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NNHS Introductory Physics: MCAS Review Packet #1

Introductory Physics, High School
Learning Standards for a Full First-Year Course

I. Content Standards

1. Motion and Forces

Central Concept: Newton's laws of motion and gravitation describe and predict the motion of most objects.

1.1 Compare and contrast vector quantities (e.g., displacement, velocity, acceleration force, linear momentum) and scalar quantities (e.g., distance, speed, energy, mass, work).
1.2 Distinguish between displacement, distance, velocity, speed, and acceleration. Solve problems involving displacement, distance, velocity, speed, and constant acceleration.
1.3 Create and interpret graphs of 1-dimensional motion, such as position vs. time, distance vs. time, speed vs. time, velocity vs. time, and acceleration vs. time where acceleration is constant.
1.4 Interpret and apply Newton's three laws of motion.
1.5 Use a free-body force diagram to show forces acting on a system consisting of a pair of interacting objects. For a diagram with only co-linear forces, determine the net force acting on a system and between the objects.
1.6 Distinguish qualitatively between static and kinetic friction, and describe their effects on the motion of objects.
1.7 Describe Newton's law of universal gravitation in terms of the attraction between two objects, their masses, and the distance between them.
1.8 Describe conceptually the forces involved in circular motion.

2. Conservation of Energy and Momentum

Central Concept: The laws of conservation of energy and momentum provide alternate approaches to predict and describe the movement of objects.

2.1 Interpret and provide examples that illustrate the law of conservation of energy.
2.2 Interpret and provide examples of how energy can be converted from gravitational potential energy to kinetic energy and vice versa.
2.3 Describe both qualitatively and quantitatively how work can be expressed as a change in mechanical energy.
2.4 Describe both qualitatively and quantitatively the concept of power as work done per unit time.
2.5 Provide and interpret examples showing that linear momentum is the product of mass and velocity, and is always conserved (law of conservation of momentum). Calculate the momentum of an object.

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1. Motion and Forces Broad Concept: Newton's laws of motion and gravitation describe and predict the motion of most objects.	
1.) John runs one complete lap of the track, returning to the starting line. Which one of the following is true: A. John experienced a displacement of 400m. B. John ran a distance of 0m. C. John experienced a displacement of 0m. D. Not enough information was provided.	2.) Jill drives from Newton to Boston. Her ending point is 5 miles due East of her starting point but she had to drive 7 miles total since roads don't go due East. Which of the following best describes the **displacement** Jill experienced? A. Jill was displaced 7miles. B. Jill was displaced 5 miles. C. Jill was displaced 7 miles East. D. Jill was displaced 5 miles East.
My Answer and Explanation:	My Answer and Explanation:
Correct Answer and Explanation:	Correct Answer and Explanation:

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1. Motion and Forces Broad Concept: Newton's laws of motion and gravitation describe and predict the motion of most objects.	
3.) Which of the following must be included with magnitude to represent a vector? A. mass B. direction C. acceleration D. volume	4.) Which of the following is NOT a vector quantity? A. displacement B. speed C. velocity D. force
My Answer and Explanation:	My Answer and Explanation:
Correct Answer and Explanation:	Correct Answer and Explanation:

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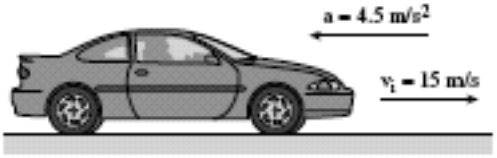
5.) The diagram below shows the path of a jet from Washington, D.C. to Dallas, TX.  The trip takes approximately 2 hours and covers approximately 1900 km. Which of the following best describes the speed and direction of the jet's flight? A. 475 km/h southwest B. 950 km/h southwest C. 1900 km/h southwest D. 3800 km/h southwest	6.) The illustration below shows a car slowing down.  The car was initially traveling at 15 m/s. The car slows with a negative acceleration of 4.5 m/s^2. How long does it take the car to slow to a final velocity of 4.0 m/s? A. 0.89 s B. 2.4 s C. 11 s D. 60 s
My Answer and Explanation:	My Answer and Explanation:
Correct Answer and Explanation:	Correct Answer and Explanation:

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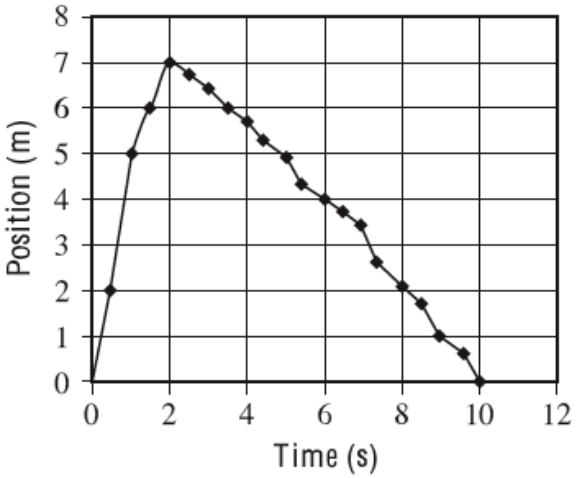
1. Motion and Forces

Broad Concept: Newton's laws of motion and gravitation describe and predict the motion of most objects.

7.) The graph below illustrates the position and time for a dog that runs to catch a stick and then returns with it.



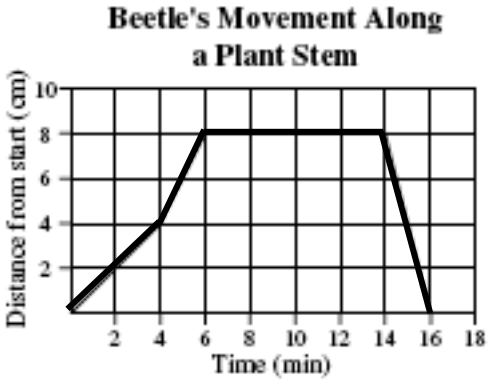
The dog caught the stick after 2 s. What was the dog's average speed as he returned with the stick?

A. His average return speed was 0.7 m/s.
B. His average return speed was 0.9 m/s.
C. His average return speed was 2 m/s.
D. His average return speed was 4 m/s.

My Answer and Explanation:

Correct Answer and Explanation:

8.)The graph below shows a beetle's movement along a plant stem.



During which span of time was the beetle not moving?

A. from 0 to 4 minutes
B. from 4 to 6 minutes
C. from 6 to 14 minutes
D. from 14 to 16 minutes

My Answer and Explanation:

Correct Answer and Explanation:

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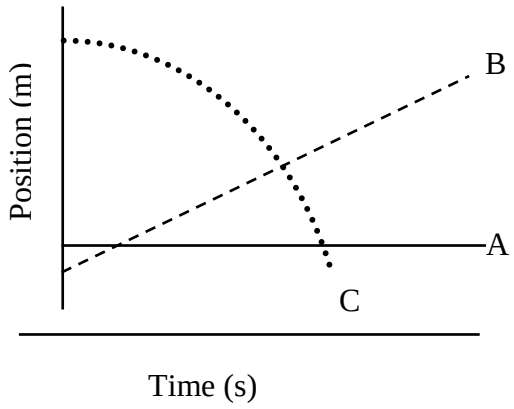
1. Motion and Forces

Broad Concept: Newton's laws of motion and gravitation describe and predict the motion of most objects.

9.) The position-time graph below shows the motion of three people. Which person is accelerating?

Position versus Time for Three People



A. Person A is accelerating.
B. Person B is accelerating.
C. Person C is accelerating.
D. None of the people are accelerating.

My Answer and Explanation:

Correct Answer and Explanation:

10.) Which of the following cars is NOT accelerating?

A. A car that is slowing down to a stop at a red light.
B. A car that is traveling at a constant speed around a sharp curve.
C. A car that is speeding up as it passes another car on the highway.
D. None of the above. All of the cars described are accelerating.

My Answer and Explanation:

Correct Answer and Explanation:

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1. Motion and Forces Broad Concept: Newton's laws of motion and gravitation describe and predict the motion of most objects.	
11.) Which of the following is certain to change as a ball accelerates? A. mass of the ball B. inertia of the ball C. velocity of the ball D. force acting on the ball	12.) A bicycle rider is traveling at 7 m/s. During an 8 s period, the bicycle rider then slows down with a constant acceleration to a speed of 3 m/s. How far does the bicycle rider travel during the 8 s? A. 19 m B. 32 m C. 40 m D. 80 m
My Answer and Explanation:	My Answer and Explanation:
Correct Answer and Explanation:	Correct Answer and Explanation:

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13.) When you see a measurement with the units m/s^2, you know that the measurement is a: A. acceleration B. velocity C. speed D. time	14.) Which of the following units is used to measured displacement? A. m/s B. m/s/s C. s D. m
My Answer and Explanation:	My Answer and Explanation:
Correct Answer and Explanation:	Correct Answer and Explanation:

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1. Motion and Forces Broad Concept: Newton's laws of motion and gravitation describe and predict the motion of most objects.	
15.) You are driving along at a constant 20 miles per hour. Then you slam on the brakes. What happens to your books that are on the passenger side seat? A. The books stay on the seat. B. The books continue moving forward and fall on the floor. C. The books fly up in the air and end up in the back seat. D. The books slide to outside of the car.	16.) What do you have to do to get a boulder that is at rest to start moving? A. Nothing. It will eventually start moving. B. Apply a force that balanced the force of friction. C. Apply an unbalanced force to the boulder. D. It is impossible to get the boulder moving because an object at rest stays at rest forever.
My Answer and Explanation:	My Answer and Explanation:
Correct Answer and Explanation:	Correct Answer and Explanation:

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1. Motion and Forces Broad Concept: Newton's laws of motion and gravitation describe and predict the motion of most objects.	
17.) The tendency of a stationary object to resist being put into motion is known as A. acceleration. B. inertia. C. weight. D. velocity.	18.) Which of the following objects has the most inertia? A. a 1 kg hamster B. a 2 kg rock C. a 4kg box of books D. a 5kg balloon in the Macy's parade.
My Answer and Explanation:	My Answer and Explanation:
Correct Answer and Explanation:	Correct Answer and Explanation:

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1. Motion and Forces

Broad Concept: Newton's laws of motion and gravitation describe and predict the motion of most objects.

19.) The illustration below shows a 2-ton elephant balancing on a tree stump.

Which of the following statements must be accurate?

A. The weight of the tree stump is greater than 2 tons.

B. A 4-ton force on the ground spreads out in all directions.

C. The tree stump is exerting a 2-ton force upward on the elephant.

D. The downward force on the ground under the tree stump is 4 tons.

My Answer and Explanation:

20.) A 1500 kg car increases its speed by 2 m/s for each second of travel. What is the net force acting on the car?

A. 750 N

B. 1500 N

C. 3000 N

D. 6000 N

My Answer and Explanation:

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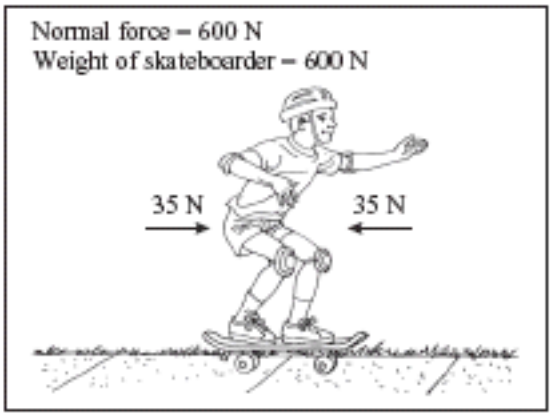
1. Motion and Forces

Broad Concept: Newton's laws of motion and gravitation describe and predict the motion of most objects.

21.) The forces acting on a skateboarder moving at a constant velocity along a sidewalk are shown in the figure below.



Which of the following is the net force on the skateboarder?

A. 0 N
B. 70 N
C. 670 N
D. 1270 N

My Answer and Explanation:

Correct Answer and Explanation:

22.) Two forces act on the 2 kg box shown below.

A 4 N force acts to the right and a 6 N force acts to the left. What is the net force acting on the box?

A. 10 N to the right
B. 10 N to the left
C. 2 N to the right
D. 2 N to the left

My Answer and Explanation:

Correct Answer and Explanation:

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1. Motion and Forces Broad Concept: Newton's laws of motion and gravitation describe and predict the motion of most objects.	
23.) You place a block on a slide at the park. The block stays at rest on the slide. What force keeps the block in place? A. weight B. static friction C. kinetic friction D. normal force	24.) An object that you are pushing with a force of 10 Newtons is sliding at a constant velocity. What do you know about the friction acting on the object? A. 10 N of kinetic friction are acting on the object. B. 10N of static friction are acting on the object. C. Less than 10N of static friction are acting. D. Less than 10N of kinetic friction are acting.
My Answer and Explanation:	My Answer and Explanation:
Correct Answer and Explanation:	Correct Answer and Explanation:

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1. Motion and Forces Broad Concept: Newton's laws of motion and gravitation describe and predict the motion of most objects.	
25.) A mosquito flies into the oncoming windshield of a large truck. The truck exerts a force of 10 Newtons on the mosquito. What can we say about the force that the mosquito exerts on the truck? A. The mosquito exerts a force much less than 10N on the truck. B. The mosquito exerts a force exactly equal to 10N on the truck. C. The mosquito exerts a force much greater than 10N on the truck. D. Not enough information is provided.	26.) You punch a wall. Afterwards your hand hurts so you know that the wall must have exerted a force on your hand. The wall didn't move or react. Did you exert a force on the wall? A. Yes, I exerted a force on the wall. Forces always occur in pairs. The force that I exerted is equal in magnitude and opposite in direction to the force that the wall exerted on me. B. Yes, I exerted a force on the wall. Forces always occur in pairs. The force that I exerted on the wall is much smaller than the force that the wall exerted on me which is why the wall doesn't move. C. No, I didn't exert a force on the wall. If I had exerted a force on the wall, the wall would have moved. D. No, I didn't exert a force on the wall. You can't exert forces on solid objects like walls.
My Answer and Explanation:	My Answer and Explanation:
Correct Answer and Explanation:	Correct Answer and Explanation:

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1. Motion and Forces Broad Concept: Newton's laws of motion and gravitation describe and predict the motion of most objects.	
27.) How would the measurable properties of a golf ball change if it were moved from Earth to the Moon? A. It would have the same mass, but a different weight. B. It would have the same weight, but a different mass. C. It would have the same density, but a different mass. D. It would have the same mass, but a different density.	28.) What is another name for weight? A. Force of Gravity B. Mass C. Inertia D. Volume
My Answer and Explanation:	My Answer and Explanation:
Correct Answer and Explanation:	Correct Answer and Explanation:

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Broad Concept: Newton's laws of motion and gravitation describe and predict the motion of most objects.

29.) On Earth, Johanna weighs 100 lbs. She calculated what her weight would be at several other locations in the solar system. The results are shown in the table below.

Location in Solar System	Weight (lbs.)
Venus	90
Earth	100
Moon	16
Mars	40
Jupiter	260

Which of the following statements is best supported by the information in the table?

A. Venus has more gravitational force than Earth.

B. Mars has less gravitational force than the Moon.

C. Earth has four times the gravitational force of Mars.

D. Jupiter has more than twice the gravitational force of Earth.

30.) How much does a 50kg student weigh?

A. 5 Newtons

B. 50 pounds

C. 50 Newtons

D. 500 Newtons

My Answer and Explanation:

My Answer and Explanation:

Correct Answer and Explanation:

Correct Answer and Explanation:

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1. Motion and Forces Broad Concept: Newton's laws of motion and gravitation describe and predict the motion of most objects.	
31.) One 7.0 kg bowling ball is lifted to a storage shelf 1.0 m above the floor. A second 7.0 kg ball is lifted to a storage shelf 2.0 m above the floor. Which of the following best explains why the measured force of gravity on each ball is nearly identical? A. The final potential energy of each ball increased. B. The amount of work required to lift each ball is identical. C. The distance of each ball from Earth's center of mass is almost identical. D. The gravitational force of each ball on the other cancels out the force of Earth's gravity.	32.) Tides, such as those along the coast of Massachusetts, are caused by gravitational attractions acting on Earth. Why is the gravitational attraction of the Moon a greater factor in determining tides than the gravitational attraction of the much larger Sun? A. Earth is much closer to the Moon than to the Sun. B. The Sun's gravity is a factor only during the day. C. The Moon's core has a much greater density than the Sun's core. D. The Sun's mass is smaller than the mass of the Moon.
My Answer and Explanation:	My Answer and Explanation:
Correct Answer and Explanation:	Correct Answer and Explanation:

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1. Motion and Forces Broad Concept: Newton's laws of motion and gravitation describe and predict the motion of most objects.	
33.) Which one of the following CAN NOT be measured using the units of Newtons? A. Weight B. Friction C. Tension D. Mass	34.) Which one of the following are units for mass? A. Joules B. Newtons C. kilograms D. Watts
My Answer and Explanation:	My Answer and Explanation:
Correct Answer and Explanation:	Correct Answer and Explanation:

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Practice: Open-response question #1

BE SURE TO ANSWER AND LABEL ALL PARTS OF THE QUESTION.
Show all your work (diagrams, tables, or computations)
If you do the work in your head, explain in writing how you did the work.

An elastic cord made for bungee jumping is being tested. A block weighing 800 N is attached to one end of the bungee cord. Then the block is released from a tall tower and it moves downward. When the elastic cord is fully extended, it exerts an opposing force of 900 N on the block.

a. Draw and label a force diagram for this situation.

b. Calculate the net force on the block. Show your calculations and include units in your answer.

c. Explain what would happen if the elastic cord exerted a maximum force of only 700 N on the block.

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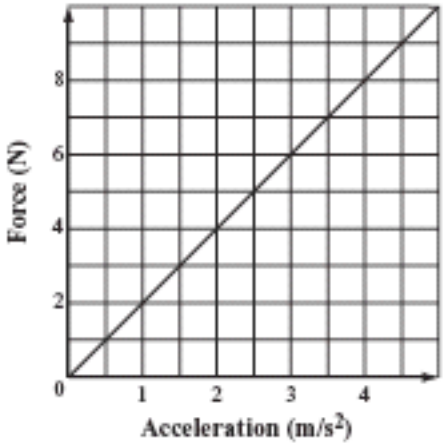
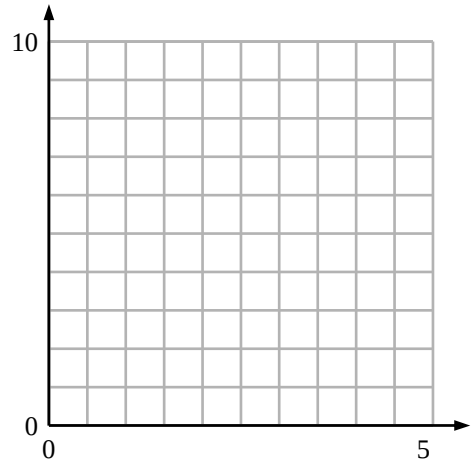
Practice: Open-response Question #2

BE SURE TO ANSWER AND LABEL ALL PARTS OF THE QUESTION.
Show all your work (diagrams, tables, or computations)
If you do the work in your head, explain in writing how you did the work.

The figure below is a graph of net force vs. the acceleration of an object.



a. Use the graph to determine the mass of the object. Show your calculations and include units in your answer.
b. What acceleration will the object have if the net force is 50 N and the trend shown by the graph continues? Show your calculations and include units in your answer.
c. On the grid in your Student Answer Booklet, draw a graph of force vs. acceleration if the mass of the object is halved and the object is subjected to the same net forces. Label the axes on your graph and be sure to include units. Label this graph "c."
d. On the same axes that you used in part (c), draw a graph of force vs. acceleration if the mass of the object is doubled and the object is subjected to the same net forces. Label this graph "d."



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Practice: Open-response Question #3

BE SURE TO ANSWER AND LABEL ALL PARTS OF THE QUESTION.
Show all your work (diagrams, tables, or computations)
If you do the work in your head, explain in writing how you did the work.

The chart below shows the position of a car moving in a straight line.

Position of a Car

Time (s)	Position (m)
0	75
10	125
20	175
30	225
40	275

a. Use the data in the chart to draw and correctly label a position versus time graph.
b. Based on the data in the chart, what is the average speed of the car from 0 s to 40 s?
c. Based on the graph that you have drawn, describe the acceleration of the car.

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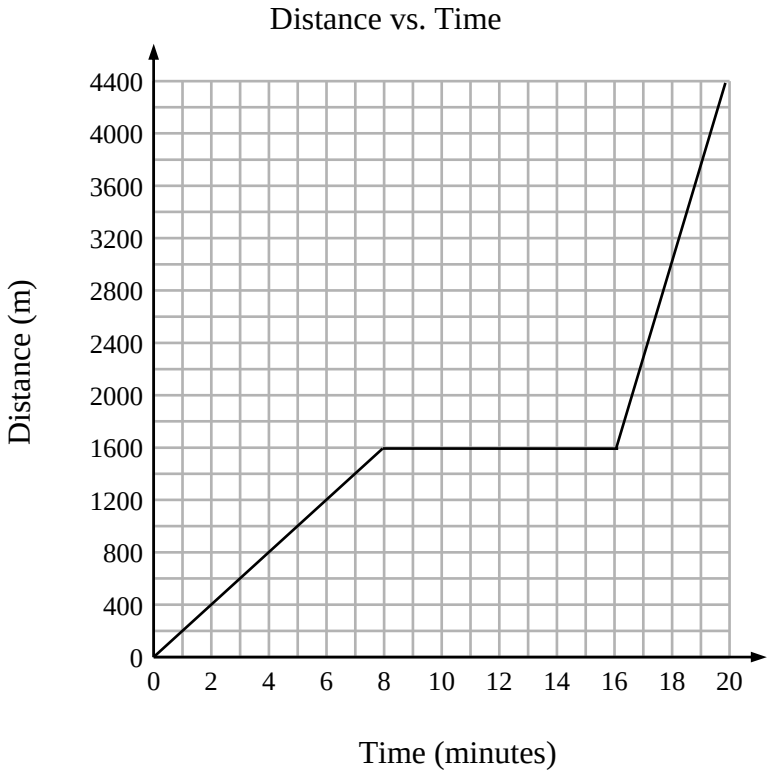
Practice: Open-response Question #4

BE SURE TO ANSWER AND LABEL ALL PARTS OF THE QUESTION.
Show all your work (diagrams, tables, or computations)
If you do the work in your head, explain in writing how you did the work.

The graph below relates distance to time for a jogger on a morning run.



Juan is on a morning jog. His speed is represented in the graph.
a. At what rate of speed is Juan running between 4 min and 6 min?
b. According to this graph, what can you tell about Juan's motion between 8 min and 16 min?
c. If Juan had maintained the same speed as in the first 8 min, how long would it have taken him to run 4000 m? Explain your answer.