains attracted to it. Which diagram best represents the charge distribution on the balloon and the wall?



20) A positively charged rod is held near the knob of a neutral electroscope. Which diagram below best represents the distribution of charge on the electroscope?



21) Which graph best represents the relationship between electric field intensity and the distance from a point charge?



Student Sheet – Electric Potential

1.) What is the difference between the total electric potential energy an object has and its electric potential.

2.) How does the amount of charge on the inside of the Van de Graaff generator compare to the charge on the outside surface of the sphere.

3.) Suppose a metal file cabinet is charged. How will the charge concentration at the corners of the cabinet compare with the charge concentration on the flat parts of the cabinet?

4.) A balloon is charged to an electric potential of 5000 V. Why is this not dangerous?

5.) 12 J of work is done to push 0.001 C of charge from point A to point B in an electric field. (a) Determine the energy gained in units of eV. (b) Determine the potential difference between points A and B?

6.) Suppose that you double the charge that is placed in the same field from #5 to 0.002 C and move the charge from A to B. What is the potential difference between points A and B?

7.) Charge flows through a potential difference of 50 V and produces 25 J of electrical potential energy. (a) Determine the magnitude of the charge in both elementary charge units and coulombs. (b) Convert the energy to electron volts

Student Sheet – Electric Current, Voltage. Resistance

1.) A lightening bolt delivers 35 coulombs of charge to the ground in 1/1000 of a second. (a) How many electrons are transferred, (b) What is the current of the lightening bolt.

2.) What do the units (a) J/C represent? (b) C/s represent?

3.) What is the easiest way to reduce the resistance in a single conductive wire?

4.) Can a material have a high conductivity and a high resistivity, explain?

5.) A battery does 18 J of work on 3 coulombs of charge. What is the potential difference across the terminals?

6.) A toaster with a 14 ohm heating element is connected to a 120 V outlet. What is the current in the coil?

7.) What is the resistance in a wire that has 40 mA of current running through it while it is connected to a battery with a potential difference of 1.5 V?

8.) If both voltage and resistance are doubled, how does that affect the current?

Regents Practice 13

1) How much energy is required to move 3.2×10^{-19} coulomb of charge through a potential difference of 5 volts?

1. 5 eV
2. 2 eV
3. 10 eV
4. 20 eV

2) Which is a vector quantity?

1. electric charge
2. electrical resistance
3. electrical potential difference
4. electrical field intensity

3) In an electric field, 0.90 joule of work is required to bring 0.45 coulomb of charge from point *A* to point *B*. What is the electric potential difference between points *A* and *B*?

1. 5.0 V
2. 2.0 V
3. 0.50 V
4. 0.41 V

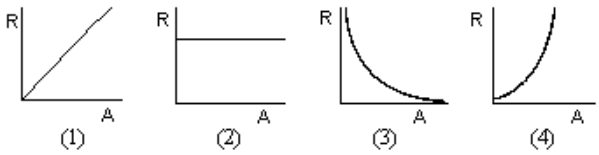
4) Moving 2.0 coulombs of charge a distance of 6.0 meters from point *A* to point *B* within an electric field requires a 5.0-N force. What is the electric potential difference between points *A* and *B* ?

1. 60. V
2. 30. V
3. 15 V
4. 2.5 V

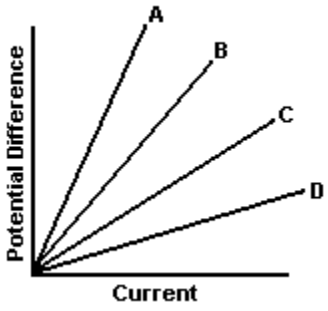
5) How much electrical energy is required to move a 4.00-microcoulomb charge through a potential difference of 36.0 volts?

1. 9.00×10^{6} J
2. 144 J
3. 1.44×10^{-4} J
4. 1.11×10^{-7} J

6) Which graph below best represents how the resistance (*R*) of a series of copper wires of uniform length and temperature varies with cross-sectional area (*A*)?



7) The graph shows the relationship between current and potential difference for four resistors, *A*, *B*, *C*, and *D* .



Which resistor has the greatest resistance?

1. *A*
2. *B*
3. *C*
4. *D*

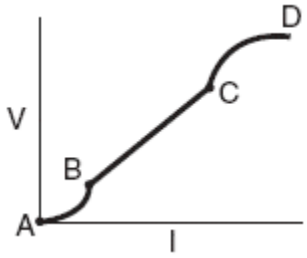
8) A 330.-ohm resistor is connected to a 5.00-volt battery. The current through the resistor is

1. 0.152 mA
2. 15.2 mA
3. 335 mA
4. 1650 mA

9) If the diameter of a wire were to increase, its electrical resistance would

1. decrease
2. increase
3. remain the same

10) The graph below represents the relationship between the potential difference (*V*) across a resistor and the current (*I*) through the resistor.



Through which entire interval does the resistor obey Ohm's law?

1. *AB*
2. *BC*
3. *CD*
4. *AD*

11) What is the resistance at 20°C of a 1.50-meter long aluminum conductor that has a cross-sectional area of 1.13×10^{-6} meter^2?

1. $1.87 \times 10^{-3}\ \Omega$
2. $2.28 \times 10^{-2}\ \Omega$
3. $3.74 \times 10^{-2}\ \Omega$
4. $1.33 \times 10^{6}\ \Omega$

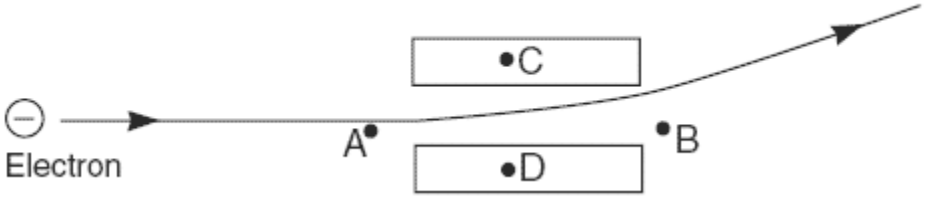
12) A metal conductor is used in an electric circuit. The electrical resistance provided by the conductor could be increased by

1. decreasing the length of the conductor
2. decreasing the applied voltage in the circuit
3. increasing the temperature of the conductor
4. increasing the cross-sectional area of the conductor

13) An incandescent light bulb is supplied with a constant potential difference of 120 volts. As the filament of the bulb heats up, its resistance

1. increases and the current through it decreases
2. increases and the current through it increases
3. decreases and the current through it decreases
4. decreases and the current through it increases

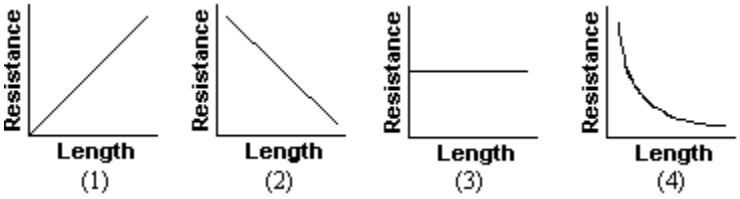
14) A moving electron is deflected by two oppositely charged parallel plates, as shown in the diagram below.



The electric field between the plates is directed from

1) A to B
2) C to D
3) B to A
4) D to C

15) Which graph below best represents the relationship between the resistance of a copper wire of uniform cross-sectional area and the wire's length at constant temperature?



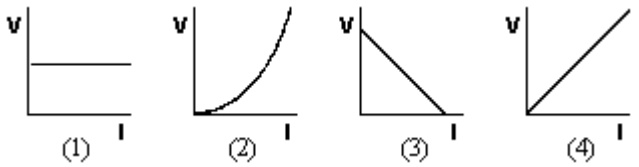
16) The table below lists various characteristics of two metallic wires, *A* and *B*.

Wire	Material	Temperature (°C)	Length (m)	Cross-Sectional Area (m^2)	Resistance (Ω)
A	silver	20.	0.10	0.010	R
B	silver	20.	0.20	0.020	???

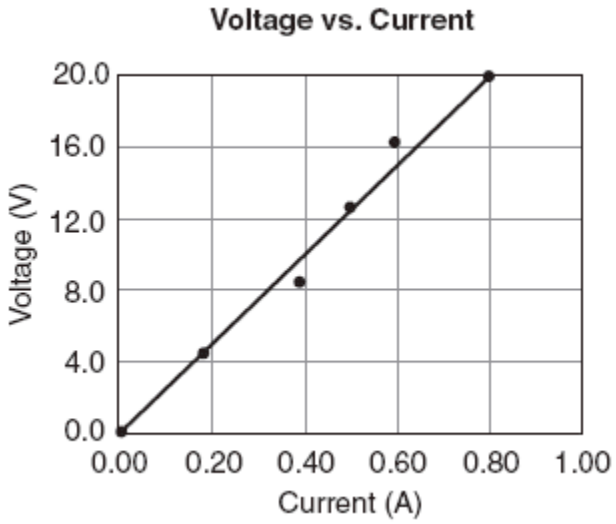
If wire *A* has resistance *R*, then wire *B* has resistance

1. *R*
2. 2*R*
3. $\frac{R}{2}$
4. 4*R*

17) Which graph best represents a circuit element at constant temperature that obeys Ohm's law?



18) A long copper wire was connected to a voltage source. The voltage was varied and the current through the wire measured, while temperature was held constant. The collected data are represented by the graph below.



Using the graph, the resistance of the copper wire is approximately

1. 8.0 Ω
2. 25 Ω
3. 30 Ω
4. 2.5 Ω

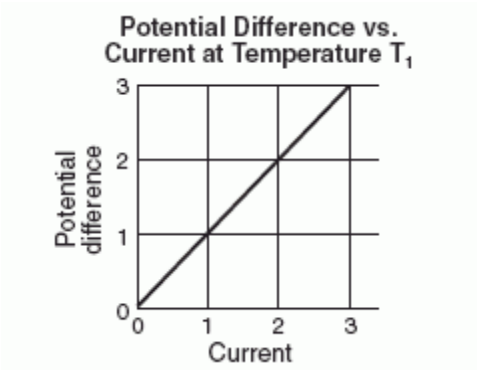
19) A 0.500-meter length of wire with a cross sectional area of 3.14×10^{-6} meters squared is found to have a resistance of 2.53×10^{-3} ohms. According to the resistivity chart, the wire could be made of

1. aluminum
2. copper
3. nichrome
4. silver

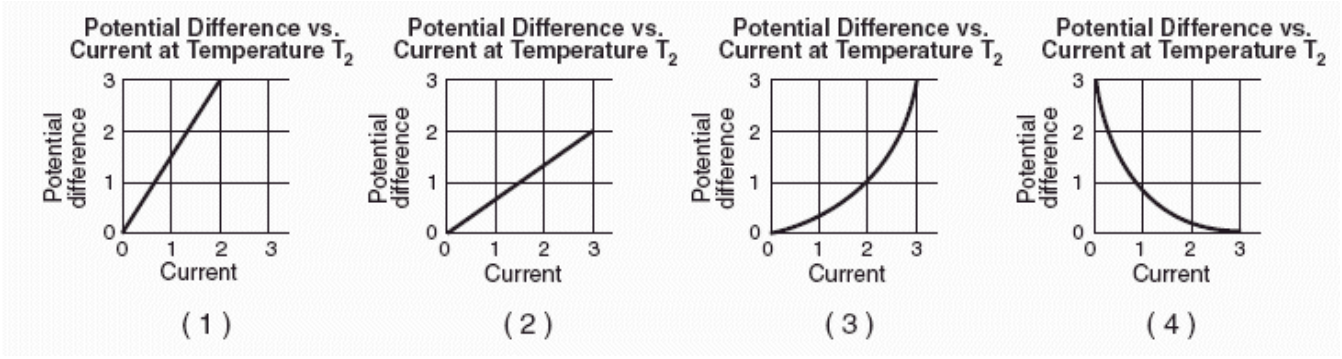
20) A wire carries a current of 6.0 amperes. How much charge passes a point in the wire in 120 seconds?

1. 6.0 C
2. 20. C
3. 360 C
4. 720 C

21) The graph below shows the relationship between the potential difference across a metallic conductor and the electric current through the conductor at constant temperature T_1.



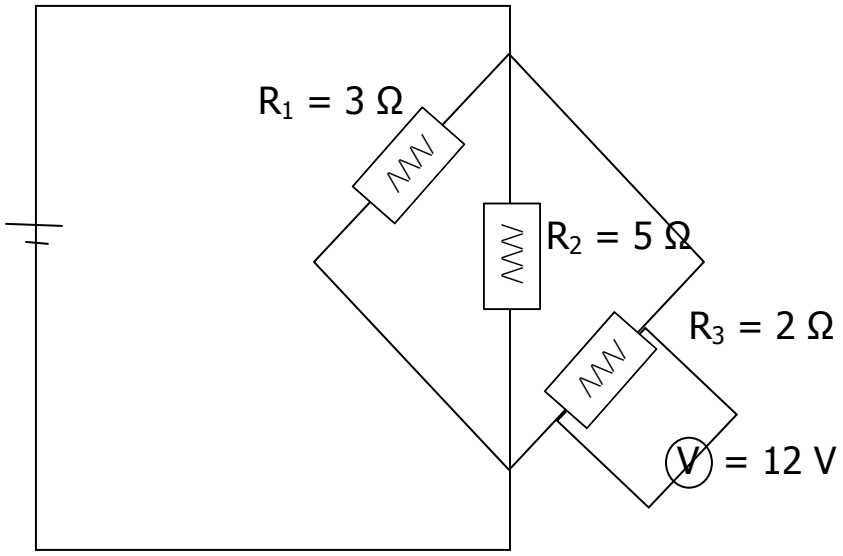
Which graph best represents the relationship between potential difference and current for the same conductor maintained at a higher constant temperature, T_2?



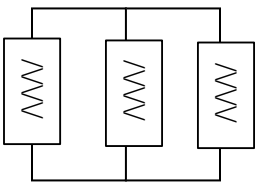
Electric Circuits

Student Circuit Sheet

1.) Draw a voltmeter and an ammeter that could be used to measure the total voltage and total current in the circuit. Solve for the voltage and current in each element.

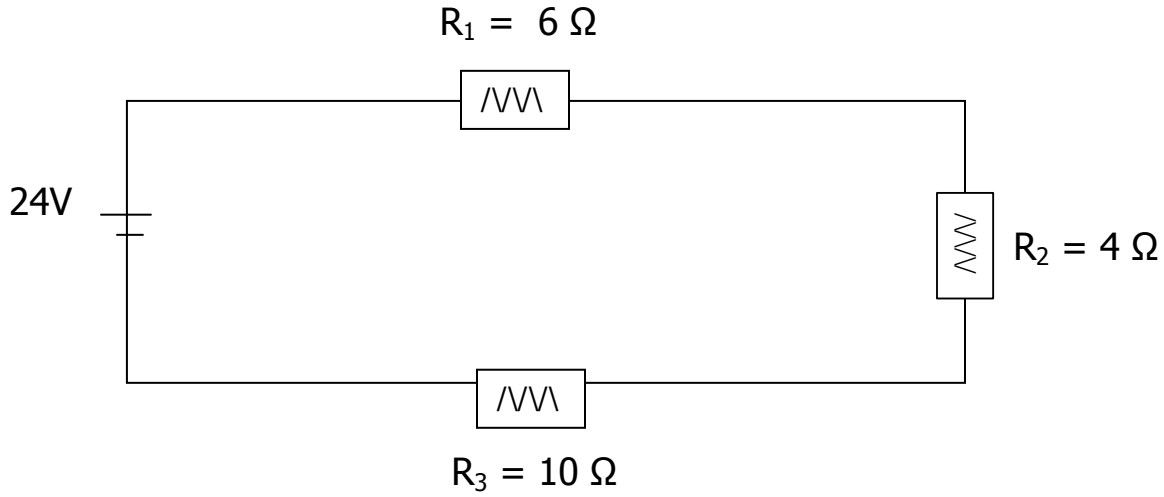


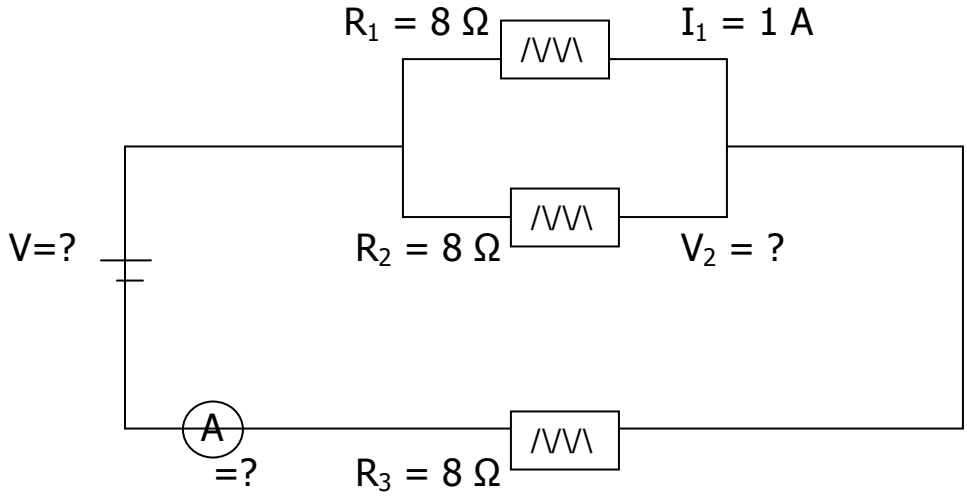
2.) Find the equivalent resistance of the resistors shown connected below

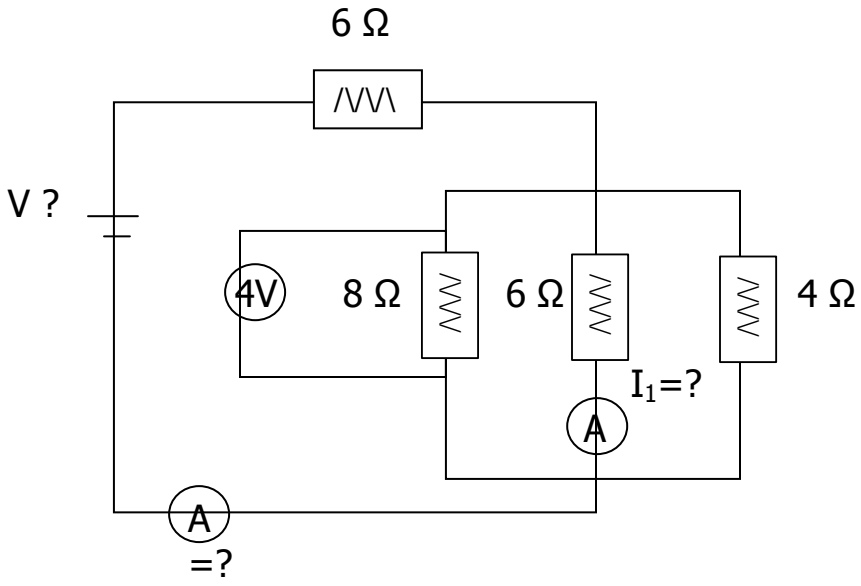


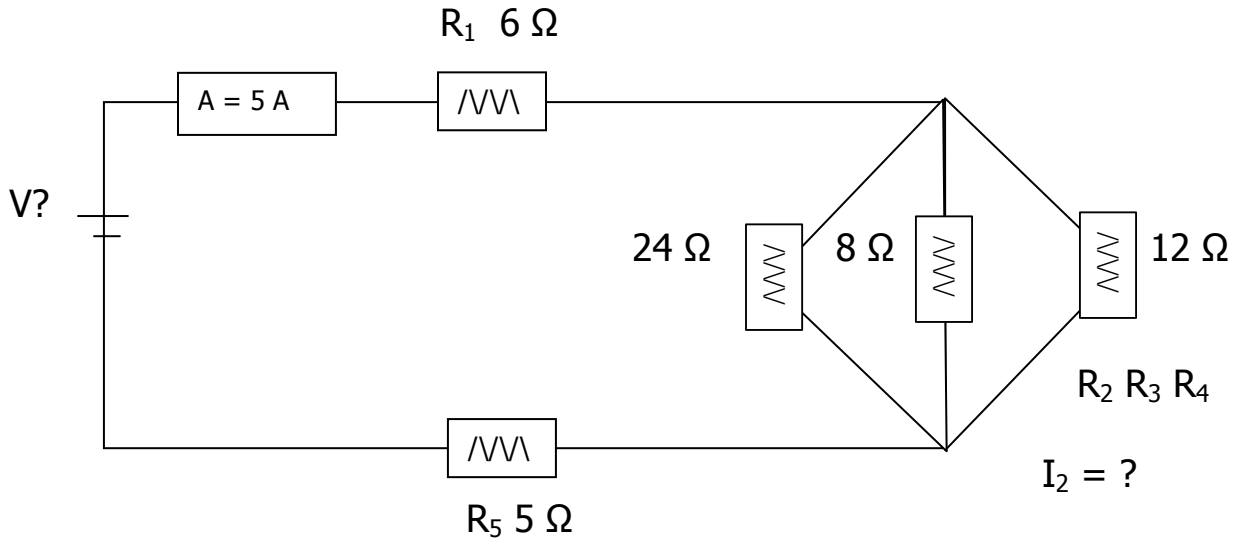
R_1 = 3 Ω R_2 = 10 Ω R_3 = 6 Ω

3.) Find all.



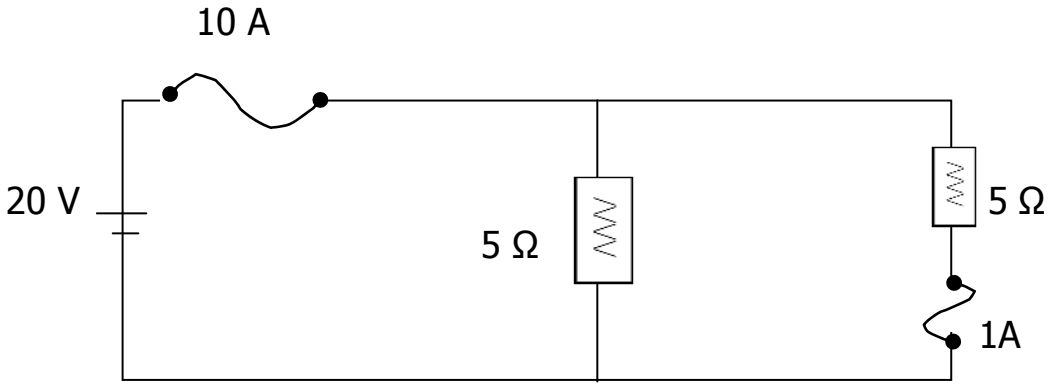

R1 = 8 Ω
I1 = 1 A
/\/\/\
/\/\/\
V=?
R2 = 8 Ω
V2 = ?
A
=?
/\/\/\
R3 = 8 Ω


6 Ω
/\/\/\
V ?
4V
8 Ω
6 Ω
4 Ω
I1=?
A
A
=?


R1 6 Ω
A = 5 A
/\/\/\
V?
24 Ω
8 Ω
12 Ω
R2 R3 R4
/\/\/\
I2 = ?
R5 5 Ω

Student Sheet – Fused Circuits

1) Will either of the fuses in the circuit below burn out when the circuit is closed?



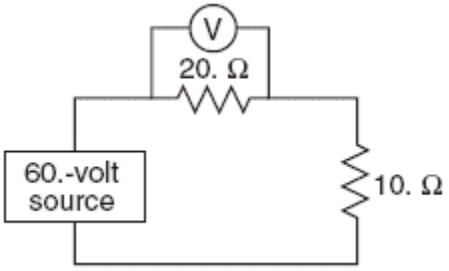
2. The 1 A fuse is removed and replace with a wire, then A third 5 ohm resistor is added in parallel to the circuit above, redraw the circuit and determine if the 10 A fuse will burn out.

1.) A 150 W light bulb operates with a 120 V potential difference. (a) How much energy does it used in 2 hrs. (b) at a rate of $.20/ kW-hr how much does it cost to operate the bulb for 2 hrs (c) Determine the resistance of the bulb (d) If the bulb was connected to a 12 V battery, at what rate would it consume energy

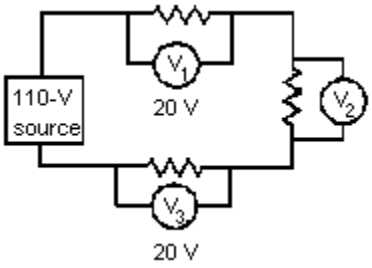
2.) A 90 W b&w TV is connected to a 120 V outlet and operated for 1 hr. A color TV is connected to a separate 120 V outlet and draws 2.5 A of current.
(a) What is the power of the color TV
(b) Based on the power rating, which device has the larger resistance
(c) How long could the color TV be operated using the same energy that the B&W does in 1 hr
(d) If electric energy costs $0.20/kW-hr, how much more expensive is a color TV compared to a b&W TV for 100 hrs of viewing time.

Regents Practice 14

1) In the circuit represented by the diagram, what is the reading of voltmeter *V*?



1. 20. V
2. 2.0 V
3. 30. V
4. 40. V



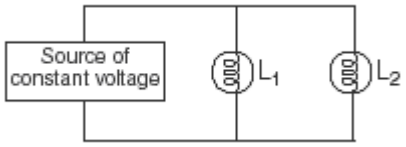
2) In the circuit shown in the diagram, which is the correct reading for meter V_2?

1. 20 V
2. 70 V
3. 90 V
4. 110 V

3) A 100.-ohm resistor and an unknown resistor are connected in series to a 10.0-volt battery. If the potential drop across the 100.-ohm resistor is 4.00 volts, the resistance of the unknown resistor is

1. 50.0 Ω
2. 100. Ω
3. 150. Ω
4. 200. Ω

4) In the diagram below, lamps L_1 and L_2 are connected to a constant voltage power supply.



If lamp L_1 burns out, the brightness of L_2 will

1. decrease
2. increase
3. remain the same

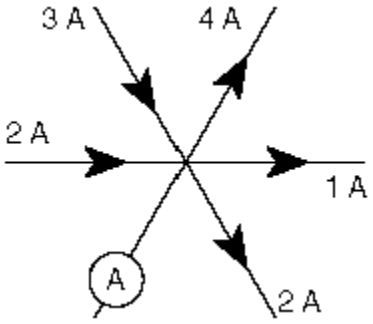
5) In a series circuit containing two lamps, the battery supplies a potential difference of 1.5 volts. If the current in the circuit is 0.10 ampere, at what rate does the circuit use energy?

1. 0.015 W
2. 0.15 W
3. 1.5 W
4. 15 W

6) An electric circuit contains an operating heat element and a lit lamp. Which statement best explains why the lamp remains lit when the heating element is removed from the circuit?

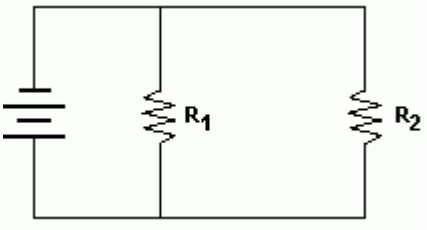
1. The lamp has less resistance than the heating element.
2. The lamp has more resistance than the heating element.
3. The lamp and the heating element were connected in series.
4. The lamp and the heating element were connected in parallel.

7) The diagram below represents currents in a segment of an electric circuit.



What is the reading of ammeter *A*?

1. 1 A
2. 2 A
3. 3 A
4. 4 A



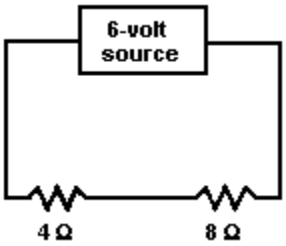
8) Resistors R_1 and R_2 have an equivalent resistance of 6 ohms when connected in the circuit shown in the diagram. The resistance of R_1 could be

1. 1 Ω
2. 5 Ω
3. 8 Ω
4. 4 Ω

9) A simple electrical circuit contains a battery, a light bulb, and a properly connected ammeter. The ammeter has a very low internal resistance because it is connected in

1. parallel with the bulb to have little effect on the current through the bulb
2. parallel with the bulb to prevent current flow through the bulb
3. series with the bulb to have little effect on the current through the bulb
4. series with the bulb to prevent current flow through the bulb

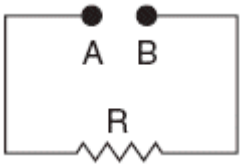
10) The diagram shows a circuit with two resistors.



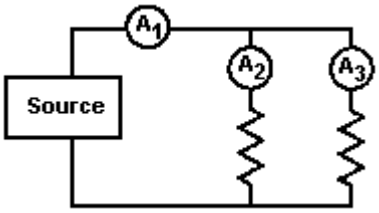
Compared to the potential drop across the 8-ohm resistor, the potential drop across the 4-ohm resistor is

1. the same
2. twice as great
3. one-half as great
4. four times as great

11) What must be inserted between points *A* and *B* to establish a steady electric current in the incomplete circuit represented in the diagram below?

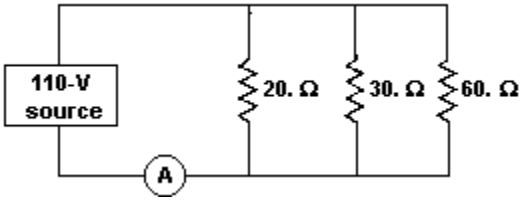


1. switch
2. voltmeter
3. magnetic field source
4. source of potential difference



12) Three ammeters are placed in a circuit as shown in the diagram. If A_1 reads 5.0 amperes and A_2 reads 2.0 amperes, what does A_3 read?

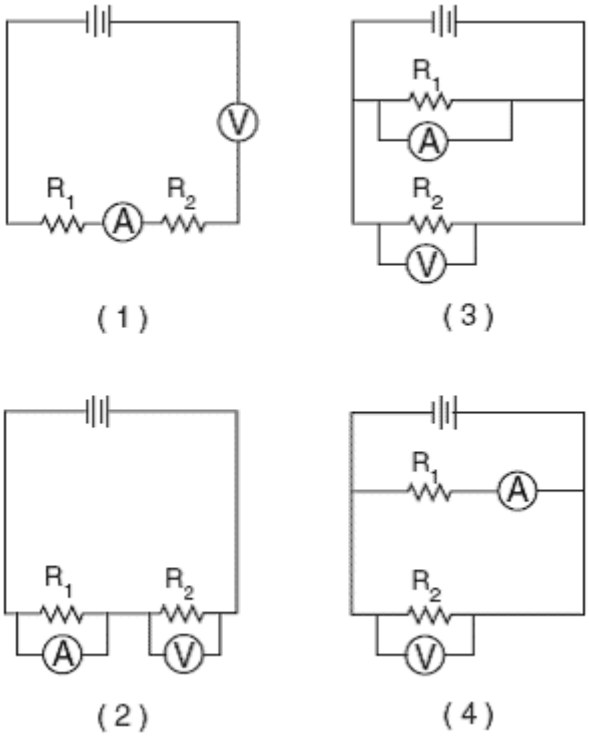
1. 1.0 A
2. 2.0 A
3. 3.0 A
4. 7.0 A



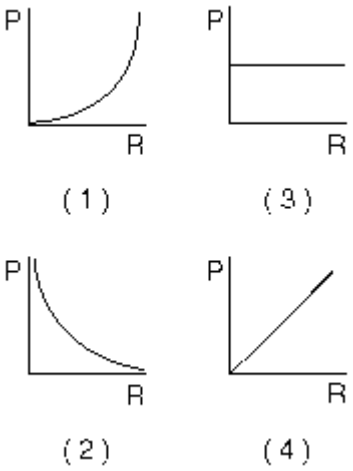
13) In the diagram of a parallel circuit, ammeter *A* measures the current supplied by the 110-volt source. The current measured by ammeter *A* is

1. 1.0 A
2. 0.10 A
3. 5.5 A
4. 11 A

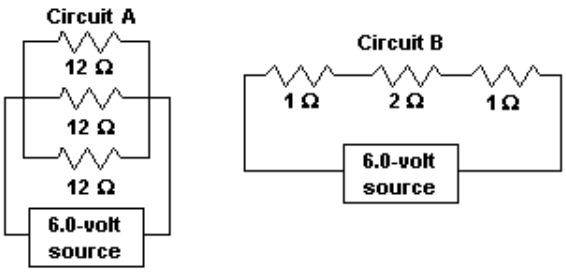
14) In which circuit represented below are meters properly connected to measure the current through resistor R_1 and the potential difference across resistor R_2?



15) The potential difference applied to a circuit element remains constant as the resistance of the element is varied. Which graph best represents the relationship between power *(P)* and resistance *(R)* of this element?



16) Circuit *A* and circuit *B* are shown in the diagram.



Compared to the total resistance of circuit *A*, the total resistance of circuit *B* is

1. less
2. greater
3. the same

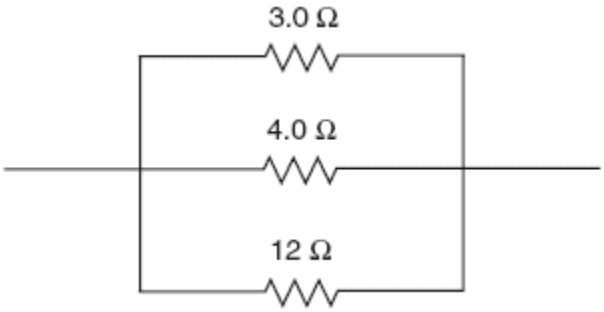
17) Which statement about ammeters and voltmeters is correct?

1. The internal resistance of both meters should be low.
2. Both meters should have a negligible effect on the circuit being measured.
3. The potential drop across both meters should be made as large as possible.
4. The scale range on both meters must be the same.

18) What is the total electrical energy used by a 1,500-watt hair dryer operating for 6.0 minutes?

1. 4.2 J
2. 250 J
3. 9.0×10^3 J
4. 5.4×10^5 J

19) The diagram below represents part of an electric circuit containing three resistors.



What is the equivalent resistance of this part of the circuit?

1. 0.67 Ω
2. 1.5 Ω
3. 6.3 Ω
4. 19 Ω

20) In a lightning strike, a charge of 18 coulombs is transferred between a cloud and the ground in 2.0×10^{-2} second at a potential difference of 1.5×10^6 volts. What is the average current produced by this strike?

1. 3.6×10^{-1} A
2. 9.0×10^2 A
3. 3.0×10^4 A
4. 7.5×10^7 A

21) A potential drop of 50. volts is measured across a 250-ohm resistor. What is the power developed in the resistor?

1. 0.20 W
2. 5.0 W
3. 10. W
4. 50. W

22) A proton moves through a potential difference of 1,000 volts. The change in the proton's potential energy will be

1. 1,000 eV
2. 2,000 eV
3. 3,000 eV
4. 4,000 eV

23) Which is a unit of electrical power?

1. volt/ampere
2. ampere/ohm
3. $ampere^2$/ohm
4. $volt^2$/ohm

24) As the resistance of a constant-voltage circuit is increased, the power developed in the circuit

1. decreases
2. increases
3. remains the same

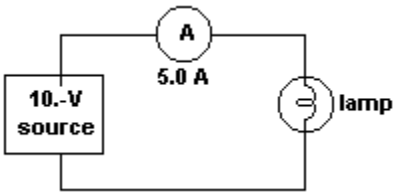
25) Which physical quantity is correctly paired with its unit?

1. power and watt·seconds
2. energy and newton·seconds
3. electric current and amperes/coulomb
4. electric potential difference and joules/coulomb

26) To increase the brightness of a desk lamp, a student replaces a 60-watt light bulb with a 100-watt bulb. Compared to the 60-watt bulb, the 100-watt bulb has

1. less resistance and draws more current
2. less resistance and draws less current
3. more resistance and draws more current
4. more resistance and draws less current

27) A lamp and an ammeter are connected to a source as shown in the diagram.

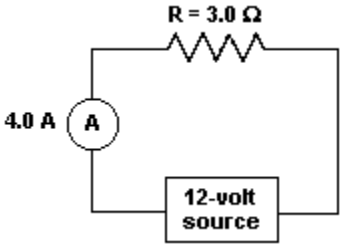


What is the electrical energy expended in the lamp in 3.0 seconds?

1. 50. J
2. 150 J
3. 50. W
4. 150 W

28) An electric motor uses 15 amperes of current in a 440-volt circuit to raise an elevator weighing 11,000 newtons. What is the average speed attained by the elevator?

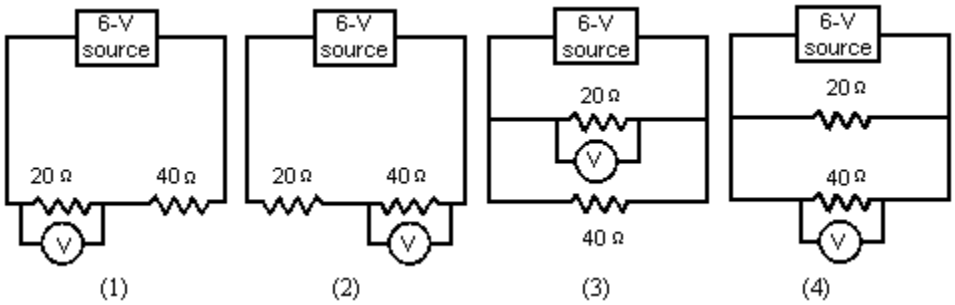
1. 0.0027 m/s
2. 0.60 m/s
3. 27 m/s
4. 6000 m/s



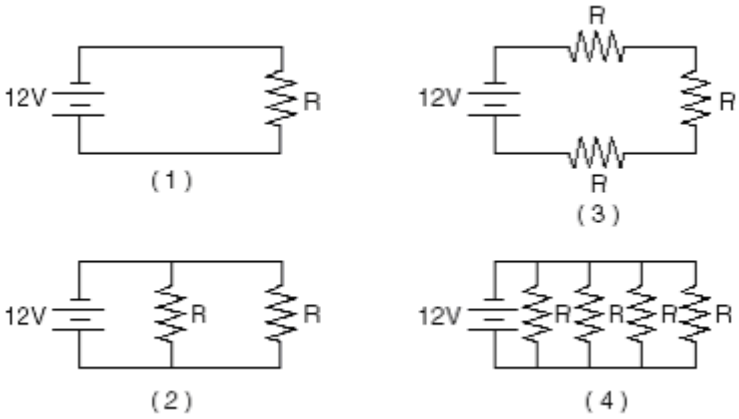
29) The diagram represents a sample electric circuit. How much charge passes through the resistor in 2.0 seconds?

1. 6.0 C
2. 2.0 C
3. 8.0 C
4. 4.0 C

30) Which circuit below would have the *lowest* voltmeter reading?

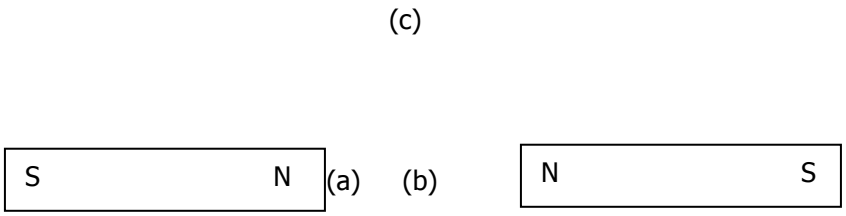


31) Identical resistors (*R*) are connected across the same 12-volt battery. Which circuit uses the greatest power?



Magnetism Student Sheet #1 for Weird People

1.) Draw the flux lines between and around the two magnets



2.) For the diagram above, compare the flux density at points a,b and c.

3.) The north pole of a magnet points to the magnetic south pole of the earth. Why is the north pole of the magnet referred to as the north seeking pole.

4.) A substance that can be magnetized is placed near a magnet and becomes magnetized. This process is called

5.) The number of magnetic field lines per a unit of area is defined as _____ and has units of _____

6.) Individual small groups of atoms that share the same field direction in a material are referred to as magnetic

7.) Which substance is not magnetic?
- (a) cobalt
- (b) tin
- (c) iron
- (d) nickel

Waves Student Sheet #1

1.) A 5 kg pendulum bob on a 2 m long string is swinging with a period of 2 seconds. If the mass of the bob is changed to 10 kg what would the period of the pendulum be?

2.) A pendulum swings back and forth 3 times in 5 seconds. What is the period of the pendulum? What is the length of the string attached to the pendulum?

3.) If the wave below is drawn to scale, what is its amplitude and wavelength.

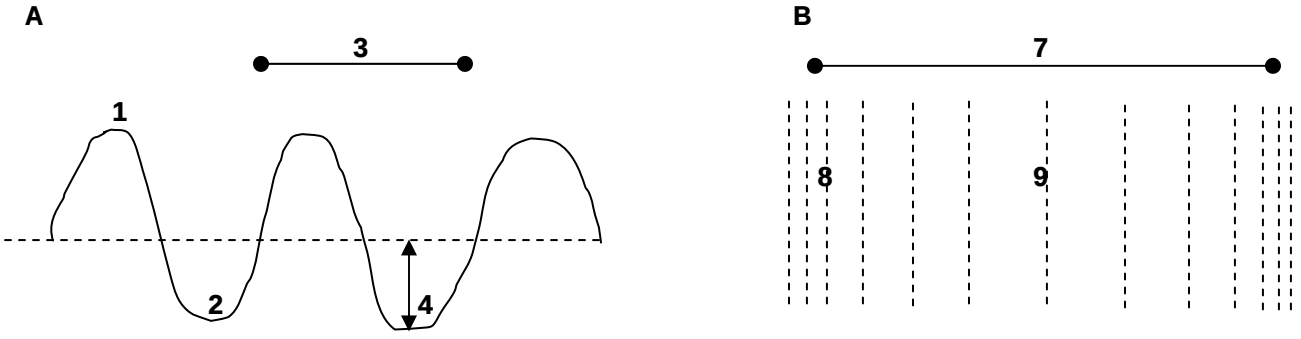
Using the wave drawn above as a reference, sketch a wave with

(a) twice the amplitude, same f, same λ

(b) twice the frequency, same A

(c) twice the wavelength, same A

4.) Two waves are shown below, wave A is on the left and wave B is on the right



Define wave type A and B as well as all of the numbered areas

5.) What kind of wave requires a material medium for energy transfer.

6.) What kind of wave required NO medium for travel.

7.) What kind of wave causes the particles of a medium to vibrate in a direction perpendicular to the direction in which the wave is traveling

8.) A single disturbance moving through a medium is referred to as a _____

9.) The # of waves that pass a given point per second is called the waves _____

10.) The energy content of a mechanical wave can be characterized by looking at its _____

11.) A sound wave moves from A to B in a medium in the direction shown below. In which direction do the particles of the medium vibrate?

A ⟶ B (a)  (b) 

12.) Why is there no sound in space?

13.) What is the period of a wave with a frequency of 15 Hz.

14.) What is simple harmonic motion?

15.) A kid on a playground swing, swings back and forth in 2 seconds. What is the frequency and period of the swing?

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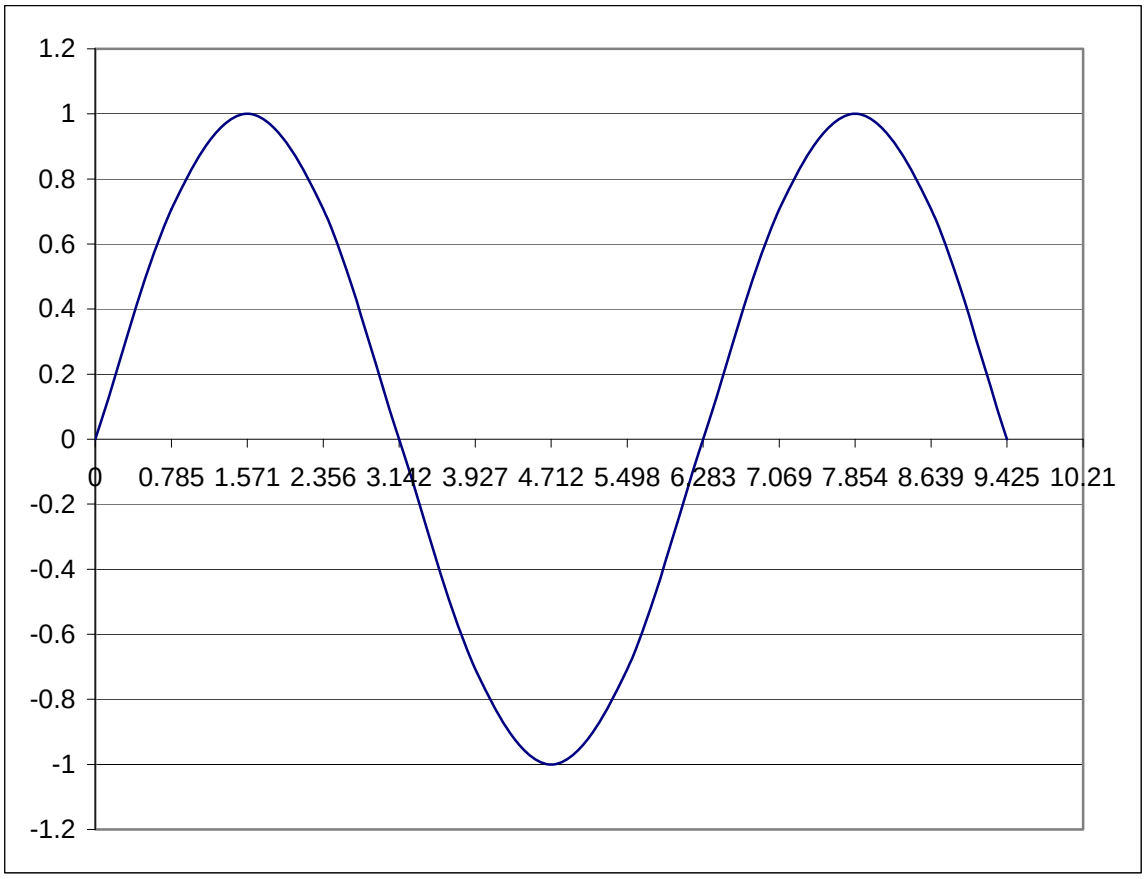
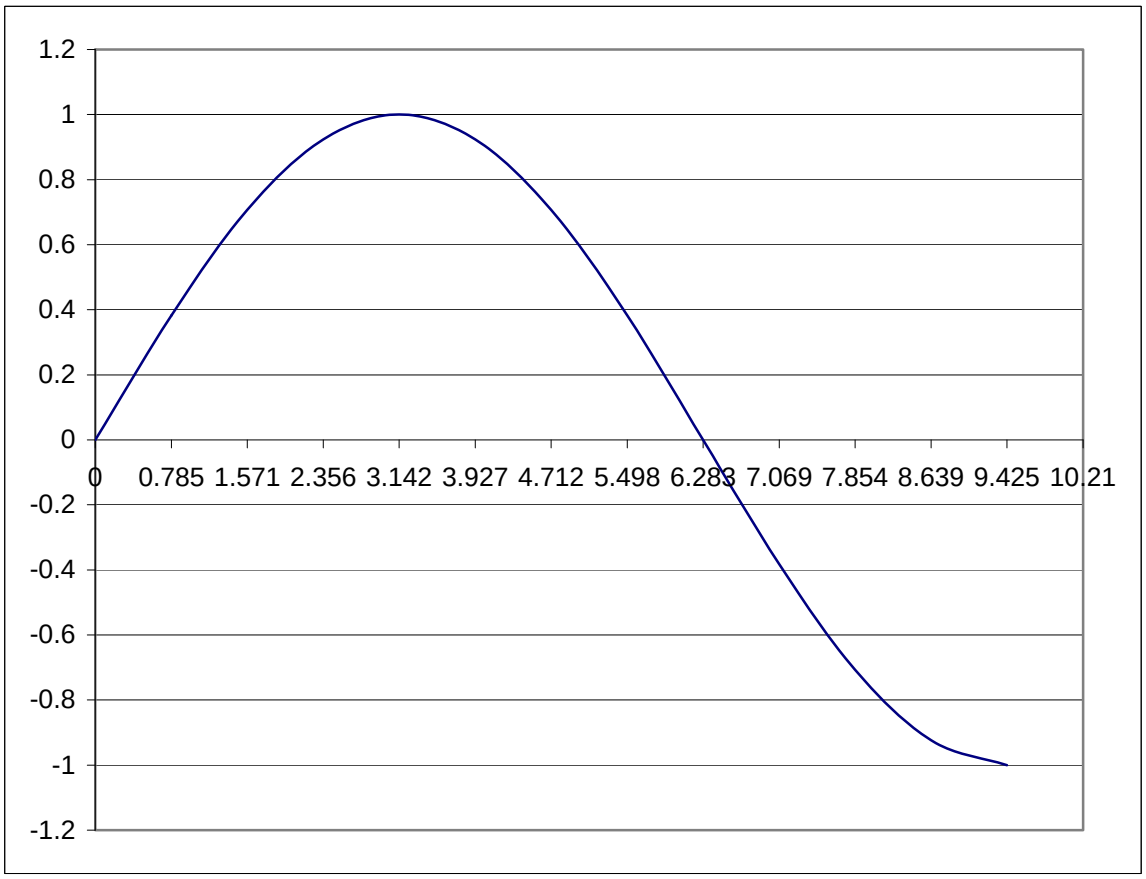
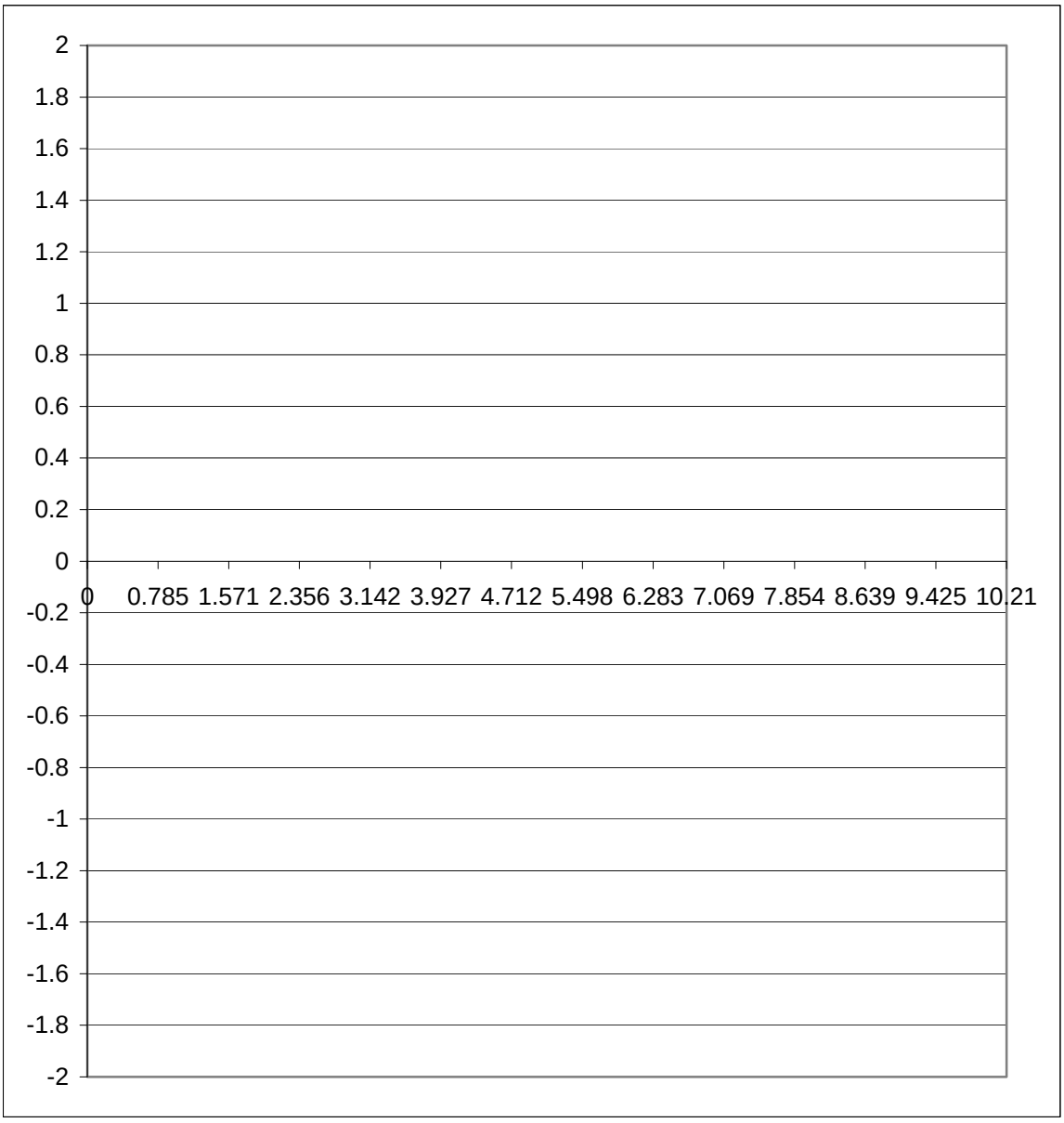
Student Sheet – Wave Interference (Use superposition to draw the resultant wave of the wave below)



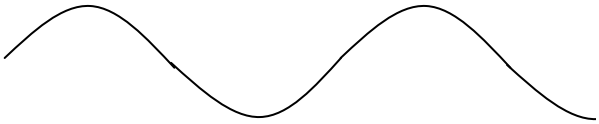



2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-1.2
-1.4
-1.6
-1.8
-2
0
0.785
1.571
2.356
3.142
3.927
4.712
5.498
6.283
7.069
7.854
8.639
9.425
10.21

Waves Student Sheet #2

1.) Use a ruler to measure the wavelength and amplitude of the wave below

2.) The total length of the wave shown below is 40 cm and it takes 3 seconds for the disturbance to cover the total distance. Find the wavelength, frequency, period, and speed.



3.) When two waves occupy the same spot and the same time, this is referred to as _____

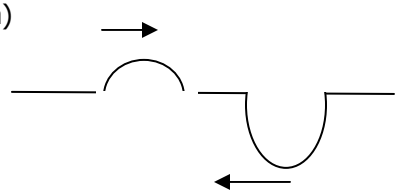
4.) When two waves interfere with each other to make a smaller amplitude, this is referred to as _____

5.) The speed of an ocean wave on the coast is 42 m/s and the wavelength is 1.5 m. (a) What is the frequency with which the wave hits the beach. (b) How many wave crests would strike the beach in 10 seconds

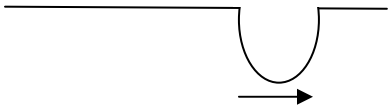
6) On the wave shown below, draw two points that are out of phase, two points that are in phase and two points with a phase difference of 270°

7.) Use the principle of superposition to sketch the shape of the pulses when they meet

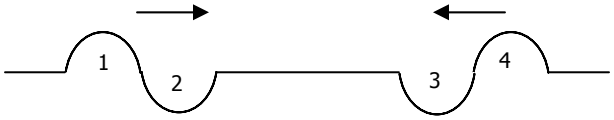
(a)



(b) Sketch the resulting waveform if the pulse below were to hit a free boundary, then redo for fixed boundary

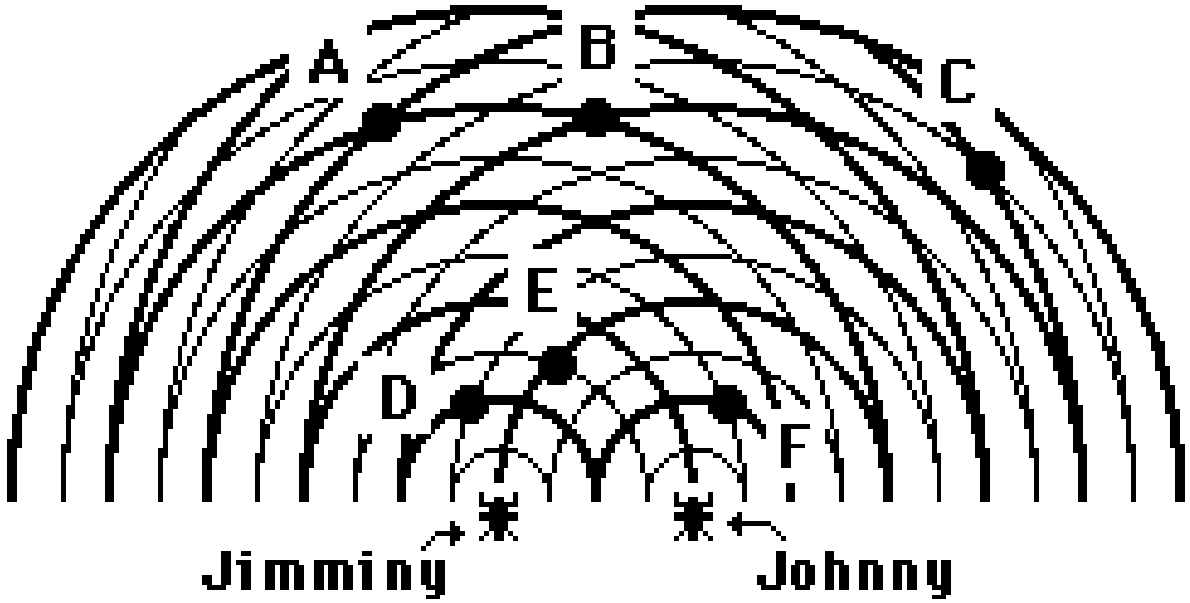


(c) Sketch the resultant waveforms in three separate steps as each pulse passes.



Waves Student Sheet #3

1.) Twin water bugs Jimminy and Johnny are both creating a series of circular waves by jiggling their legs in the water. The waves undergo interference and create the pattern represented in the diagram at the right. The thick lines in the diagram represent wave crests and the thin lines represent wave troughs. Several of positions in the water are labeled with a letter. Categorize each labeled position as being a position where either constructive or destructive interference occurs.

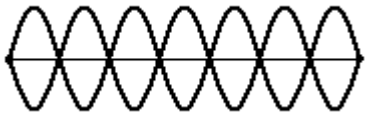


2. A standing wave is formed when

a. a wave refracts due to changes in the properties of the medium.
b. a wave reflects off a canyon wall and is heard shortly after it is formed.
c. red, orange, and yellow wavelengths bend around suspended atmospheric particles.
d. two identical waves moving different directions along the same medium interfere.

3. The number of nodes in the standing wave shown in the diagram at the right is

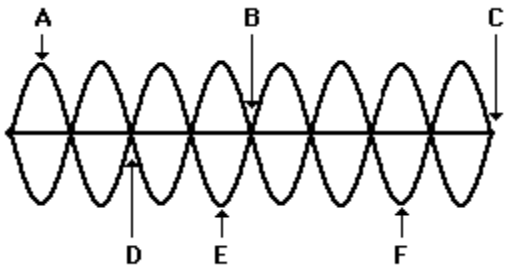
a. 6
b. 7
c. 8
d. 14



4. The number of antinodes in the standing wave shown in the diagram above right is

a. 6
b. 7
c. 8
d. 14

Consider the standing wave pattern at the right in answering this next two questions.



5. The number of nodes in the entire pattern is

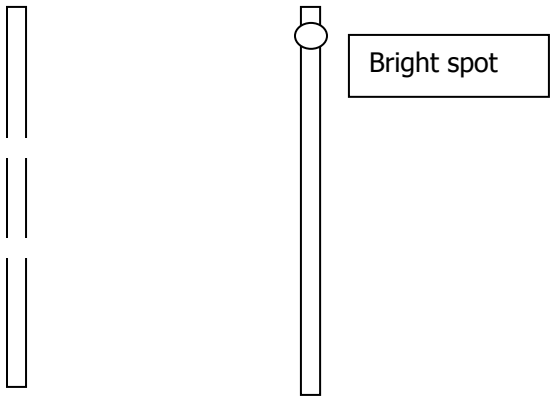
a. 7
b. 8
c. 9
d. 16

6. Of all the labeled points, destructive interference occurs at point(s)

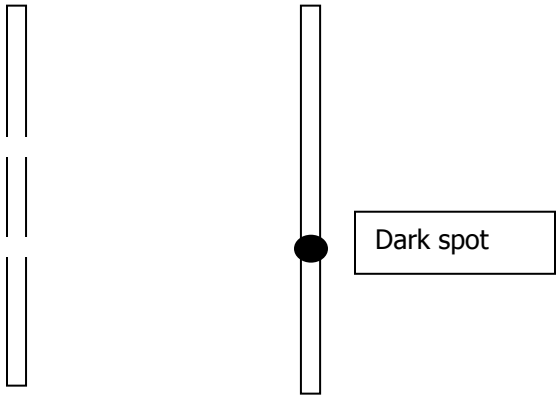
a. B, C, and D
b. A, E, and F
c. A only
d. C only
e. all points

7.) A stream of monochromatic light is incident on two narrow closely spaced slits. Draw a single wave from each slit to the location on the screen where the bright spot is formed that demonstrates why this bright spot is created. Label and state your path difference

screen



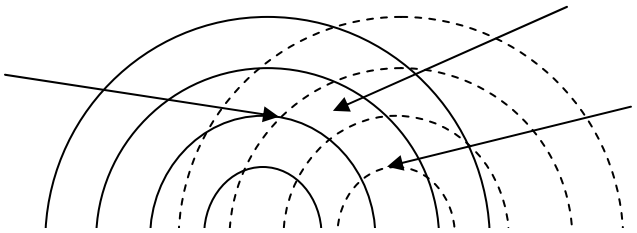
8.) Repeat the above for a dark spot location



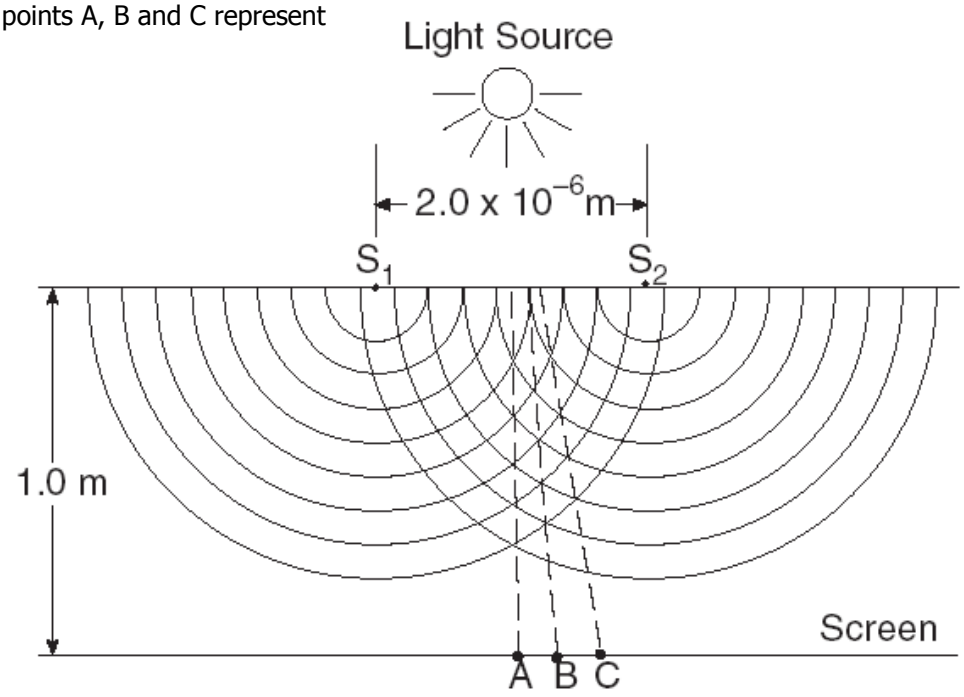
9.) What term describes the cause of these bright spot? And for dark spots?

Waves Student Sheet #4

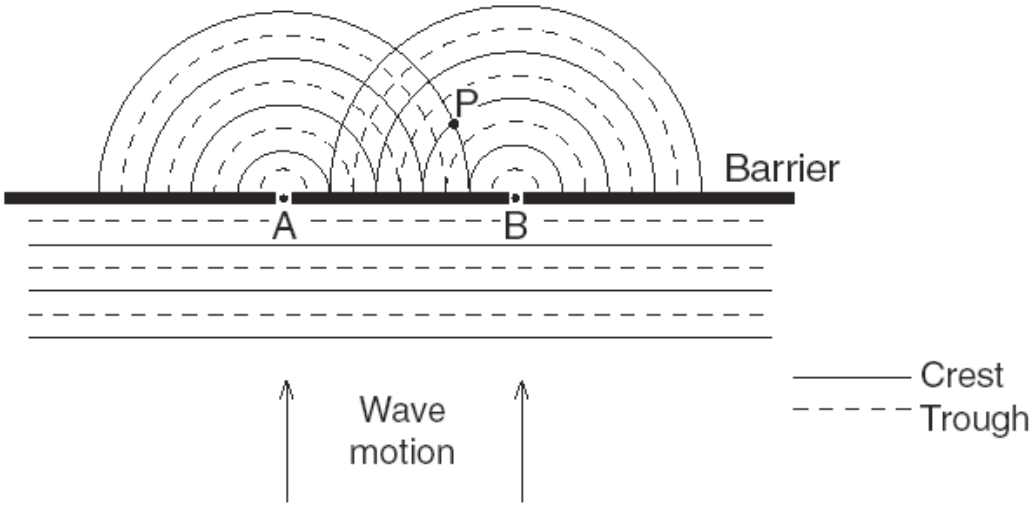
1.) A source of light passes through two adjacent slits to create to wave patterns as shown below. What occurs at the points indicated by the arrows?



2.) What do points A, B and C represent



3.)



How much longer is the length of path AP than the length of path BP?

(1) 1λ
(2) 2λ
(3) 3λ
(4) 4λ

4.) What is the difference between diffraction and refraction?

5.) Given the wave fronts approaching the barrier shown below, complete the sketch of the wave as it passes the barrier

6.) A microwave has a frequency of $1x10^5$ MHz. What is its speed in a vacuum?

7.) Quantitatively compare the wavelength of the radio wave emitted from the AM broadcast 880 kHz to the FM broadcast 100.3 MHz

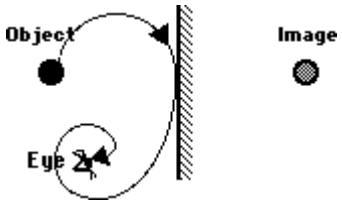
8.) How is a sound wave different from a radio wave?

9.) When comparing microwaves and X rays, which has a larger wavelength, which has a larger frequency and which has a larger speed?

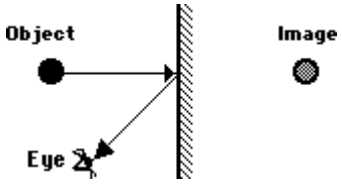
Light Reflection Student Sheet

The following diagrams depict some ideas about how light might travel from an object location to an eye location when viewed the image of the object is viewed in a mirror. Comment on the incorrectness of the following diagrams. Discuss what makes them incorrect.

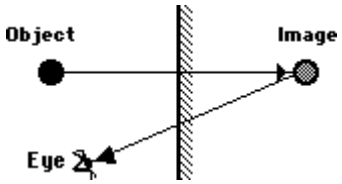
1.



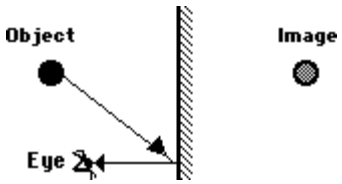
2.



3.

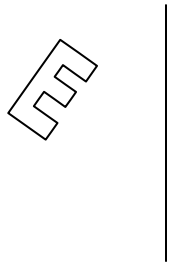


4.

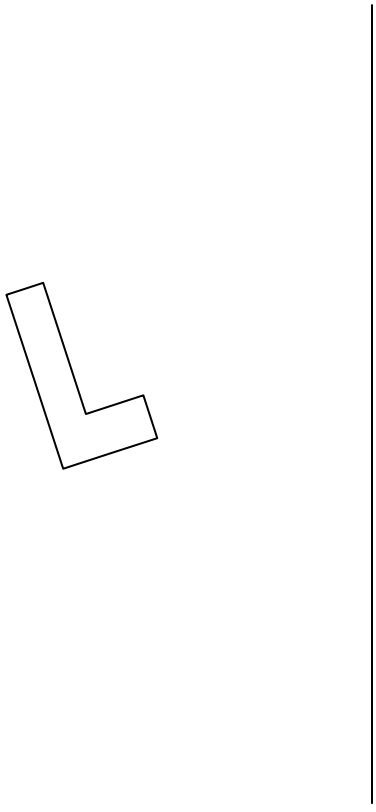


5.) What type of image is formed in a plane mirror?

6.) Sketch the image of the object below



7.) Sketch the image of the object below and use a ray diagram

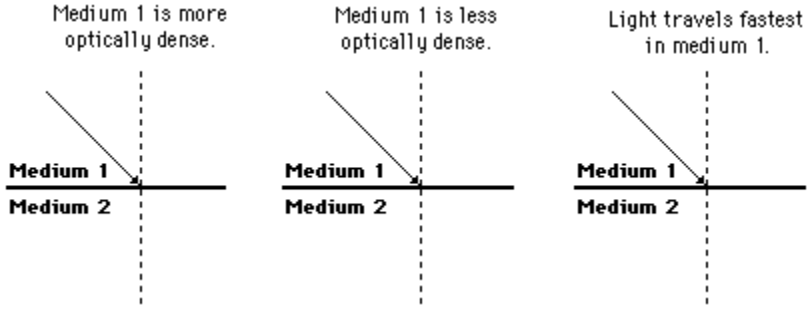


Refraction Student Sheet #1

1. When light passes from a more optically dense medium into a less optically dense medium, it will bend _____ (towards, away from) the normal.

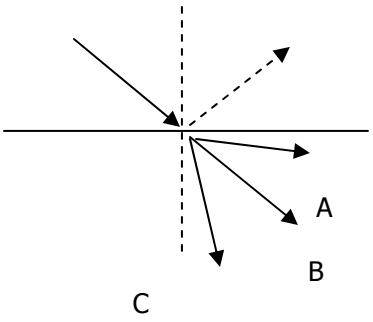
2. When light passes from a medium with a low index of refraction value into a medium with a high index of refraction value, it will bend _____ (towards, away from) the normal.

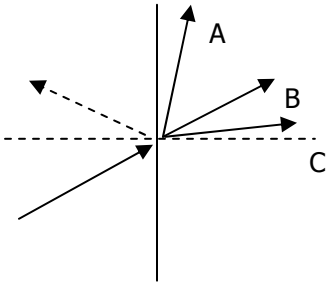
3. In each diagram, draw the "missing" ray (either incident or refracted) in order to appropriately show that the direction of bending is towards or away from the normal.



4. Arthur Podd's method of fishing involves spearing the fish while standing on the shore. The actual location of a fish is shown in the diagram below. Because of the refraction of light, the observed location of the fish is different than its actual location. Indicate on the diagram the approximate location where Arthur observes the fish to be. Must Arthur aim above or below where the fish appears to be in order to strike the fish?

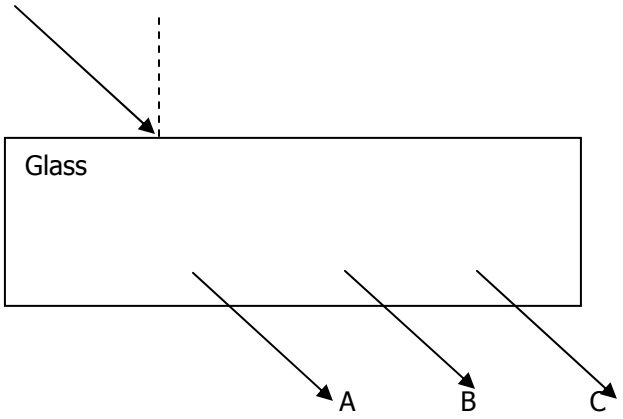
5.) The sketch shown here shows a light ray moving from air into water at a 45 degree angle to the normal. The normal line is vertical and shown dotted. Which of the three rays indicated with capital letters is most likely the light ray that continues inside the water

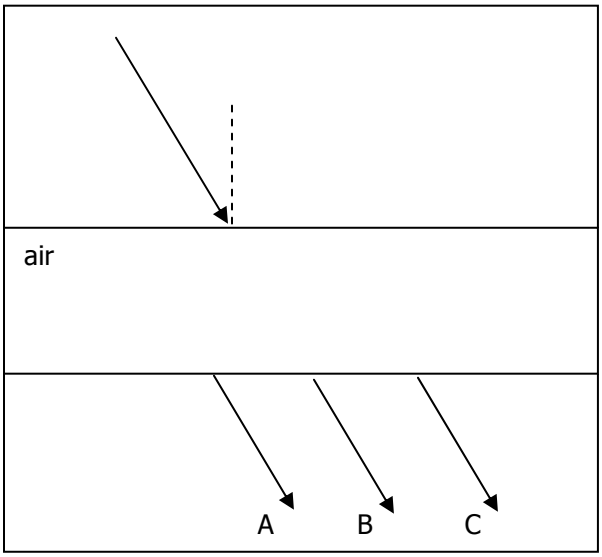




6.) The sketch shown here shows a light ray moving from glass into air at a 30 degree angle to the normal. The normal line is horizontal and shown dotted. Which of the three is most likely the light ray that continues in the air

7.) The sketch shown here shows a light ray moving from air into glass at an angle of 40 degrees to the normal. Which of the three rays is most likely the light ray that travels in the air after emerging from the opposite side of the block? Sketch the path of the ray inside the block

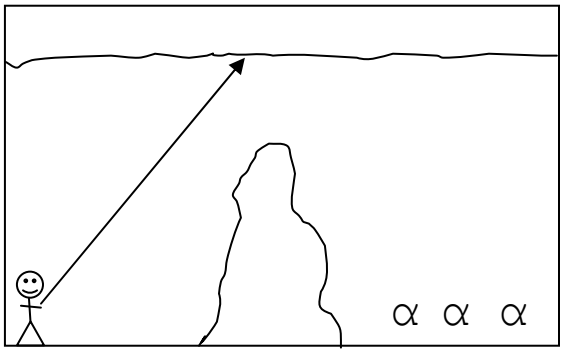




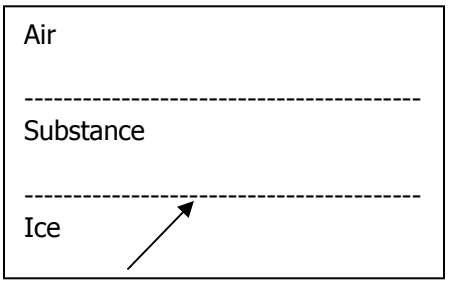
8.) The sketch shown here shows a light ray moving from water into a rectangular air block at 40 degrees to the normal. Which of the three rays is most likely the light ray that continues into the water on the opposite side? Sketch the path of the ray inside the block

9.) As the light ray above travels from water to air and then water again. What happens to the speed of the light? The wavelength of the light? And the frequency of the light?

1.) You are on the bottom of the ocean and want to send a signal with a light beam to a hotty mermaid colony but there is a coral reef in the way. Using your physics skilz, calculate the minimum angle at which you would have to aim your flashlight to bounce the full beam (totally reflect) to the mermaid colony on the other side.



2.) A light ray travels from ice into an unknown substance and then towards and air layer on top. The light ray hits the first surface at an angle of 53° away from the normal line. (the substance can be a solid, liquid or gas)



(a) It is observed that the light ray slows down to 1.807×10^8 m/s when it enters the substance. What is this substance?

(b) Will the ray bend away from or towards the normal line as it enters the substance?

(c) Find the angle of the refracted ray in the substance

(d) Draw a sketch this situation clearly showing the light ray moving in the ice and the light ray moving in the substance with all angles labeled properly.

(e) Finish the sketch you created in part "d" by determining what will happen to the light as it hits the air boundary.

Regents Practice 15

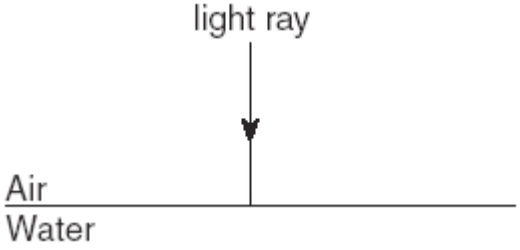
1.) Rubbing a moistened finger around the rim of a water glass transfers energy to the glass at the natural frequency of the glass. Which wave phenomenon is responsible for this effect? [1]

2.) Calculate the wavelength in a vacuum of a radio wave having a frequency of 2.2×10^6 hertz.
[Show all work, including the equation and substitution with units.] [2]

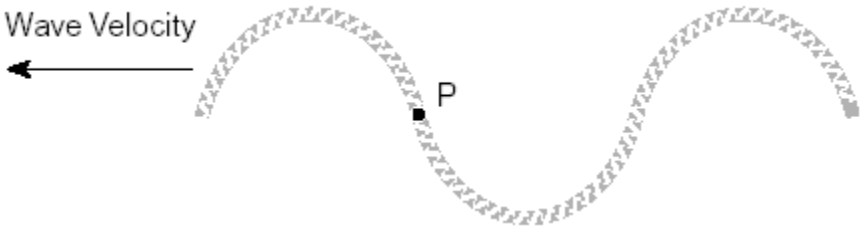
3.) Two monochromatic, coherent light beams of the same wavelength converge on a screen. The point at which the beams converge appears dark. Which wave phenomenon best explains this effect? [1]

4.) Exposure to ultraviolet radiation can damage skin. Exposure to visible light does not damage skin. State *one* possible reason for this difference. [1]

5.) A ray of light traveling in air is incident on an air water boundary as shown below. On the diagram provided *in your answer booklet*, draw the path of the ray in the water. [1]



6.) The diagram below shows a transverse wave moving toward the left along a rope. At the instant shown, point *P* on the rope is moving toward the
(1) bottom of the page
(2) top of the page
(3) left of the page
(4) right of the page

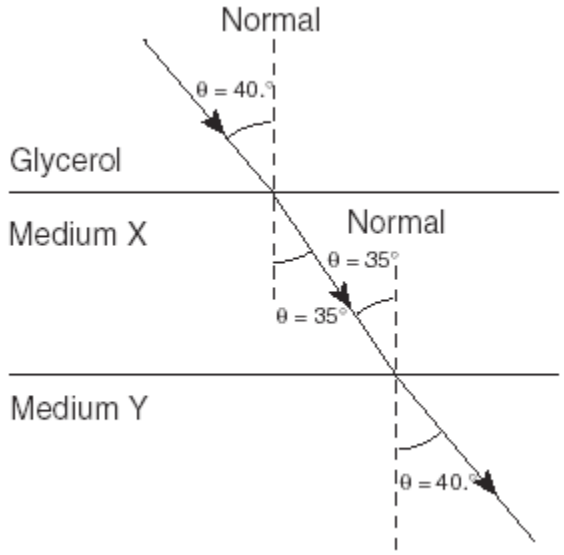


7.) An astronomical body emitting high-intensity pulses of green light is moving toward Earth at high velocity. To an observer on Earth, this light may appear
(1) red
(2) blue
(3) orange
(4) yellow

8.) A change in the speed of a wave as it enters a new medium produces a change in
(1) frequency (3) wavelength
(2) period (4) phase

9.) The speed of light ($f = 5.09 \times 10^{14}$ Hz) in a transparent material is 0.75 times its speed in air. The absolute index of refraction of the material is approximately
(1) 0.75 (3) 2.3
(2) 1.3 (4) 4.0

10.) A beam of monochromatic light ($f = 5.09 \times 10^{14}$ hertz) passes through parallel sections of glycerol, medium *X*, and medium *Y* as shown in the diagram below. What could medium *X* and medium *Y* be?
(1) *X* could be flint glass and *Y* could be corn oil.
(2) *X* could be corn oil and *Y* could be flint glass.
(3) *X* could be water and *Y* could be glycerol.
(4) *X* could be glycerol and *Y* could be water.



11.) Standing waves in water are produced most often by periodic water waves
(1) being absorbed at the boundary with a new medium
(2) refracting at a boundary with a new medium
(3) diffracting around a barrier
(4) reflecting from a barrier

12.) What happens to the frequency and the speed of an electromagnetic wave as it passes from air into glass?
(1) The frequency decreases and the speed increases.
(2) The frequency increases and the speed decreases.
(3) The frequency remains the same and the speed increases.
(4) The frequency remains the same and the speed decreases.

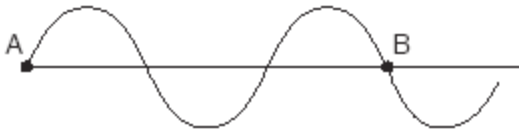
13.) Which wave phenomenon makes it possible for a player to hear the sound from a referee's whistle in an open field even when standing behind the referee?
(1) diffraction (3) reflection
(2) Doppler effect (4) refraction

14.) A beam of monochromatic light travels through flint glass, crown glass, Lucite, and water. The speed of the light beam is slowest in
(1) flint glass (3) Lucite
(2) crown glass (4) water

15.) Which phenomenon occurs when an object absorbs wave energy that matches the object's natural frequency?
(1) reflection (3) resonance
(2) diffraction (4) interference

16.) A motor is used to produce 4.0 waves each second in a string. What is the frequency of the waves?
(1) 0.25 Hz (3) 25 Hz
(2) 15 Hz (4) 4.0 Hz

17.) The diagram shows two points, *A* and *B*, on a wave train. How many wavelengths separate point *A* and point *B*?



(1) 1.0 (3) 3.0
(2) 1.5 (4) 0.75

18.) Compared to the period of a wave of red light the period of a wave of green light is
(1) less
(2) greater
(3) the same

19.) In a demonstration, a vibrating tuning fork causes a nearby second tuning fork to begin to vibrate with the same frequency. Which wave phenomenon is illustrated by this demonstration?
(1) the Doppler effect (3) resonance
(2) nodes (4) interference

20.) A 2.00 x 10^6 hertz radio signal is sent a distance of 7.30 x 10^{10} meters from Earth to a spaceship orbiting Mars. Approximately how much time does it take the radio signal to travel from Earth to the spaceship?
(1) 4.11 x 10^{-3} s (3) 2.19 x 10^8 s
(2) 2.43 x 10^2 s (4) 1.46 x 10^{17} s

21.) As a sound wave passes from water, where the speed is 1.49 x 10^3 meters per second, into air, the wave's speed
(1) decreases and its frequency remains the same
(2) increases and its frequency remains the same
(3) remains the same and its frequency decreases
(4) remains the same and its frequency increases

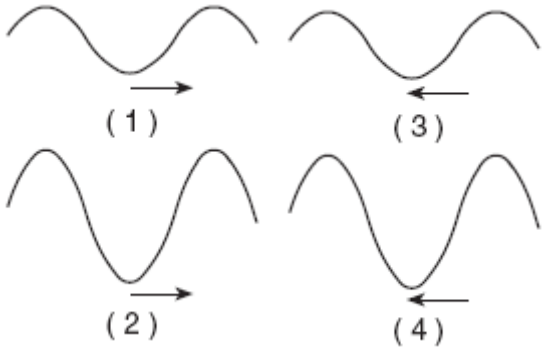
22.) A ray of monochromatic light (f = 5.09 x 10^{14} hertz) in air is incident at an angle of 30° on a boundary with corn oil. What is the angle of refraction, to the nearest degree, for this light ray in the corn oil?
(1) 6° (3) 30°
(2) 20° (4) 47°

23.) A wave is diffracted as it passes through an opening in a barrier. The amount of diffraction that the wave undergoes depends on both the
(1) amplitude and frequency of the incident wave
(2) wavelength and speed of the incident wave
(3) wavelength of the incident wave and the size of the opening
(4) amplitude of the incident wave and the size of the opening

24.) A sonar wave is reflected from the ocean floor. For which angles of incidence do the wave's angle of reflection equal its angle of incidence?
(1) angles less than 45°, only
(2) an angle of 45°, only
(3) angles greater than 45°, only
(4) all angles of incidence

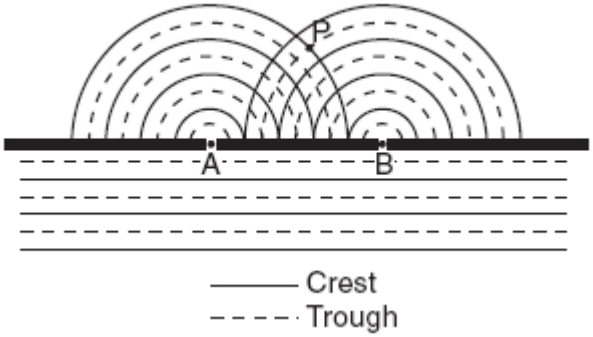
25.) The diagram below represents a wave moving toward the right side of this page.

Which wave shown below could produce a standing wave with the original wave?



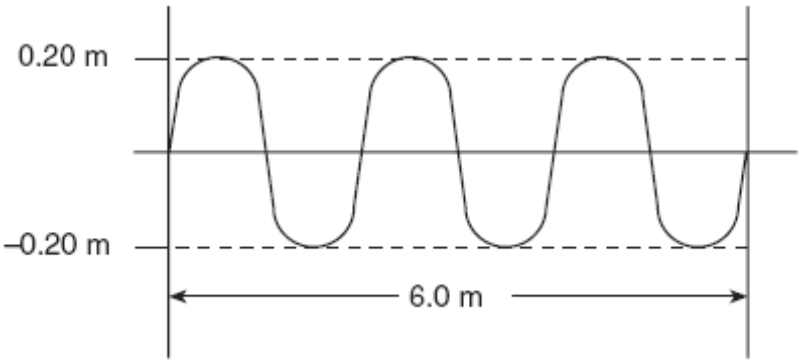
26.) Radio waves diffract around buildings more than light waves do because, compared to light waves, radio waves
(1) move faster
(2) move slower
(3) have a higher frequency
(4) have a longer wavelength

27.) The diagram below represents shallow water waves of constant wavelength passing through two small openings, *A* and *B*, in a barrier.



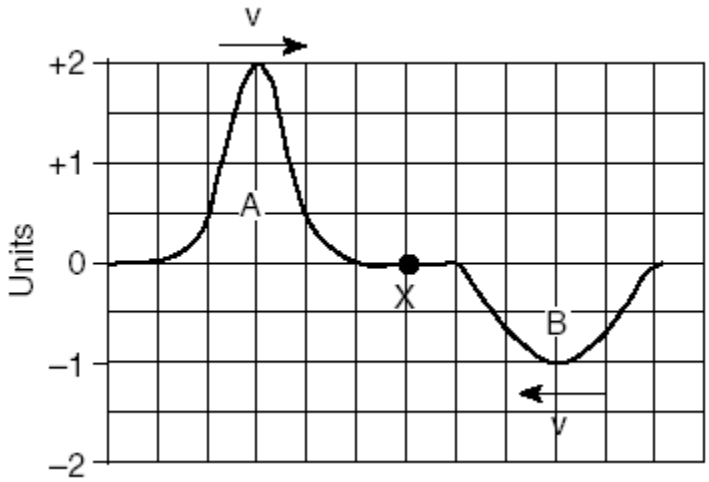
Which statement best describes the interference at point *P*?
(1) It is constructive, and causes a longer wavelength.
(2) It is constructive, and causes an increase in amplitude.
(3) It is destructive, and causes a shorter wavelength.
(4) It is destructive, and causes a decrease in amplitude.

28.) The diagram below represents a wave.

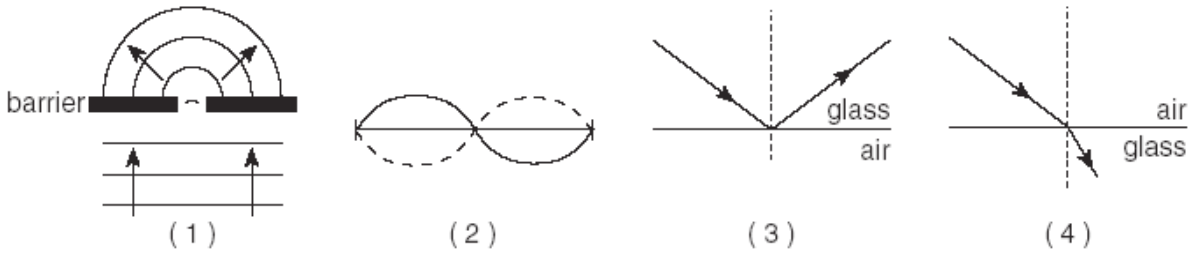


What is the speed of the wave if its frequency is 8.0 hertz?
(1) 48 m/s (3) 3.2 m/s
(2) 16 m/s (4) 1.6 m/s

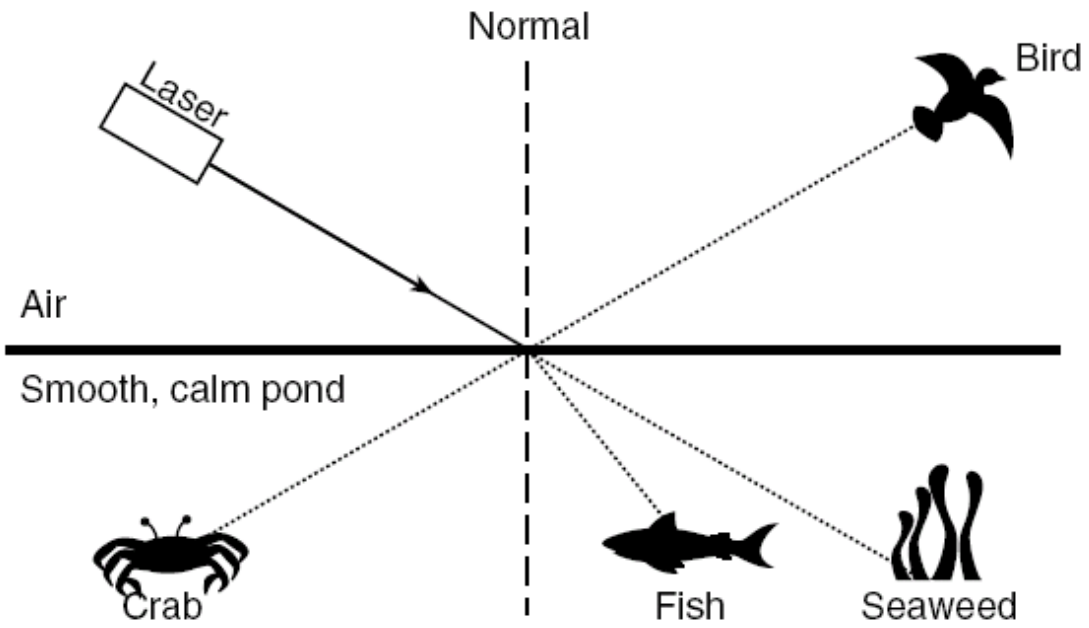
29.) Two pulses, *A* and *B*, travel toward each other along the same rope, as shown below. When the centers of the two pulses meet at point *X*, the amplitude at the center of the resultant pulse will be
(1) +1 unit (3) 0
(2) +2 units (4) –1 unit



30.) Which diagram below best represents the phenomenon of diffraction?

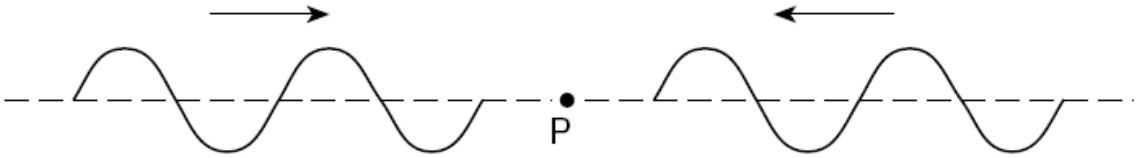


31.) A laser beam is directed at the surface of a smooth, calm pond as represented in the diagram below.



Which organisms could be illuminated by the laser light?
(1) the bird and the fish (3) the crab and the seaweed
(2) the bird and the seaweed (4) the crab and the fish

32.) The diagram below represents two waves of equal amplitude and frequency approaching point *P* as they move through the same medium.



As the two waves pass through each other, the medium at point *P* will
(1) vibrate up and down (3) vibrate into and out of the page
(2) vibrate left and right (4) remain stationary

Photoelectric Effect Video Program Questions (becomes a quiz if you don't pay attention and do it)

1.) How do we know that light behaves like a wave?

2.) What equation describes the energy of a light photon?

3.) In the photoelectric effect, a small piece of foil is charged.

(a) Does white light discharge the foil? support your answer.

(b) What type of light is used to discharge the foil?

(c) What happens when glass is placed in front of the light from (b), why does this happen?

(d) based on the answers above, and your knowledge of the EM spectrum what does this experiment show about EM wave frequencies and discharging an electroscope?

4.) What is the work function

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Modern Physics Student Sheet – 1

1.) What is the energy in eV of one quantum (photon) of yellow light w/ a frequency of 6×10^{14} Hz?

2.) 1 quantum of light has an energy of 5×10^{-19} J. What is the color of this light photon?

3.) Radiation has a λ=940 μm. (a) what is the frequency of this radiation (b) What type of EM wave is this radiation (c) How much energy is in 1 quantum of this radiation

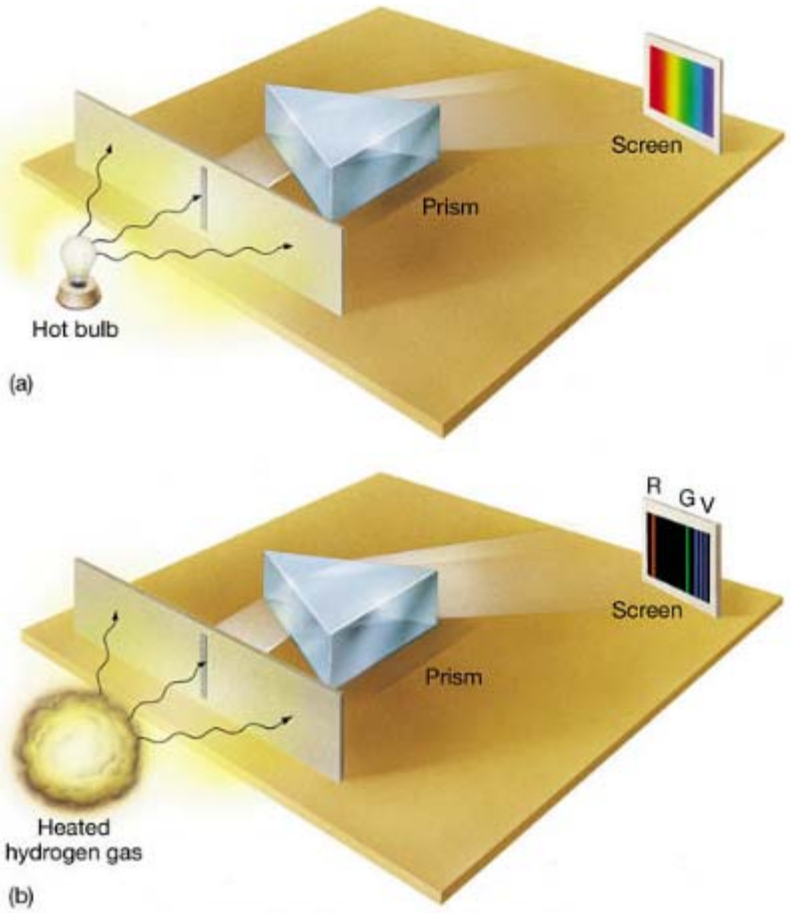
4.) Tungsten metal has a work function of 4.6 eV. If light of wavelength = 1×10^{-7} m shines on tungsten, are electrons ejected?

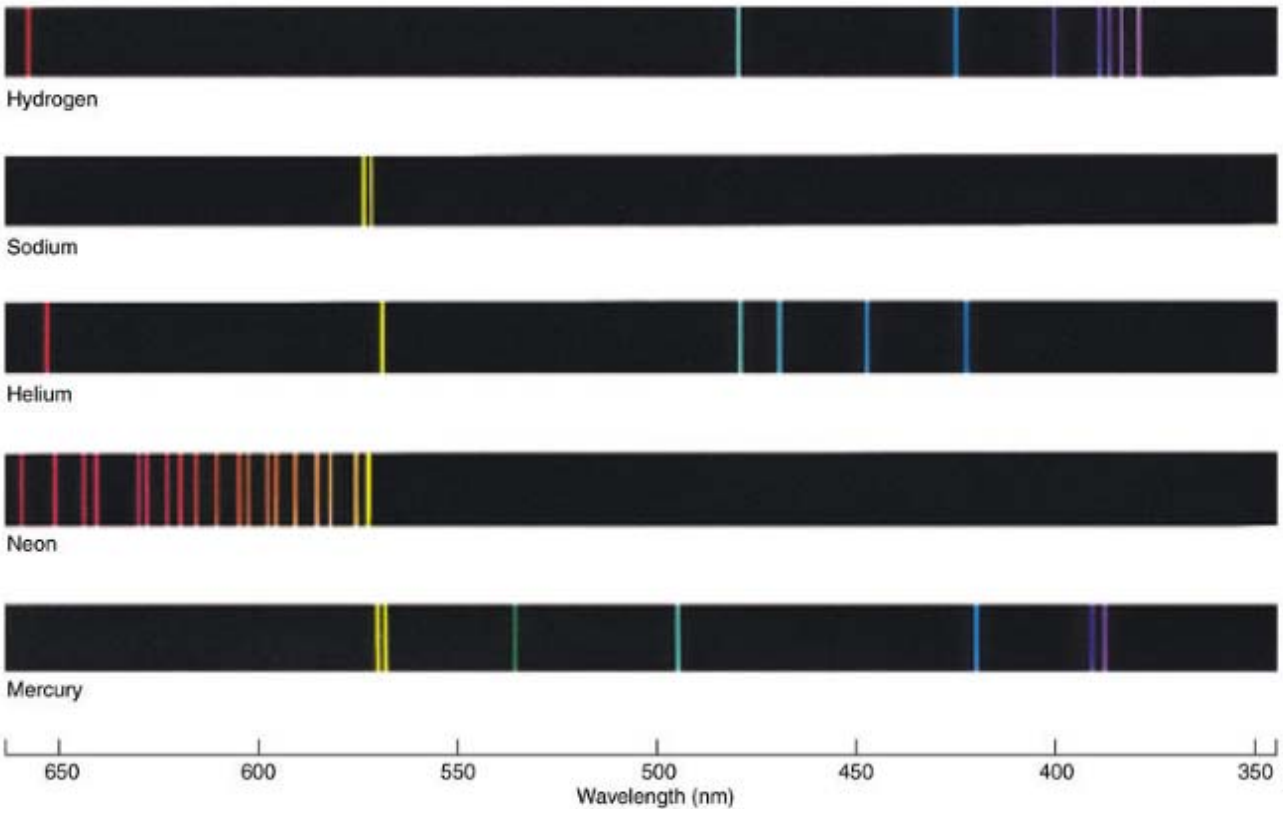
5.) Does a red light or green light photon have more energy?

6.) The energy of a photon varies inversely with the
(a) frequency (b) momentum (c) speed (d) wavelength

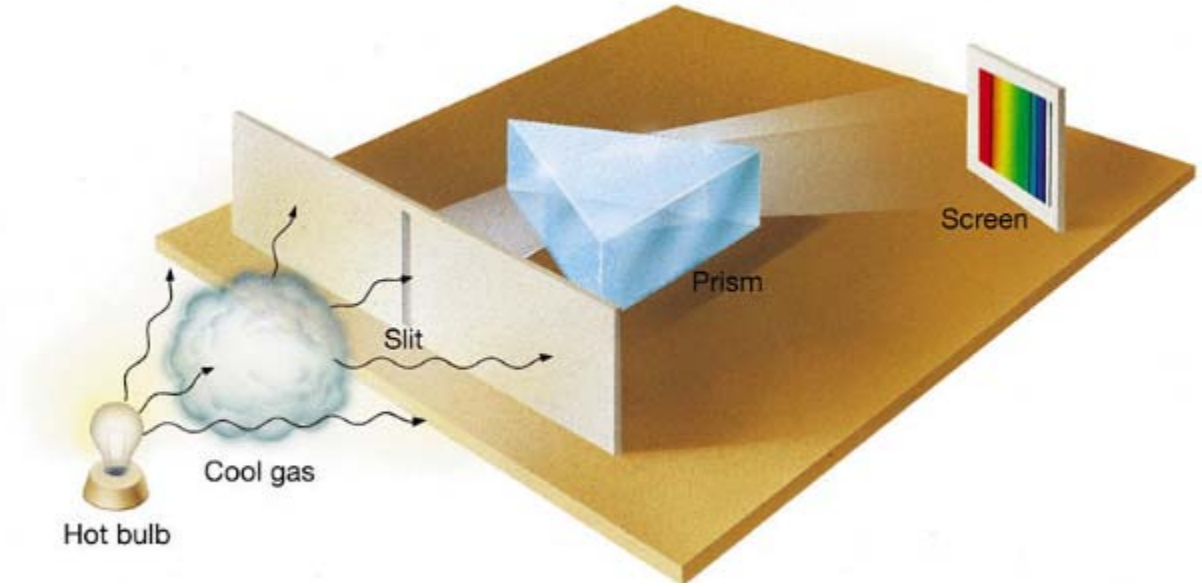
7.) An X ray photon hits an electron at rest. During the interaction, the momentum of the photon
(a) decreases (b) increases (c) remains the same

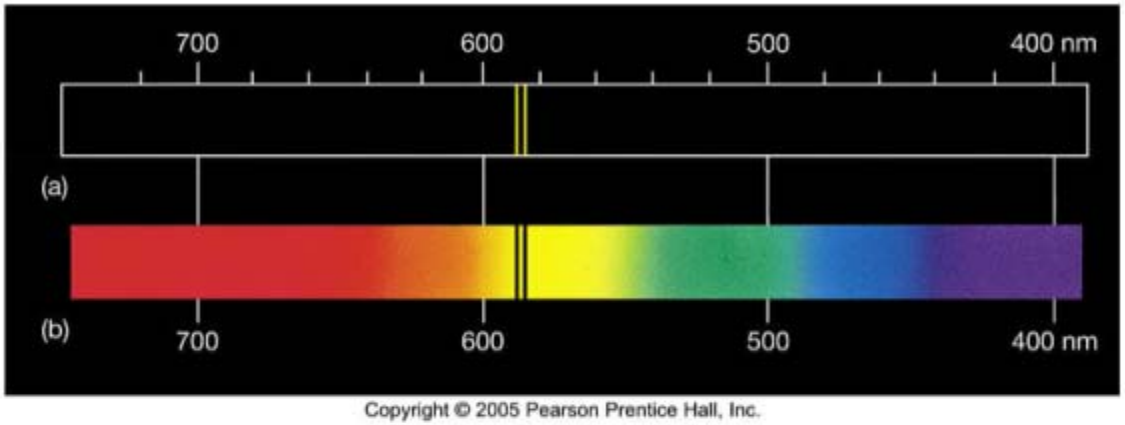
SPECTRAL LINES
Emission Spectra
Production

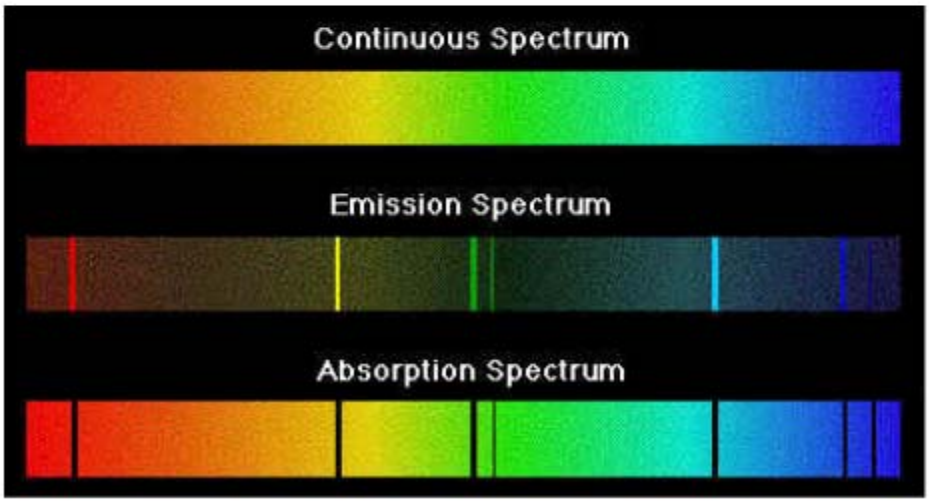




Absorption Spectra Production







Models of the Atom Video Program Questions – Bohr and Thomson

1.) What was Thomson's model of the atom called and what was it.

2.) Why did Rutherford say that the positive charge of an atom needs to be clumped together in a nucleus? What was his model of the atom?

3.) Bohr adds special allowed orbits to Rutherford's model. What happens when electrons jump orbits?

4.) How did deBroglie (dah-Broy) explain why Bohr's special orbits are the only allowed ones possible?

5.) What improvement does Schrödinger's model have over Bohr's model?

6.) What is the basic design of Schrödinger's model of the atom?

Class Notes – Modern Physics
Models of The Atom

Atomic Physics studies the structure and makeup of the atom. Over the years, a number of models have been proposed and revise as new discoveries have been made and theories have been examined.

1st Model – Thomson "plum pudding" model (J.J. Thomson)

This model assumes that an atom is a positive charged sphere with electrons embedded inside it. It is called "plum pudding" because the electrons are like raisins stuck inside a positive pudding sphere.

2nd Model – Ernest Rutherford – Planetary Model

This model adds a nucleus and shows the plum pudding model incorrect by the "Gold Foil Experiment"

Gold Foil Experiment
- Small + charged particles are launched towards a piece of thin gold foil.
- Most of the + particles pass right through the foil.
- Every once in a while a + charged particle is deflected or bounces back off the gold foil.

Model
The results of the gold foil experiment can not be explained by a plum pudding model with uniform + charge. There must be a small clump of positive charge in the atom. This was termed the **nucleus**
- A planetary model of the atom was proposed where electrons orbit a small nucleus of positive charge.
- The model is incomplete because the result of this model would be electrons whose orbits get less and less until they fall into the nucleus, and this makes an unstable atom. The model also does not explain atomic spectra (discussed later).

3rd Model – Neils Bohr – Revisions of the Rutherford Model

- Bohr applies Planck's previous ideas of the quantum (packets of energy) and applied a similar reasoning to the model of the atom
- Bohr suggests that the atom is made up of specific orbits where electrons have a particular amount of energy and are confined to be in these orbits alone. Each orbit is called an Energy Level.
- The orbit nearest the nucleus is the point with the smallest amount of energy the electron can have and is called the ground state. It is most common to find the electron at this ground state and the radius at this location is called the "Bohr Radius".
- Electrons can jump between level's by absorbing or emitting the proper amount energy, but can not exist between the levels. When the electron is in levels other than the ground state, it is said to be in an excited state.
- Bohr's model makes a few unexplained assumptions and the main problem with it is that it only works for Hydrogen and elements like Hydrogen. When other elements were applies to the model, the results could not be explained.

Bohr orbit explained: Matter Waves – Louis deBroglie (pronounced "dah-broy") – deBroglie proposed that all matter (electrons) have wave-like properties and wavelengths. This explained why there would need to be only predefined radii (orbits) where electrons could be. The electrons would have to occupy orbits where the length around would represent a whole number of wavelengths to get constructive interference and keep the electron there. Each integer whole number wavelength represents a different energy level. Calculations of the wavelength for each orbit matched the orbit locations proposed by Bohr

4th Model (Todays Current View, Quantum Mechanics Model) – Erwin Schrödinger – Electron Cloud Model

Schrödinger said that electron matter waves did not need to be confined to a particular orbit. He proposed it could be located anywhere in the surrounding space.

Heisenberg Uncertainly Principle - It is impossible to know the location of an electron with complete certainty. In order to see an electron, a photon of light needs to bounce off it and come to your eye. When the light photon hits the electron, it might change the electrons position and thereby give you a false indication of where the electron actually is when the photon leaves it.

Based on the principle above, Schrödinger developed an equation to measure the probability of finding the electron at a given location. There are different probabilities of finding the electron at all locations in the surrounding areas of the nucleus. The electron locations are viewed as a cloud of possibilities around the nucleus (electron cloud). The highest probability of finding an electron coincides with the Bohr radius (the ground state radius in the Bohr model)

These probability matter waves and electron clouds are some of the key ideas in Quantum theory.

Bohr's Energy Levels

Energy Level Notes:

1.) To jump up levels energy needs to be gained by electrons by absorbing photons. To move down levels, energy needs to be lost by emitting (give up) photons

2.) The amount of energy absorbed or emitted is determined by the frequency of the photon and is given by E=hf. The energy is given in units of eV electron volts, but should be converted to Joules if being used in the equation E = hf

3.) Moving between levels (such as n=1 to n=3 or n=4 to n=5) requires a specific amount of energy transfer and can only be reached by absorbing or emitting the exact right amount of energy for the jump.

4.) Different amounts of energy are needed depending on what level you start at and what level you go to.

5.) You do not need to go through each level to move up or down: you can skip from n=2 right to n=6 without hitting numbers in-between.

6.) The energies listed on the chart are the amounts of energy needed to completely remove the electron from the atom (to move it from the current level to the n=∞ level). When this happens, the atom becomes an ion. Therefore, these energies are called the **ionization potentials** (energy needed to create and ion)

7.) To find the energy needed to move to a level, you subtract the energy at one level from the energy at another level. (Don't worry about the signs +/- just remember that moving up levels requires energy gain, moving down requires energy loss)

8.) The energies are negative because they represent the lack of energy the electron has compared to the amount needed to be freed from the atom.

Reference Table. – Energy Level Diagrams for Hydrogen and Mercury.

Modern Physics Student Sheet - 2

1.) The lowest energy state of an atom is called its
(a) ground state (b) ionized state (c) initial energy (d) final energy state

2.) Which electron transition in the hydrogen atom results in the emission of a photon with the greatest energy?
(a) n=2 to n=1 (b) n=3 to n=2 (c) n=4 to n=2 (d) n=5 to n=3

3.) What is the minimum energy required to ionize a hydrogen atom in the n=3 state?
(a) 13.6 eV (b) 12.09 eV (c) 5.52 eV (d) 1.51 eV

4.) Which photon energy could be absorbed by a hydrogen atom that is in the n=2 state?
(a) 0.66 eV (b) 1.51 eV (c) 1.89 eV (d) 2.40 eV

5.) Electrons in various hydrogen atoms being in energy level state n=3 and end up in the ground state. What is the total number of different possibilities of photon energy emissions that could be created.

6.) An electron in a mercury atom jumps from level a to level g by absorbing a single photon. What is the energy of the photon in Joules?

7.) As an atom absorbs a photon of energy, one of its electrons will (a) exchange energy levels with another of its electrons (b) undergo a transition to a higher energy level (c) undergo a transition to a lower energy level (d) increase its charge

8.) Which transition between the energy levels of mercury causes the emission of a photon of highest frequency? (a) e to d (b) e to c (c) c to b (d) b to a

9.) As an atom goes from the ground state to an excited state, the energy of the atom
(a) decreases (b) increases (c) remains the same

10.) It is possible for an excited hydrogen atom to return to the ground state by the emission of a single photon. Regardless of the initial excited state, this electron transition produces a spectral line in which region of the EM spectrum (a) ultraviolet (b) infrared (c) visible light (d) radio waves

11.) (a) Determine the frequency of the photon emitted when an excited hydrogen atom changes from energy level n=3 to n=2 (b) What color spectral line does this emission represent

12.) An electron in a mercury atom changes from energy level b to level e. This energy-level change occurs as the atom (1) absorbs a 2.03 eV photon (2) absorbs a 5.74 eV photon (3) emits a 2.03 eV photon (4) emits a 5.74 eV photon

13.) A hydrogen atom emits a 2.55 electronvolt photon as its electron changes from one energy level to another.
(a) determine the energy level change for the electron
(b) Express the energy of the emitted photon in joules
(c) determine the frequency of the emitted photon
(d) determine the color of the spectral line produced from this emission

14.) A photon with 14.5 eV of electronvolts of energy collides with a mercury atom in its ground state.

(a) express the energy of the incident photons in joules

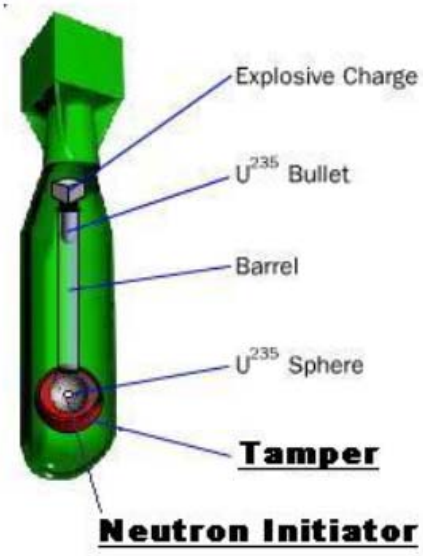
(b) determine the frequency of the incident photon

(c) In what region of the electromagnetic spectrum is the frequency of the incident photon (1) gamma (2) infrared (3) visible (4) ultraviolet

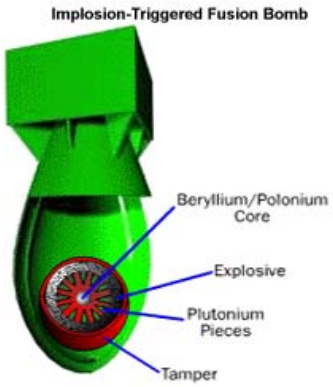
(d) If the photon collision ionizes the atom, what is the maximum energy that the electron removed from the atom can have? (1) 0.00 eV (2) 4.12 eV (3) 10.38 eV (4) 14.60 eV

ATOMIC WEAPONS

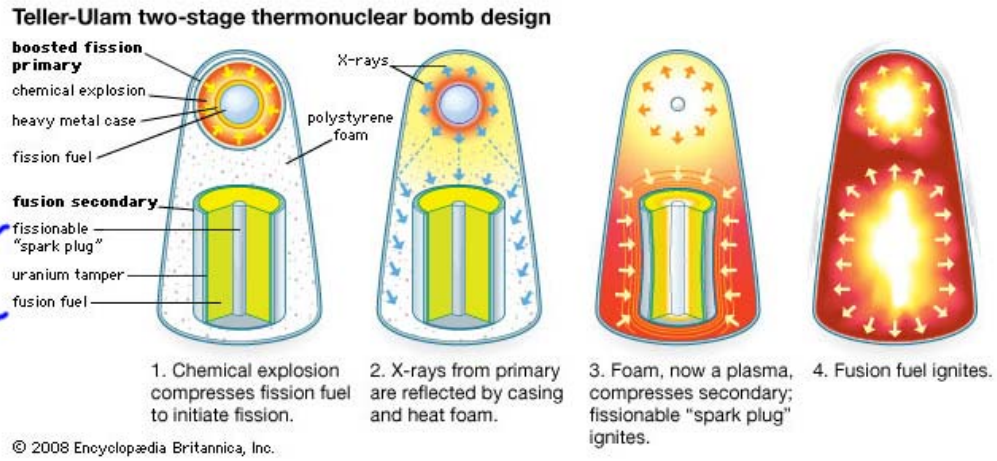
Gun trigger bomb



Implosion Bomb



Teller–Ulam Hydrogen Fusion Bomb



Lithium 6 Deuteride

Plutonium 239

Nuclear Destruction

Damage cause by
- Heat
- Pressure from heat (shockwaves)
- Direct Radiation and Radiation fallout (clouds of radiation fall to ground)

Atomic Bomb

Destruction
1/3 mile – concrete buildings destroyed from air pressure, tiles on houses melted
1 mile – brick buildings destroyed, heat burned clothing

Radiation
1/16 mile – death within a few hours if not killed from heat or pressure
½ mile – death within a month

1 Megaton Hydrogen Bomb (80 times more powerful)

Destruction
- center - 1000 ft wide, 200 ft deep hole. Nothing left
- 1.7 miles – 98% dead, everything in rubble
- 2.7 miles – 50% dead, 40% injured, most buildings destroyed.
- 4.7 miles – 5% dead, 40% injured, houses and building damaged
- 7.4 miles – 25 % injuries from flying debris and heat. Moderate damage to houses

Up to about 60 miles away, if you looked at the blast you could be permanently blinded.

Radiation
- 30 miles – Death can occur within hours. 10 years time before safe to enter blast zone.
- 90 miles – Death 2 – 14 days
- 160 miles – Extensive internal damage, half population may die over time.
- 250 miles – Temporary decrease in white blood cells, no immediate harm
  2 -3 years pass for safety by normal standards

25 megaton bomb

Destruction
A- 6.5 miles – 98 % dead, everything in rubble
B- 10.7 miles – 50 % dead, most buildings destroyed
C- 20 miles - 5% dead, 40% injured, houses and building damaged
D- 30.4 miles – 25 % injuries from flying debris and heat. Moderate damage to houses

Radioactive fallout estimates are hard to determine and wind conditions are a large factor.

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Most powerful bomb ever tested, 50 megaton (4000 x more powerful than Hiroshima bomb)
- 100 km out, 3rd degree burns, severe damage
- 25 km out , complete destruction
- Could have been 100 megaton but was cut in half due to concerns of the plane dropping it being safe

Modern Physics Student Sheet – 3

1.) Which particles are most likely to be found in an atomic nucleus? (1) neutrons only (2) protons only (3) both protons and neutrons (4) both neutrons and electrons

2.) Which statement most accurately describes the interactaction which binds a nucleus together (a) long range and weak (2) long range and strong (3) short range and weak (4) short range and strong

3.) What is the force that holds the nucleus together (1) nuclear force (2) magnetic force (3) gravitational force (4) electrostatic force

4.) One universal mass unit is defined as (1) the mass of an electron (2) the mass of a proton (3) the mass of a carbon-12 atom (4) 1/12 the mass of a carbon-12 atom

5.) In the equation $E=mc^2$, E may be expressed in (1) newtons/coulomb (2) joules/second (3) electron volts (4) coulombs

6.) As a star gives off energy in a thermonuclear reaction, the mass of the star (1) decreases (2) increases (3) remains the same

7.) Determine how many joules of energy would be produced if 2.5×10^{-3} kg of matter was entirely converted into energy

8.) If the mass of one proton was totally converted into energy, the yield would be
(1) 2.79×10^{-38} J (2) 5.01×10^{-19} J (3) 1.50×10^{-10} J (4) 9.00×10^{16} J

9.) In a nuclear reaction, 9.90×10^{-13} joule of energy was released. Determine the mass equivalent of this energy

10.) Sketch a graph that represents the relationship between mass and energy in the equation $E = mc^2$

11.) Uranium has a mass of 235 u, Barium has a mass of 137.9 u, Krypton has a mass of 94.9 u and a neutron has a mass of 1.0 u. In the nuclear reaction where Uranium is bombarded by a neutron (U + neutron) the products of the reaction are Barium + Kryton + 3 neutrons + E, where E represents energy. The E is equivalent to a mass of (1) 0.2 u (2) 2.0 u (3) 2.2 u (4) 0.0 u

12.) The nuclear fusion reaction in the sun combines tritium (3.01695 u) with hydrogen (1.00813 u) to form Helium (4.00388 u) and energy. Find the energy released in this reaction in units of MeV

Subatomic Physics Student Sheet

1.) A baryon may have a charge of (1) -1/3 e (2) 0 e (3) +2/3 e (4) +4/3 e

2.) An antibaryon is composed of (1) three quarks (2) one quark and two antiquarks (3) three antiquarks (4) two quarks and one antiquark

3.) What is the electric charge on a pion having quark composition $u\bar{d}$

4.) What is the electric charge on a particle having a quark composition of $d\bar{b}$

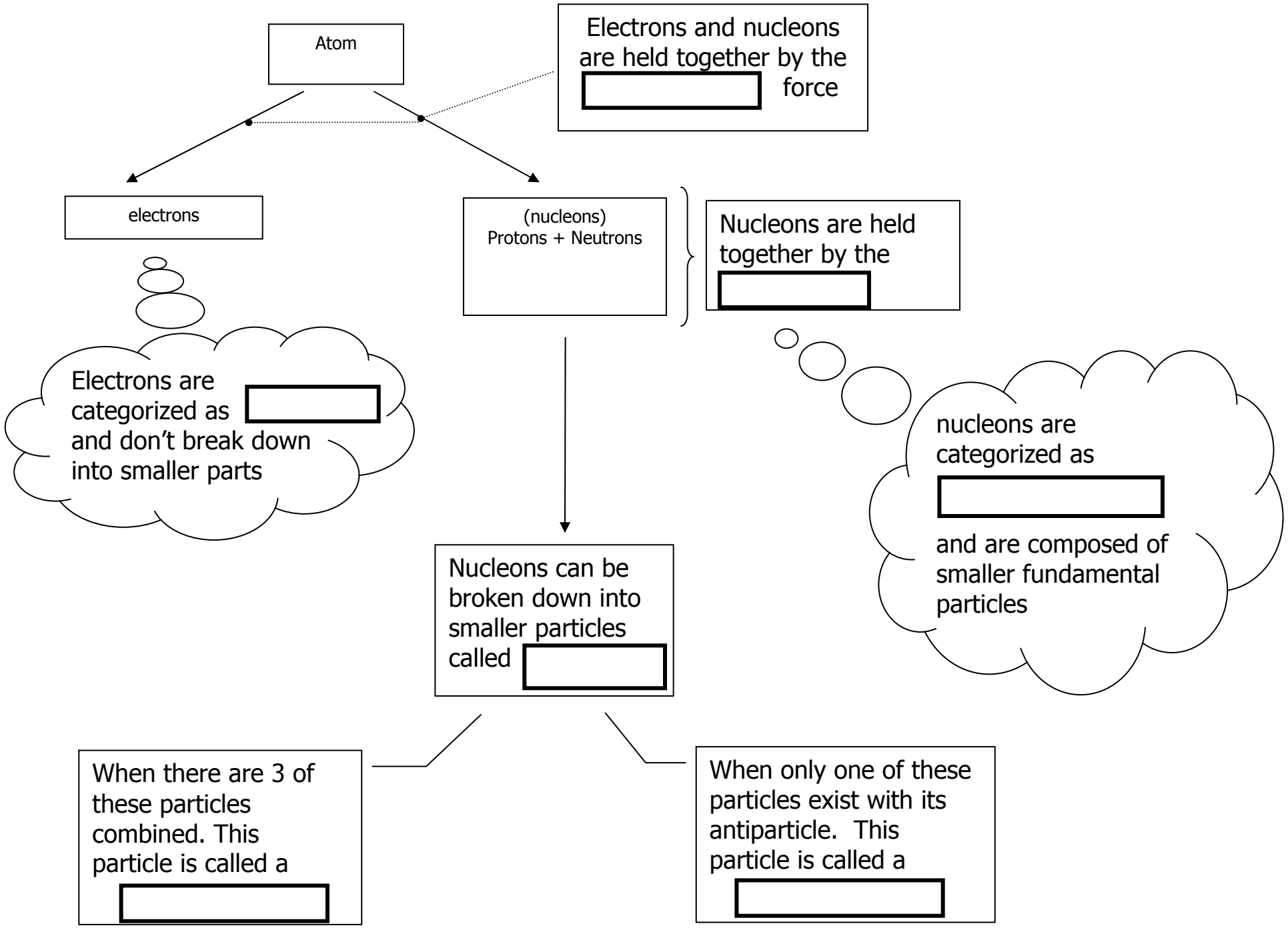
5.) A particle has a quark composition of dds. What is the charge on and classification of the particle? (1) -1e baryon (2) +1 e baryon (3) -1e meson (4) +1 e meson

6.) A particle has a quark composition of $s\bar{u}$. What is the charge on and classification of the particle (1) -1e bayon (2) +1e baryon (3) -1e meson (4) +1e meson

7.) What is the mass of an antineutron in kilograms?

8.) The subatomic particles that make up protons and neutrons are called (1) electrons (2) positrons (3) leptons (4) quarks

9.) How much energy is involved when a positron and an electron collide an annihilate each other?


Atom
Electrons and nucleons are held together by the force
electrons
(nucleons)
Protons + Neutrons
Nucleons are held together by the
Electrons are categorized as and don't break down into smaller parts
nucleons are categorized as
and are composed of smaller fundamental particles
Nucleons can be broken down into smaller particles called
When there are 3 of these particles combined. This particle is called a
When only one of these particles exist with its antiparticle. This particle is called a

Regents Practice 16

1) The diagram shows the collision of an incident photon having a frequency of 2.00×10^{19} hertz with an electron initially at rest.

a) Calculate the initial energy of the photon. [Show all calculations, including the equation and substitution with units.] [2]

b) What is the total energy of the two-particle system after the collision? [1]

2.) Explain why a hydrogen atom in the ground state can absorb a 10.2-electronvolt photon, but can *not* absorb an 11.0-electronvolt photon. [1]

3.) When an electron and its antiparticle (positron) combine, they annihilate each other and become energy in the form of gamma rays.

a) The positron has the same mass as the electron. Calculate how many joules of energy are released when they annihilate. [Show all work, including the equation and substitution with units.] [2]

b) What conservation law prevents this from happening with two electrons? [1]

4.) How much energy, in megaelectronvolts, is produced when 0.250 universal mass unit of matter is completely converted into energy? [1]

5.) What are the sign and charge, in coulombs, of an antiproton? [1]

6.) A lambda particle consists of an up, a down, and a strange quark.

(A) A lambda particle can be classified as a

(1) baryon (3) meson

(2) lepton (4) photon

(B) What is the charge of a lambda particle in elementary charges? [1]

7.) A baryon may have a charge of
(1) – (1/3) e
(2) 0 e
(3) +(2/3) e
(4) +(4/3) e

8.) The force that holds protons and neutrons together is known as the
(1) gravitational force
(2) strong force
(3) magnetic force
(4) electrostatic force

9.) The energy equivalent of 5.0 x $\cdot 10^{-3}$ kilogram is
(1) 8.0 x 10^{5} J (3) 4.5 x $\cdot 10^{14}$ J
(2) 1.5 x 10^{6} J (4) 3.0 x $\cdot 10^{19}$ J

10.) White light is passed through a cloud of cool hydrogen gas and then examined with a spectroscope. The dark lines observed on a bright background are caused by
(1) the hydrogen emitting all frequencies in white light
(2) the hydrogen absorbing certain frequencies of the white light
(3) diffraction of the white light
(4) constructive interference

11.) Protons and neutrons are examples of
(1) positrons (3) mesons
(2) baryons (4) quarks

12.) The strong force is the force of
(1) repulsion between protons
(2) attraction between protons and electrons
(3) repulsion between nucleons
(4) attraction between nucleons

13.) A photon of light carries
(1) energy, but not momentum
(2) momentum, but not energy
(3) both energy and momentum
(4) neither energy nor momentum

14.) An electron in a mercury atom drops from energy level *i* to the ground state by emitting a single photon. This photon has an energy of
(1) 1.56 eV (3) 10.38 eV
(2) 8.82 eV (4) 11.94 eV

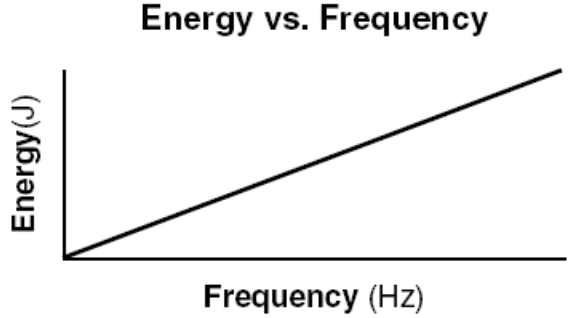
15.) Which phenomenon best supports the theory that matter has a wave nature?
(1) electron momentum
(2) electron diffraction
(3) photon momentum
(4) photon diffraction

16.) Which combination of quarks would produce a neutral baryon?

(1) uud (3) ūūd
(2) udd (4) ūdd

17.) The energy equivalent of the rest mass of an electron is approximately
(1) $5.1 \cdot 10^{5}$ J (3) $2.7 \cdot 10^{-22}$ J
(2) $8.2 \cdot 10^{-14}$ J (4) $8.5 \cdot 10^{-28}$ J

18.) The graph below represents the relationship between the energy and the frequency of photons.



The slope of the graph would be
(1) $6.63 \cdot 10^{-34}$ J•s
(2) $6.67 \cdot 10^{-11}$ N•m2/kg2
(3) $1.60 \cdot 10^{-19}$ J
(4) $1.60 \cdot 10^{-19}$ C

19.) A meson may *not* have a charge of
(1) +1e (3) 0e
(2) +2e (4) –1e

20.) The charge of an antistrange quark is approximately
(1) $+5.33 \times 10^{-20}$ C (3) $+5.33 \times 10^{20}$ C
(2) -5.33×10^{-20} C (4) -5.33×10^{20} C

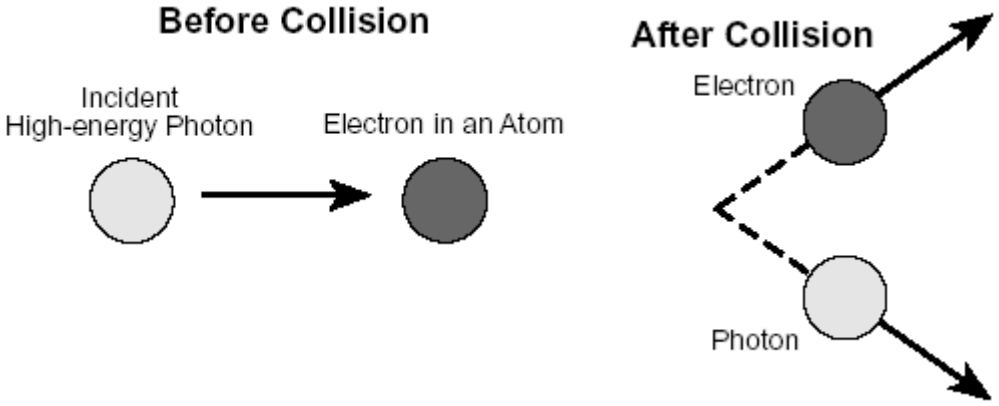
21.) What is the total number of quarks in a helium nucleus consisting of 2 protons and 2 neutrons?
(1) 16 (3) 8
(2) 12 (4) 4

22.) According to the Standard Model, a proton is constructed of two up quarks and one down quark (*uud*) and a neutron is constructed of one up quark and two down quarks (*udd*). During beta decay, a neutron decays into a proton, an electron, and an electron antineutrino. During this process there is a conversion of a
(1) *u* quark to a *d* quark
(2) *d* quark to a meson
(3) baryon to another baryon
(4) lepton to another lepton

23.) How much energy is required to move an electron in a mercury atom from the ground state to energy level *h*?
(1) 1.57 eV (3) 10.38 eV
(2) 8.81 eV (4) 11.95 eV

24.) Wave-particle duality is most apparent in analyzing
the motion of
(1) a baseball (3) a galaxy
(2) a space shuttle (4) an electron

Base your answers on the diagrams below, which show a photon and an electron before and after their collision.



25.) Compared to the wavelength of the photon before its collision with the electron, the wavelength of the photon after the collision is
(1) shorter
(2) longer
(3) the same

26.) Compared to the total momentum of the photon-electron system before the collision, the total momentum of the photon-electron system after the collision is
(1) less
(2) greater
(3) the same

27.) After a uranium nucleus emits an alpha particle the total mass of the new nucleus and the alpha particle is less than the mass of the original uranium nucleus. Explain what happens to the missing mass.

28.) A tritium nucleus is formed by combining two neutrons and a proton. The mass of this nucleus is $9.106 \cdot 10^{-3}$ universal mass unit less than the combined mass of the particles from which it is formed. Approximately how much energy is released when this nucleus is formed?

(1) $8.48 \cdot 10^{-2}$ MeV (3) 8.48 MeV

(2) 2.73 MeV (4) 273 MeV

29.) Find the energy in MeV released in the reaction $^{238}_{92}U \longrightarrow {}^{234}_{90}Th + {}^{4}_{2}He$

Mass of U-238 = 238.050786 U
Mass of Th-234 = 234.043583 U
Mass of He-4 = 4.002603 u

30.) What is the binding energy, in Joules, for Uranium-235?

Given: atom mass($^{235}_{92}U$) = 235.043923 u $m(p^+) = 1.007276$ u

$m(^{0}_{1}n) = 1.008665$u $m(e^-) = 0.000549$ u