Name:_____ Block: _____ Date: _____

NNHS Introductory Physics: Midyear Review

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

Part A: Motion Practice Problems

Standard 1A1. Students will distinguish between the concepts of displacement and distance.

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.

Standard 1A2. Students will distinguish between vector quantities and scalar quantities.

3.) Which of the following must be included with magnitude to represent a vector?
A. mass
B. direction
C. acceleration
D. volume

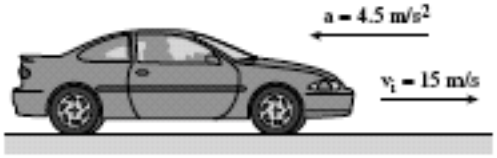
4.) Which of the following is NOT a vector quantity?
A. displacement
B. speed
C. velocity
D. force

Standard 1A3. Students will solve problems involving distance, displacement, average speed, average velocity, time, and acceleration.

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

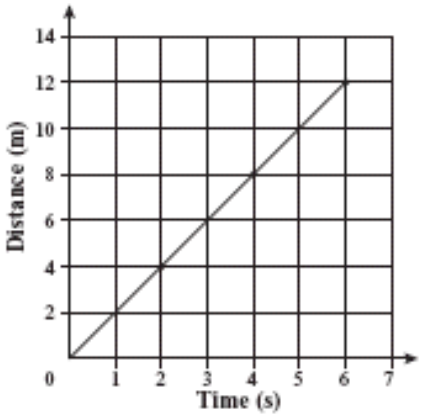
6.) The illustration below shows a car slowing down.



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

Standard 1A4. Students will create and use motion graphs to relate distance, displacement, average speed, average velocity, time, and acceleration.

7.) The graph below relates distance to time for a rolling ball.



What is the average speed of the ball?

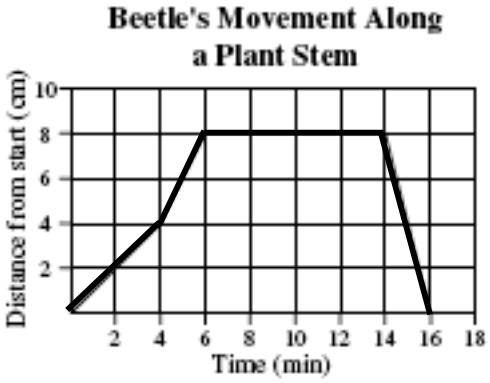
A. 2 m/s

B. 6 m/s

C. 8 m/s

D. 72 m/s

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

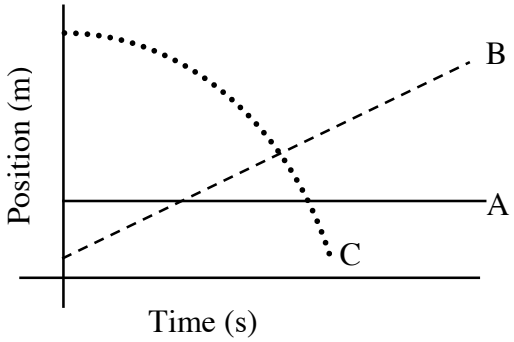
C. from 6 to 14 minutes

D. from 14 to 16 minutes

Standard 1A5. Students will identify whether an object is accelerating from verbal descriptions, graphs, or motion maps.

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.

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.

Standard 1A6. Students will describe the motion of an accelerating object.

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.) The following table describes the distance a toy car travels away from its starting point.

Time(s)	0	1	2	3
Distance (cm)	0	5	10	?

The car travels with a constant velocity for the first 2 seconds. If the toy car starts accelerating, which of the following **could** be the next distance in the table?

A. 0cm

B. 3cm

C. 12cm

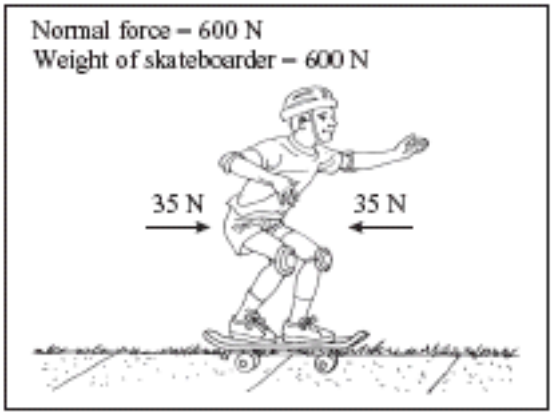
D. 15cm

Standard 1A7. Students will identify appropriate standard international units of measurement for time (s), distance and displacement (m), speed and velocity (m/s), and acceleration (m/s^2).	
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

1. Motion and Forces Broad Concept: Newton's laws of motion and gravitation describe and predict the motion of most objects.	
Part B: Forces Practice Problems	
Standard 1B1. Students will describe and be able to use Newton's First Law.	
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 balances 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.
Standard 1B2. Students will understand that mass is a measure of inertia.	
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.
Standard 1B3. Students will describe and be able to use Newton's Second Law, solving word problems using forces, masses, and accelerations.	
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.	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

Standard 1B4. Students will 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.

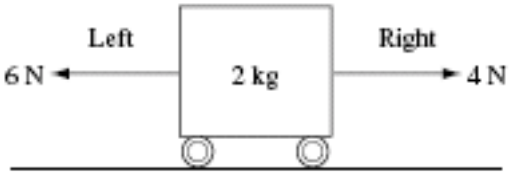
21.) The forces acting on a skateboarder moving at a constant velocity along a sidewalk are shown in the figure below.



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

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

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

Standard 1B5. Students will distinguish qualitatively between static and kinetic friction, and describe their effects on the motion of 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.

Standard 1B6. Students will describe and be able to use Newton's Third Law.

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.

Standard 1B7. Students will distinguish between mass and weight.

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

Standard 1B8. Students will solve problems relating mass, weight, and the local acceleration of gravity.

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

Standard 1B9. Students will understand conceptually Newton's Law of Universal Gravitation.

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.

Standard 1B10. Students will identify appropriate standard international units of measurement for force (N), mass (kg), and weight (N).

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

2. Conservation of Energy and Momentum

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

Part A: Energy Practice Problems

Standard 2A1. Students will define and calculate the kinetic energy of an object.

35.) Which of the following objects has the most kinetic energy?
A. Toy car with a mass of 1kg and a speed of 1m/s.
B. Toy car with a mass of 1kg and a speed of 5m/s.
C. Real car with a mass of 1000kg and a speed of 1m/s.
D. Real car with a mass of 1000kg and a speed of 5m/s.

36.) Calculate the kinetic energy of a dog, mass=10kg, running at a speed of 2m/s.
A. 10 J
B. 20 J
C. 40 J
D. 80 J

Standard 2A2. Students will define and calculate the gravitational potential energy of an object relative to the ground.

37.) A person is sitting at rest at the top of the biggest hill of a rollercoaster. If the person has a weight of 600N, and the hill is 30m high, what is the person's gravitational potential energy?
A. 18000 J
B. 20 J
C. 180000 J
D. 9000J

38.) You hold a .5kg mass 1 meter above the ground. Its gravitational potential energy is approximately:
A. .5 J
B. 5 J
C. 10 J
D. 50 J

Standard 2A3. Students will interpret and provide examples that illustrate the law of conservation of energy.

39.) The water contained in a geyser system gains energy from the underground material surrounding it. The water molecules gain kinetic energy and this results in an increase in the pressure of the water. Eventually the geyser erupts and expels water into the air above ground.
Which of the following types of energy is the source for the initial energy gain of the water?
A. electrical
B. magnetic
C. mechanical
D. thermal

40.) Which one of the following objects has mechanical energy (KE +GPE) that remains constant?
A. A crate being lifted vertically upwards at a constant velocity.
B. An apple in free-fall.
C. A car accelerating on a level(flat) highway.
D. A sky-diver falling to Earth with his parachute open.

Standard 2A4. Students will apply the concept of conservation of mechanical energy, and describe energy conversions between kinetic and gravitational potential energies.

41.) An astronaut drops a 1.0 kg object and a 5.0 kg object on the Moon. Both objects fall a total distance of 2.0 m vertically. Which of the following best describes the objects after they have fallen a distance of 1.0 m?
A. They have each lost kinetic energy.
B. They have each gained the same amount of potential energy.
C. They have each lost the same amount of potential energy.
D. They have each gained one-half of their maximum kinetic energy.

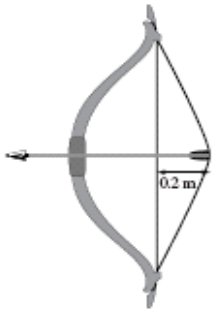
42.) The figure below shows a wagon that moves from point X to point Y.

Which of the following best describes the wagon's change in energy as it coasts from point X to point Y?
A. The wagon has the same kinetic energy at point Y and at point X.
B. The wagon has more kinetic energy at point Y than at point X.
C. The wagon has the same gravitational potential energy at point Y and at point X.
D. The wagon has more gravitational potential energy at point Y than at point X.

Standard 2A5. Students will describe the relationship among energy, work, and power both conceptually and quantitatively.

43.) At a weightlifting competition, two competitors lifted the same weight to the same height. The second competitor accomplished the lift 2 seconds faster than the first competitor. This demonstrated that the second competitor had more
A. energy than the first.
B. inertia than the first.
C. power than the first.
D. work than the first.

44.) An archer pulls back the bowstring to prepare to shoot an arrow as shown below.



She uses an average force of 40 N, moving the bowstring 0.2 m. How much energy is stored in the bow?
A. 8 J
B. 16 J
C. 24 J
D. 36 J

Standard 2A6. Students will identify appropriate standard international units of measurement for energy and work (J), and power (W),

45.) The Watt is the unit for which quantity:
A. energy
B. work
C. force
D. power

46.) One Joule is equal to
A. One Watt
B. One kg*m/s
C. One Newton-meter
D. One Newton

2. Conservation of Energy and Momentum

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

Part B: Momentum Practice Problems

Standard 2B1. Students will calculate momentum of an object.

47.) What is the mass of an asteroid with a speed of 200 m/s and a momentum of 2,000 kg*m/s?
A. 10 kg
B. 1,800 kg
C. 2,200 kg
D. 400,000 kg

48.) A bowling ball with a mass of 8.0 kg rolls down a bowling lane at 2.0 m/s. What is the momentum of the bowling ball?
A. 4.0 kg • m/s
B. 6.0 kg • m/s
C. 10.0 kg • m/s
D. 16.0 kg • m/s

Standard 2B2. Students will interpret the law of conservation of momentum and provide examples that illustrate it.

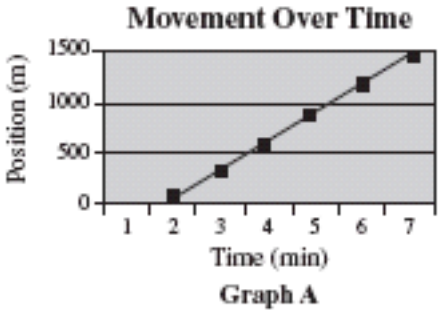
49.) A student is standing on a skateboard that is not moving. The total mass of the student and the skateboard is 50 kilograms. The student throws a ball with a mass of 2 kilograms forward at 5 m/s. Assuming the skateboard wheels are frictionless, how will the student and the skateboard move?
A. forward at 0.4 m/s
B. forward at 5 m/s
C. backward at 0.2 m/s
D. backward at 5 m/s

50.) You are at an ice skating rink and are gliding towards a friend who is initially at rest. When you reach your friend, you grab your friend around the waist and the two of you continue gliding forward. Which one of the following is true:
A. Your speed after the collision is greater than your speed before the collision.
B. Your speed after the collision is the same as your speed before the collision.
C. Your speed after the collision is smaller than your speed before the collision.
D. Not enough information has been provided.

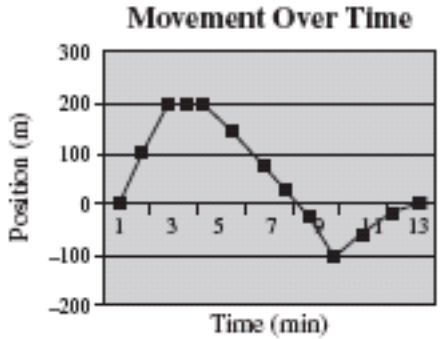
Practice: Open-response question #1

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.

The graphs below show movement over time.



Graph A



Graph B

A truck and car are on separate journeys on the same straight road. The truck is traveling at a constant velocity. The car changes speed and direction.

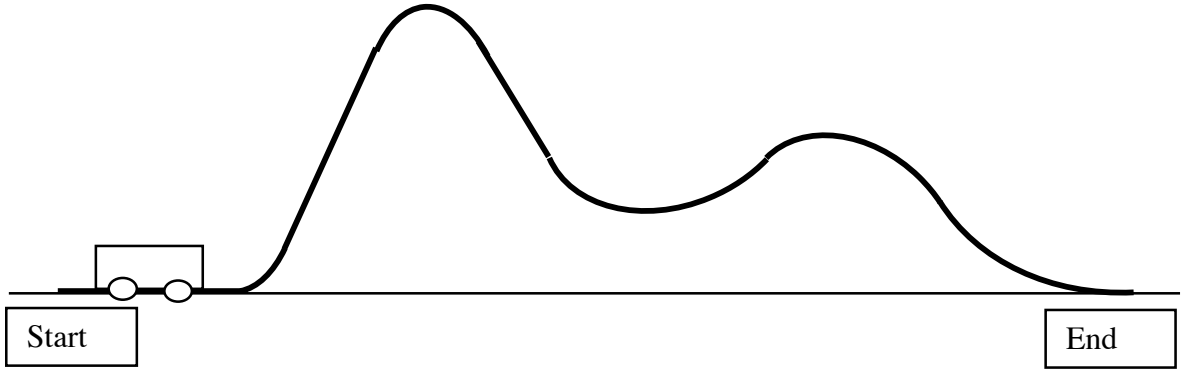
a. Which of the graphs **best** represents the truck's journey? Explain your answer.
b. Which of the graphs **best** represents the car's journey? Explain your answer.

a. The truck's journey is best represented by graph A. I know this because the truck is going at constant velocity and graph A shows an object moving at constant velocity: the position changes in the same amount every second, in other words it is a straight line, with a unique slope.

b. The car's journey is best represented by graph B. I know this because the car changes speed and direction and graph B shows that. Each segment has a different slope, or different velocity. Graph B also shows and object changing direction: increasing position or positive slope and decresing position or negative slope.

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 above diagram shows a simple roller coaster track and one roller coaster car. The car, when full of passengers, has a mass of 500kg.

A.) If the first hill has a height of 20 meters, calculate the amount of work that must be done to get the full car to the top of the first hill.
B.) If there were no friction, where on this track would the car be going the fastest? Place an x on the spot on the diagram. Explain.
C.) In reality, there is friction on a roller coaster track. Explain why this means that the first hill must be the highest hill on a roller coaster track.

A.) Work is equal to the change in gravitational PE.

$m = 500\ kg$
$\Delta h = 20\ m$
$g = 10\ m/s^2$
$W = \Delta GPE = mg\Delta h$
$W=(500\ kg)(10\ m/s^2)(20\ m) = 100000J$

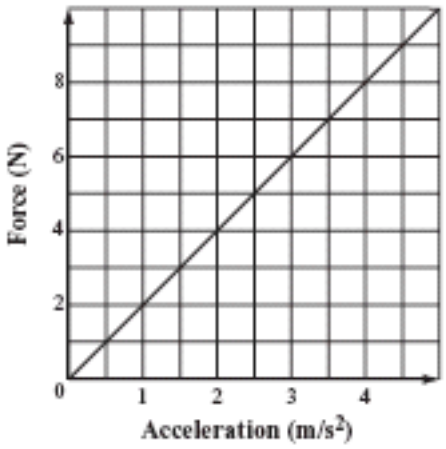
B.) The "End" is the lowest height – therefore the least PE. Because the mechanical energy is conserved, all the initial GPE will be transferred to KE at the end.

C.) Friction converts KE to thermal energy. By considering friction we are saying that not all GPE will be transformed into KE, some will become thermal energy. When going up the hill, the KE is transformed into thermal energy and GPE (this last determines the height). If less KE is available because some is being transformed into thermal energy, less height will be reached.

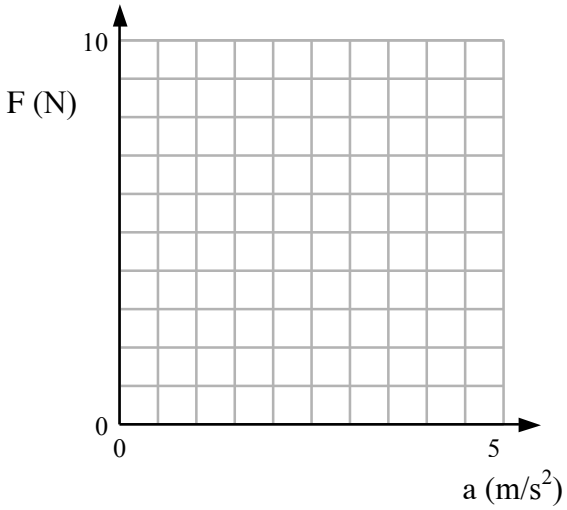
Practice: Open-response Question #3

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 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."



a. m?
F = 10 N
$a = 5\ m/s^2$
m = F/a $m = (10\ N)/(5\ m/s^2)$ m = 2 kg

b. m = 2 kg
F = 50 N
a? a = F/m a = (50 N)/(2 kg) $a = 25\ m/s^2$

c. m is halved: m = 1 kg; F = ma (SOLID LINE)

$a\ (m/s^2)$	1	2	3	4	5
F (N)	1	2	3	4	5

d. m is doubled: m = 4 kg, F = ma (DASHED LINE)

$a\ (m/s^2)$	1	2	3	4	5
F (N)	4	8	12	16	20