AP Physics Study Guide Chapter 4 **Name_____**

Circle the vector quantities below and underline the scalar quantities below
Force Acceleration Mass Weight

Write the equation that defines each quantity, include units
Newton's 2nd law kinetic friction force static friction force weight

Write a statement of Newton's 1st law.

Explain what net force is.

Describe inertia, including the name of the quantity that is a measure of inertia

Describe a normal force

Describe a tension force

Explain what a free body diagram is. Draw and label the free body diagram for a box being pulled across the floor by a rope at an angle θ with the horizontal

Write a statement of Newton's 3rd law. Give an example of an action-reaction pair

Write a statement of Newton's 2nd law using words not equations.

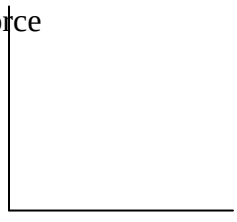
Briefly explain how the 2nd law is used to solve problems when forces act on an object in both the x and y directions.

Draw the shape of each graph which are different expressions of Newton's 2nd law.

constant mass

Force

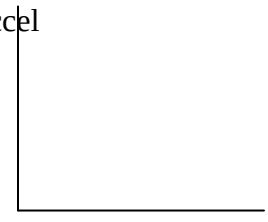
accel



constant force

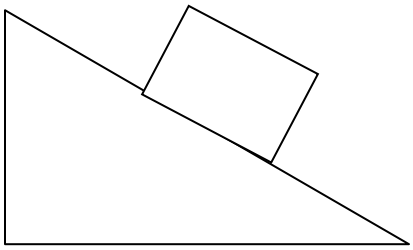
accel

mass



Show how a person's weight is determined using Newton's 2nd law when the person is in an elevator that is being accelerated vertically.

Draw and label the free body diagram for a box sliding down a rough inclined plane. Show clearly how the box's weight vector is resolved into x and y components.



List 5 important facts essential to solving 2-body/pulley problems, either two masses hanging from strings or a mass being pulled across a surface by a mass hanging from a string.

1)

2)

3)

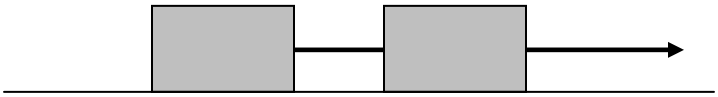
4)

5)

Is the normal force of a table on a box always equal to the box's weight? Yes No

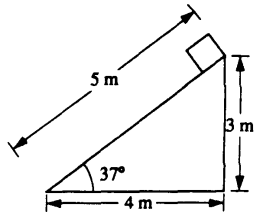
Explain your answer

For two boxes connected by a string and being pulled across a surface by another string is the tension in the string between them equal to the tension in the pulling string? Explain your answer.



No process is required to be shown for these multiple choice questions. Put your answer on the lines provided at right.

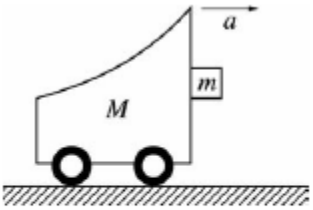
Questions 1 – 2



A plane 5 meters in length is inclined at an angle of 37°, as shown above. A block of weight 20 newtons is placed at the top of the plane and allowed to slide down.

1. The mass of the block is most nearly 1)_____
   (A) 1.0 kg (B) 1.2 kg (C) 1.6 kg (D) 2.0 kg (E) 2.5 kg

2. The magnitude of the normal force exerted on the block by the plane is most nearly
   (A) 10 N (B) 12 N (C) 16 N (D) 20 N (E) 33 N
   2)_____



3) The figure above shows a cart of mass M accelerating to the right with a block of mass m held to the front surface only by friction. The coefficient of friction between the surfaces is μ. What is the minimum acceleration a of the cart such that the block will not fall?

(A) μg

(B) $\frac{g}{\mu}$

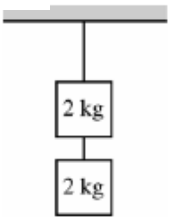
(C) $\frac{gm}{\mu(M+m)}$

(D) $\frac{gM}{\mu(M+m)}$

(E) $\frac{\mu gM}{M+m}$

3)_____

Questions 4-5



Two blocks of wood, each of mass 2 kg, are suspended from the ceiling by strings of negligible mass, as shown above.

4 What is the tension in the upper string?

(A) 10 N
(B) 20 N
(C) 40 N
(D) 50 N
(E) 60 N

4)_____

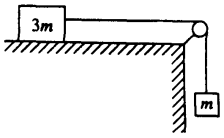
5 What is the force exerted on the upper block by the lower string?

(A) Zero
(B) 10 N upward
(C) 10 N downward
(D) 20 N upward
(E) 20 N downward

5)_____

6. A ball falls straight down through the air under the influence of gravity. There is a retarding force F on the ball with magnitude given by F = *bv*, where *v* is the speed of the ball and *b* is a positive constant. The magnitude of the acceleration a of the ball at any time is equal to which of the following?
(A) g - b (B) g - bv/m (C) g + bv/m (D) g/b (E) bv/m

6)_____



7. A block of mass 3m can move without friction on a horizontal table. This block is attached to another block of mass m by a cord that passes over a frictionless pulley, as shown above. If the masses of the cord and the pulley are negligible, what is the magnitude of the acceleration of the descending block?
(A) Zero (B) g/4 (C) g/3 (D) 2g/3 (E) g

7)_____

8)

8)_____

Three distinct forces are applied to an object, but the object remains stationary. Which of the following must be correct?

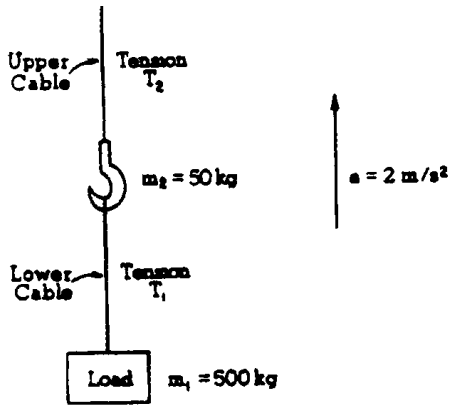
(A) The forces have the same magnitude.
(B) The forces have the same direction.
(C) The forces are perpendicular to each other.
(D) The vector sum of the forces is zero.
(E) The sum of the magnitudes of the forces is zero.

9)

9)_____

A block moving to the right on a level surface with friction is pulled by an increasing horizontal force also directed to the right. As the applied force increases, which of the following is true of the normal force and the frictional force on the block?

	Normal Force	Frictional Force
(A)	Increases	Increases
(B)	Increases	Remains constant
(C)	Remains constant	Increases
(D)	Remains constant	Decreases
(E)	Remains constant	Remains constant



1) A crane is used to hoist a load of mass m_1 = 500 kilograms. The load is suspended by a cable from a hook of mass m_2 = 50 kilograms, as shown in the diagram above. The load is lifted upward at a constant acceleration of 2 m/s^2.

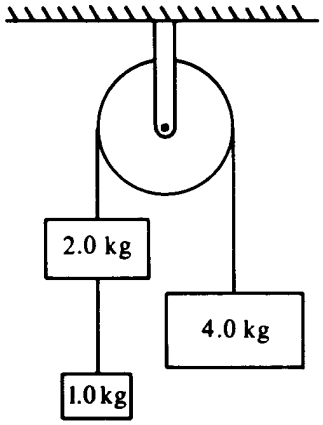
a. On the diagrams below draw and label the forces acting on the hook and the forces acting on the load as they accelerate upward

b. Determine the tension T_1 in the lower cable as the hook and load are accelerated upward at 2 m/s^2. Use g = 10 m/s^2

b)_____

c) determine the tension T_2 in the upper cable as the hook and load are accelerated upward at 2 m/s^2.

c)_____



2) Three blocks of masses 1.0, 2.0, and 4.0 kilograms are connected by massless strings, one of which passes over a frictionless pulley of negligible mass, as shown above. Calculate each of the following.

a. The acceleration of the 4-kilogram block

a)_____

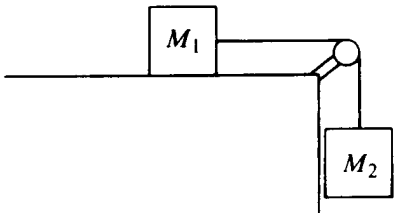
b) The acceleration of the 2 kilogram block b)_____

c. The tension in the string supporting the 4-kilogram block

c)_____

d) The tension in the string connected to the l-kilogram block

d)_____



3) In the system shown above, the block of mass M_1 is on a rough horizontal table. The string that attaches it to the block of mass M_2 passes over a frictionless pulley of negligible mass. The coefficient of kinetic friction μ_k between M_1 and the table is less than the coefficient of static friction μ_s

a. On the diagram below, draw and label all the forces acting on the block of mass M_1.

b. In terms of M_1 and M_2 determine the minimum value of μ_s that will prevent the blocks from moving.

b)_____

The blocks are set in motion by giving M_2 a momentary downward push. In terms of M_1, M_2, μ_k, and g, determine each of the following:

c. The magnitude of the acceleration of M_1

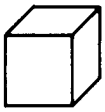
c)_____

d. The tension in the string.

d)_____

4) A helicopter holding a 70-kilogram package suspended from a rope 5.0 meters long accelerates upward at a rate of 5.2 m/s^2. Neglect air resistance on the package.

a. On the diagram below, draw and label all of the forces acting on the package.

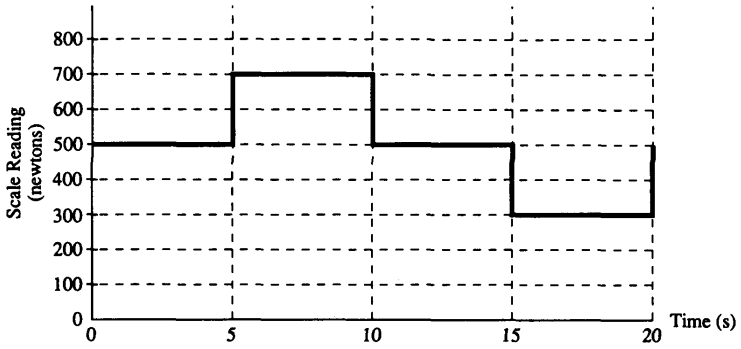


b. Determine the tension in the rope.

b)_____

c. When the upward velocity of the helicopter is 30 meters per second, the rope is cut and the helicopter continues to accelerate upward at 5.2 m/s^2. Determine the distance between the helicopter and the package 2.0 seconds after the rope is cut.

c)_____



5) A student whose normal weight is 500 newtons stands on a scale in an elevator and records the scale reading as a function of time. The data are shown in the graph above. At time t = 0, the elevator is at displacement x = 0 with velocity v = 0. Assume that the positive directions for displacement, velocity, and acceleration are upward.

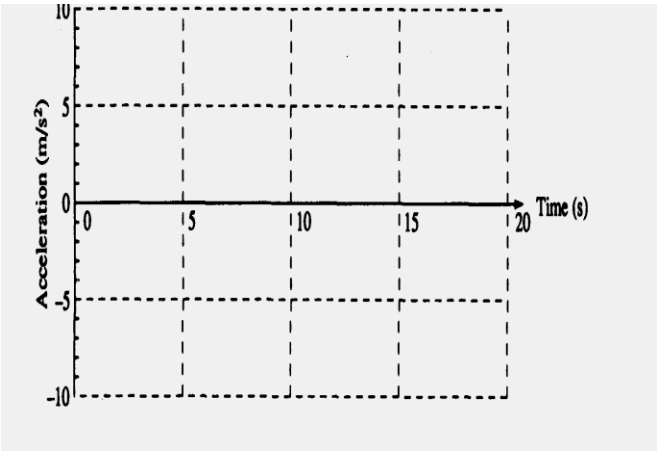
a. On the diagram below, draw and label all of the forces on the student at t = 8 seconds.

b. Calculate the acceleration a of the elevator for each 5-second interval.

i. Indicate your results by completing the following table.

Time Interval (s)	0-5	5-10	10-15	15-20
a (m|s^2)	_____	_____	_____	_____

ii. Plot the acceleration as a function of time on the following graph.

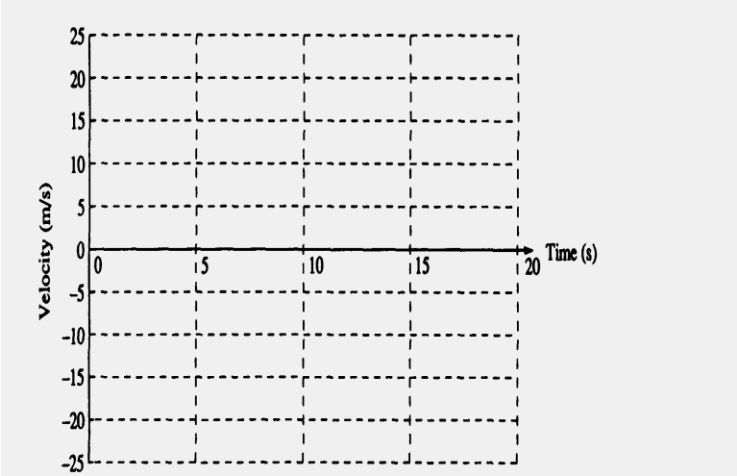


c. Determine the velocity v of the elevator at the end of each 5-second interval.

i. Indicate your results by completing the following table.

Time (s)	0-5	5-10	10-15	15-20
v (m| s)	_____	_____	_____	_____

ii. Plot the velocity as a function of time on the following graph.



d. Determine the displacement x of the elevator above the starting point at the end of each 5-second interval.

i. Indicate your results by completing the following table

Time (s)	0-5	5-10	10-15	15-20
x (m)	_____	_____	_____	_____

ii. Plot the displacement as a function of time on the following graph.