Name_____Date_____Partners_____

HOMEWORK FOR UNIT 5-1: FORCE AND MOTION

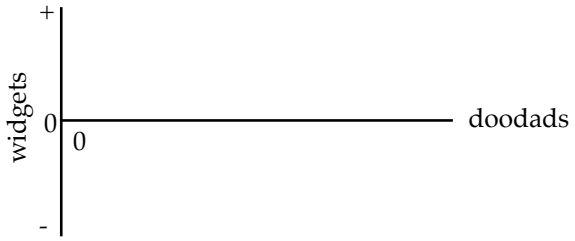
1. You are given ten identical springs. Describe how you would develop a scale of force (ie., a means of producing repeatable forces of a variety of sizes) using these springs.

2. Describe how you would use a force probe and the springs in (1) to develop a quantitative scale of force.

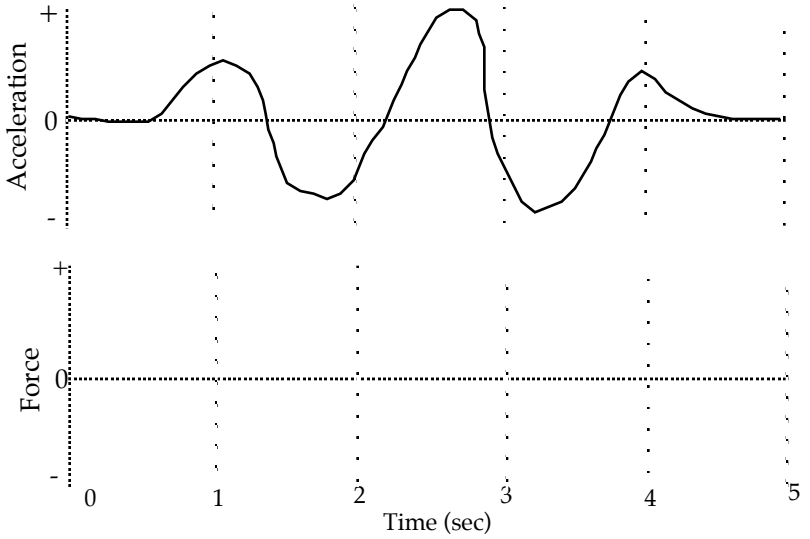
3. What is meant by a proportional relationship? Is this the same as a linear relationship? Explain.

4. Given the table of data below for widgets and doodads, how would you determine if the relationship between widgets and doodads is a proportional one? Sketch on the axes on the right of the table what the graph would look like if widgets are proportional to doodads.

widgets	doodads
0.0	0.0
150.5	10.0
305.0	20.0
442.7	30.0
601.3	40.0

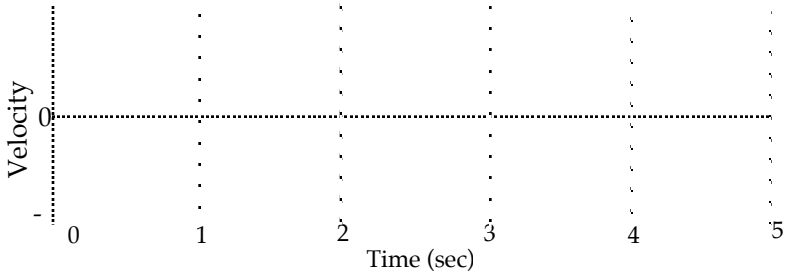


5. A force is applied which makes an object move with the acceleration shown below. Assuming that friction is negligible, sketch a force-time graph of the force on the object on the axes below.

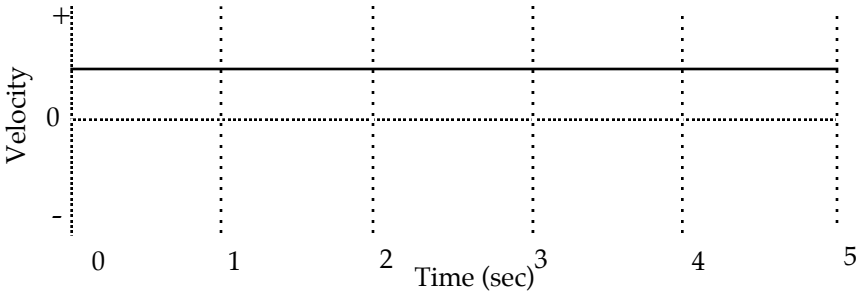


Explain your answer:

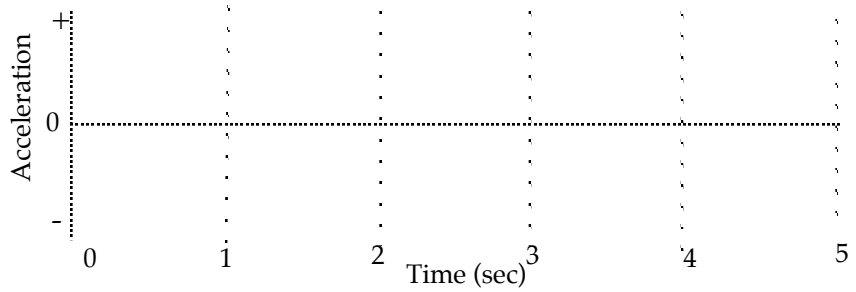
6. Roughly sketch the velocity-time graph for the object in question 5 on the axes below.



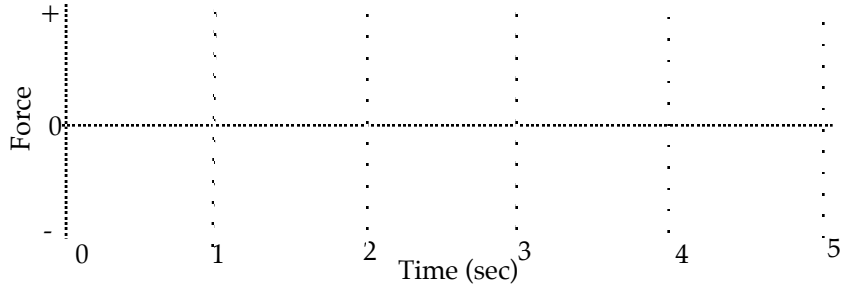
7. A cart can move along a horizontal line (the + position axis). It moves with the velocity shown below.



Assuming that friction is so small that it can be neglected, sketch on the axes that follow the acceleration-time graph of the cart's motion.



Sketch on the axes below the force which must act on the cart to keep it moving with this velocity and acceleration. (Remember that friction is negligible.)



Explain both of your graphs.

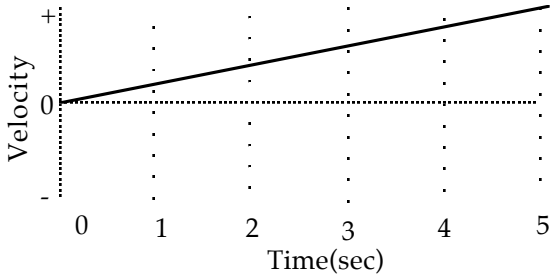
Questions 8-10 refer to an object which can move in either direction along a horizontal line (the + position axis). Assume that friction is so small that it can be neglected. Sketch the shape of the graph of the force applied to the object which would produce the motion described.

8. The object moves away from the origin with a constant velocity.

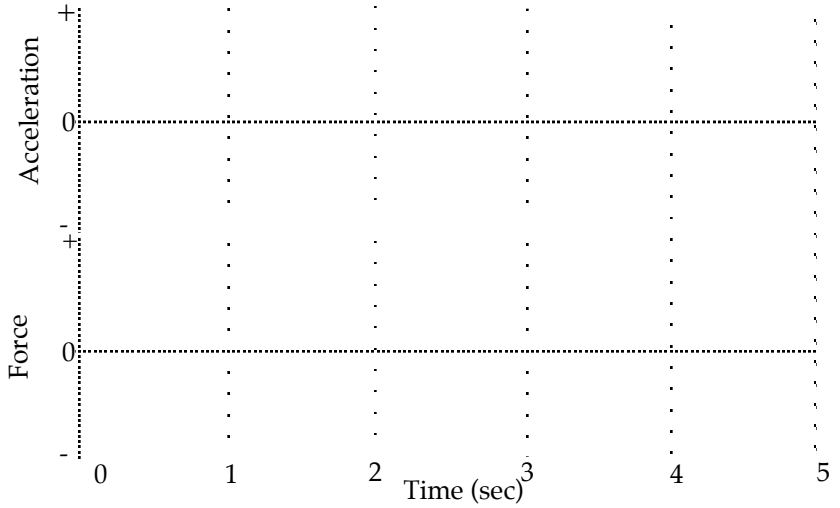
9. The object moves toward the origin with a constant velocity.

10. The object moves away from the origin with a steadily increasing velocity (a constant acceleration).

Questions 11-12 refer to an object which can move along a horizontal line (the + position axis). Assume that friction is so small that it can be ignored. The object's velocity-time graph is shown on the right.

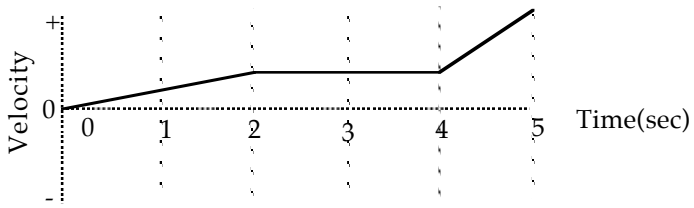


11. Sketch the shapes of the acceleration-time and force-time graphs on the axes below.

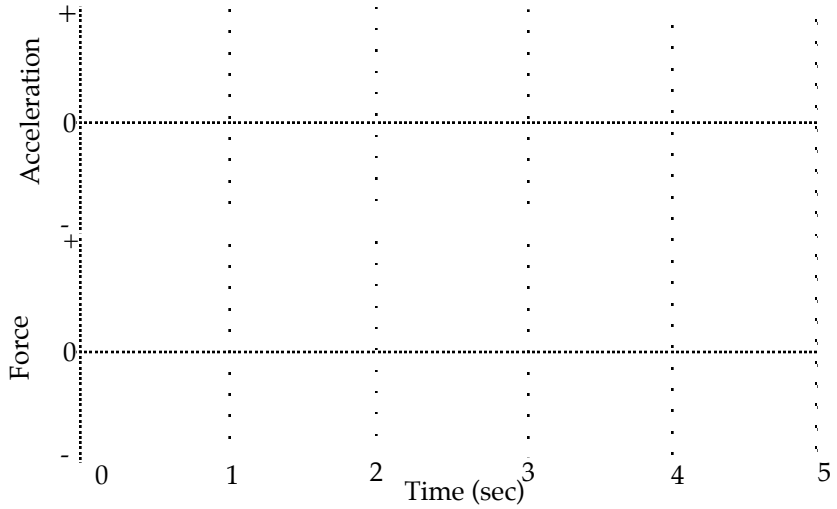


12. Suppose that the force applied to the object were twice as large. Sketch with dashed lines on the same axes above the force, acceleration and velocity.

Questions 13 refers to an object which can move along a horizontal line (the + position axis). Assume that friction is so small that it can be ignored. The object's velocity-time graph is shown



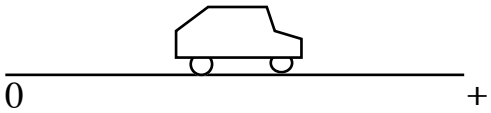
13. Sketch the shapes of the acceleration and force graphs on the axes below.



Name_____Date_____Partners_____

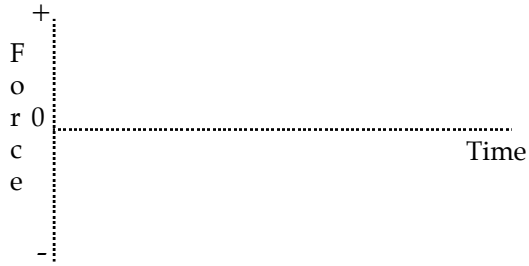
HOMEWORK FOR UNIT 5-2: COMBINING FORCES

Questions 1--5 refer to a toy car which can move in either direction along a horizontal line (the + position axis).



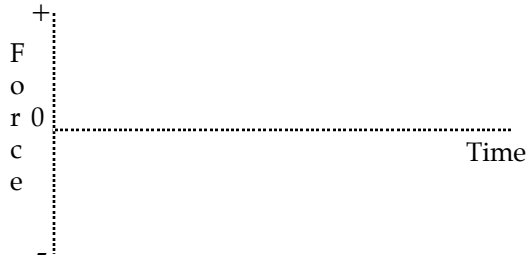
Assume that friction is so small that it can be ignored. Sketch the shape of the graph of the applied force which would keep the car moving as described in each statement.

1. The toy car moves away from the origin with a constant velocity.



2. The toy car moves toward the origin with a constant velocity.

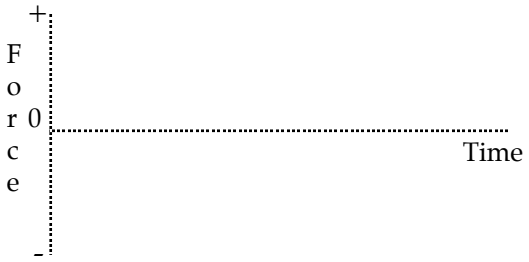
3. The toy car moves away from the origin with a steadily decreasing velocity (a constant acceleration).



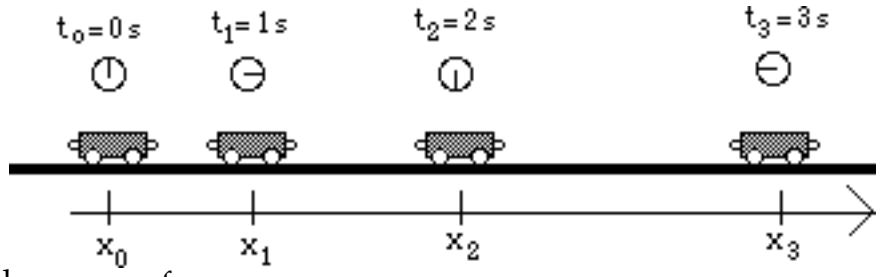
4. The toy car moves away from the origin, speeds up and then slows down.

5. The toy car moves toward the origin with a steadily increasing velocity (a constant acceleration).

6. The toy car is given a push away from the origin and released. It continues to move with a constant velocity. Sketch the force after the car is released.



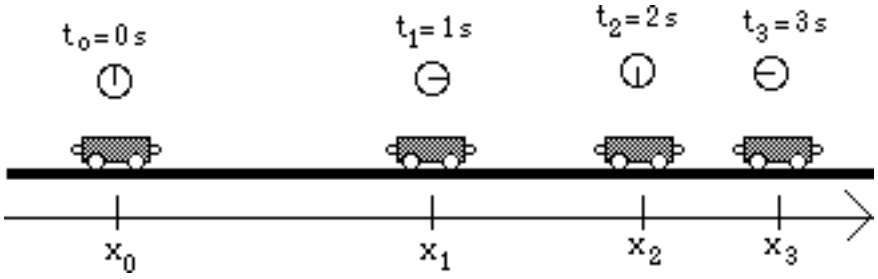
7. A cart is moving toward the right and speeding up, as shown in the diagrams below. Draw arrows above the cart representing the magnitudes and directions of the net (combinec) forces you think are needed on the cart at t = 0 s, t = 1 s, etc. to maintain its motion with a steadily increasing velocity.



Explain the reasons for your answers.

8. If the positive direction is toward the right, what is the sign of the force at t = 2 sec in question 7. Explain.

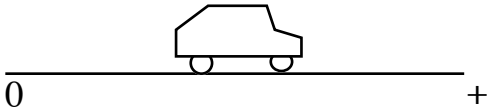
9. A cart is moving toward the right and slowing down, as shown in the diagrams below. Draw arrows above the cart representing the magnitudes and directions of the net(combined) forces you think are needed on the cart at t = 0 s, t = 1 s, etc. to maintain its motion with a steadily decreasing velocity.



Explain the reasons for your answers.

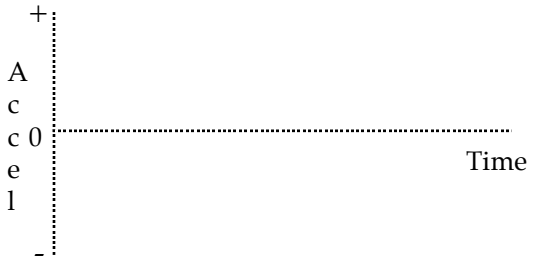
10. If the positive direction is toward the right, what is the sign of the force at t = 2 sec in question 9? Explain.

11. A toy car can move in either direction along a horizontal line (the + position axis).



Assume that friction is so small that it can be ignored. A force toward the right of constant magnitude is applied to the car.

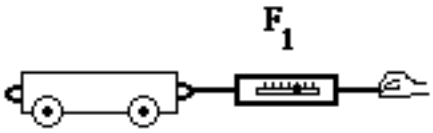
Sketch on the axes below using a solid line the shape of the acceleration-time graph of the car.



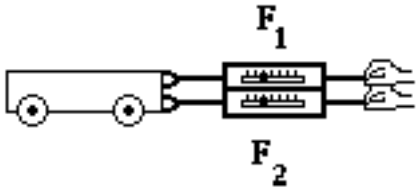
Explain the shape of your graph in terms of the applied force.

In questions 12-15, assume that friction is so small that it can be ignored.

12. The spring scale in the diagram below reads 10.5 N.

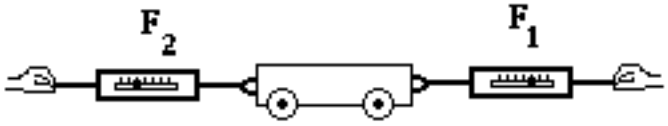


The cart moves toward the right with an acceleration toward the right of 3.25 m/s/s. Now two forces are applied to the cart with two different spring scales as shown below. The spring scale F_1 still reads 10.5 N.



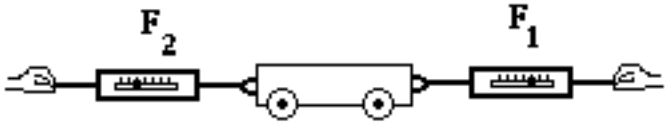
The cart now moves toward the right with an acceleration toward the right of 5.50 m/s/s. What does spring scale F_2 read? Show your calculations, and explain.

13. Now two forces are applied to the cart with two different spring scales as shown below. The spring scale F_1 still reads 10.5 N.



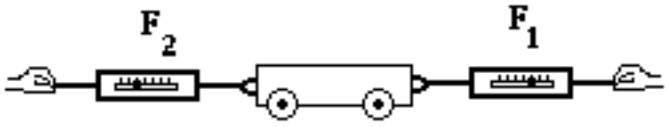
The cart now moves toward the right with an acceleration toward the right of 2.50 m/s/s. What does spring scale F_2 read? Show your calculations, and explain.

14. Again two forces are applied to the cart with two different spring scales as shown below. The spring scale F_1 still reads 10.5 N.



The cart moves with a constant velocity toward the right. What does spring scale F_2 read? Show your calculations, and explain.

15. Again two forces are applied to the cart with two different spring scales as shown below. The spring scale F_1 still reads 10.5 N.



The cart moves toward the left with an acceleration toward the left of 2.50 m/s/s. What does spring scale F_2 read? Show your calculations, and explain.

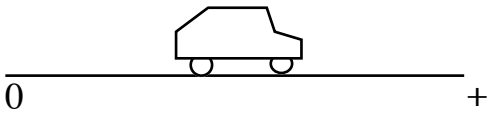
Name_____Date_____Partners_____

HOMEWORK FOR UNIT 5-3: FORCE, MASS AND ACCELERATION

1. Given the table of data below for widgets and doodads, how would you determine if the relationship between widgets and doodads is an inversely proportional one? Sketch on the axes on the right of the table what the graph would look like if widgets are inversely proportional to doodads, and write the form of the equation which relates widgets to doodads in this case.

widgets	doodads
125.0	10.0
59.0	20.0
42.0	30.0
30.5	40.0
23.5	50.0

Questions 2-3 refer to a toy car which can move in either direction along a horizontal line (the + position axis).



Assume that friction is so small that it can be ignored. A force toward the right of constant magnitude is applied to the car.

2. Sketch on the axes below using a solid line the shape of the acceleration-time graph of the car.

3. Suppose that the mass of the car were twice as large. The same constant force is applied to the car. Sketch on the axes above using a dashed line the acceleration-time graph of the car. Explain any differences in this graph compared to the acceleration-time graph of the car with the original mass.

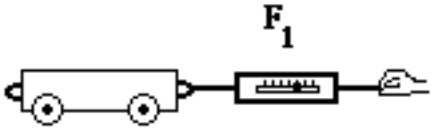
4. When a force is applied to an object with mass equal to the standard kilogram, the acceleration of the mass is 3.25 m/s/s. (Assume that friction is so small that it can be ignored.) When the same magnitude force is applied to another object, the acceleration is 2.75 m/s/s. What is the mass of this object? What would the object's acceleration be if a force twice as large were applied to it? Show your calculations.

5. Given an object with mass equal to the standard kilogram, how would you determine if a force applied it has magnitude just equal to one newton? (Assume that friction is so small that it can be ignored.)

6. Why is it necessary to calibrate the force probe? Describe how this is done.

In questions 7, assume that friction is so small that it can be ignored.

7. The spring scale in the diagram below reads 10.5 N.



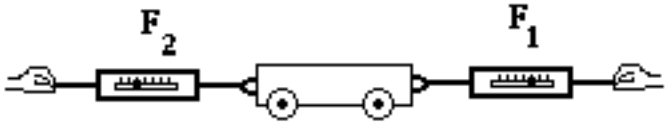
If the cart moves toward the right with an acceleration toward the right of 3.25 m/s/s, what is the mass of the cart? Show your calculations, and explain.

In questions 8-10, friction may not be ignored.

8. The force applied to the cart in (7) by spring scale F_1 is still 10.5 N. The cart now moves toward the right with a constant velocity. What are the magnitude and direction of the frictional force. Show your calculations and explain.

9. The force applied to the cart in (7) by spring scale F_1 is still 10.5 N. The cart now moves toward the right with an acceleration toward the right of 1.75 m/s/s. What are the magnitude and direction of the frictional force. Show your calculations and explain.

10. The force applied to the cart by spring scale F_1 is 10.5 N.



The cart now moves toward the right with a constant velocity. The frictional force has the same magnitude as in (9). What does spring scale F_2 read? Show your calculations, and explain.