AP Physics 1 Multiple Choice Questions - Chapter 4

1 Which of Newton's Three Laws of Motion is best expressed by the equation F=ma?

a Newton's First Law

b Newton's Second Law

c Newton's Third Law

d None of the above

4.1

2 A person is running on a track. Which of the following forces propels the runner forward?

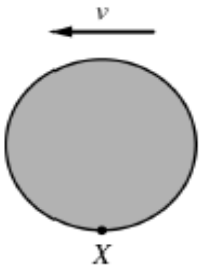
a The normal force exerted by the ground on the person

b The normal force exerted by the person on the ground

c The force of friction exerted by the ground on the person

d The force of friction exerted by the person on the ground

4.1



Top View

4.1

3 A stone disk is sliding on frictionless ice to the west with speed v, as shown in the figure above. As the disk slides by, a child uses a rubber mallet to hit the disk at point X, exerting a force directly toward the center of the disk. The child hits point X every half second for about 10 seconds, changing the trajectory of the disk but not causing it to rotate. Which of the folllowing most closely approximates the path of the disk while the child is hitting it?

(A)  A northward linear path

(B)  A northwestward linear path

(C)  A parabolic path

(D)  A circular path

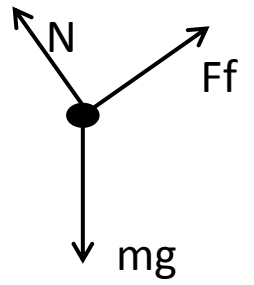
AP Physics 1 Multiple Choice Questions - Chapter 4

1 Which of the following free body diagrams best represents the situation described below?

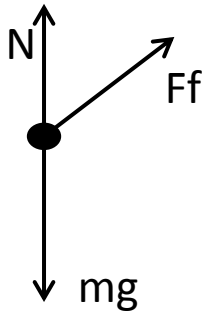
A crate sits on a rough (friction) inclined plane

4.2

a



b



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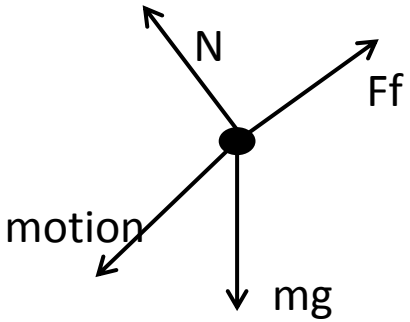

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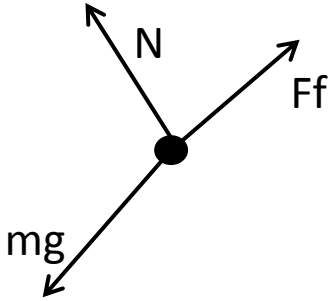
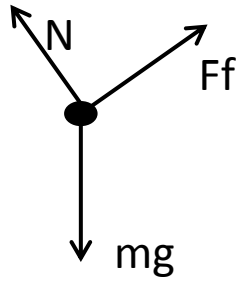


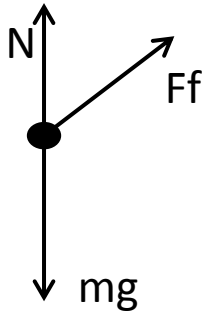
2 Which of the following free body diagrams best represents the situation described below?
A crate slides down a rough (friction) inclined plane

4.2

a



b



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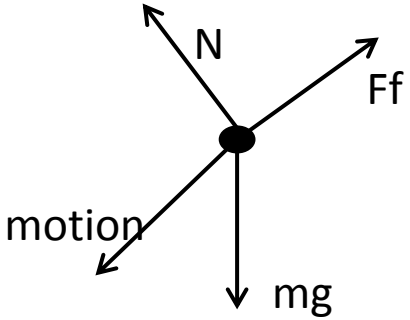

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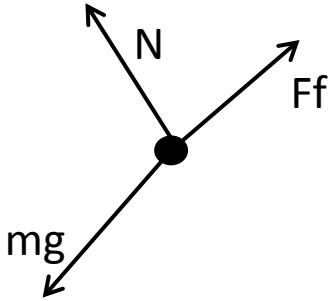
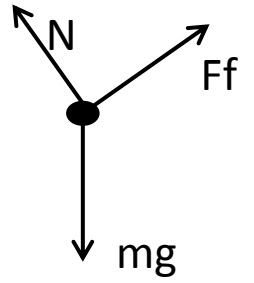


2 Which of the following free body diagrams best represents the situation described below?
A crate is pushed down a rough (friction) inclined plane

4.2

a



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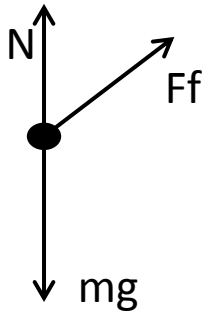

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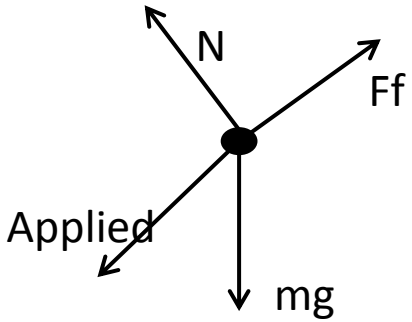

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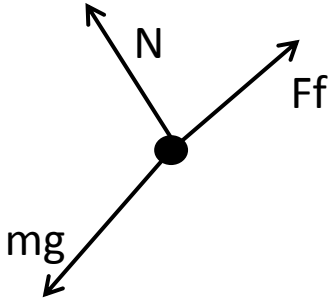


AP Physics 1 Multiple Choice Questions - Chapter 4

1 Calculate the force needed to accelerate a 5.5 kg object at 9.5 m/s^2.

a 54.0 N
b 57.5 N
c 52.3 N
d 49.2 N
e 0.0523 N

4.3

2 A stone of mass *m* is thrown upward at a 30° angle to the horizontal. At the instant the stone reaches its highest point, why is the stone neither gaining nor losing speed?

a Because the acceleration of the stone at that instant is zero
b Because the net force acting upon the stone at that instant has magnitude *mg*
c Because the angle between the stone's velocity and the net force exerted upon the stone is 90°
d Because the stone follows a parabolic trajectory and the peak of the trajectory is where the parabola has zero slope

4.3

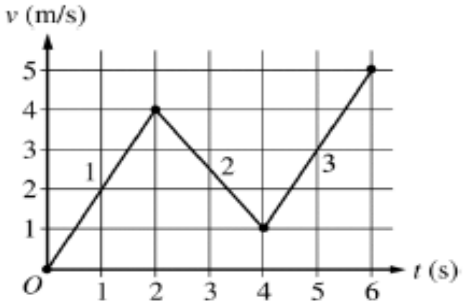
Speed	10 m/s	20 m/s	30 m/s
Breaking Distance	6.1 m	23.9 m	53.5 m

3 To analyze the characteristics and performance of the brakes on a 1500 kg car, researchers collected the data shown in the table above. It shows the car's speed when the brakes are first applied and the corresponding braking distance required to stop the car. The magnitude of the average braking force on the car is most nearly

a 75 000 N
b 30 000 N
c 12 000 N
d 1 600 N

4.3

4.3



4 The graph above shows velocity v as a function of time t for a 0.50 kg object traveling along a straight line. The graph has three segments labeled 1, 2, and 3. A rope exerts a constant force of magnitude F_T on the object along its direction of motion the whole time. During segment 2 only, a frictional force of magnitude F_f is also exerted on the object.

Which of the following correctly ranks the displacement Δx for the three segments of the object's motion?

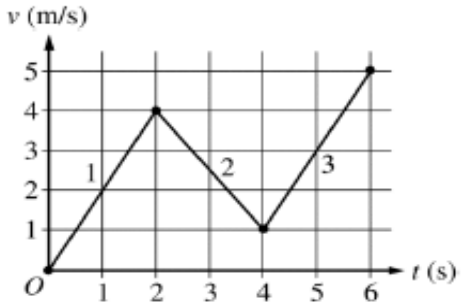
a $\Delta x_3 > \Delta x_2 > \Delta x_1 > 0$

b $\Delta x_1 = \Delta x_2 = \Delta x_3 > 0$

c $(\Delta x_1 = \Delta x_3) > \Delta x_2 > 0$

d $(\Delta x_1 = \Delta x_3) > 0 > \Delta x_2$

4.3



5 The graph above shows velocity v as a function of time t for a 0.50 kg object traveling along a straight line. The graph has three segments labeled 1, 2, and 3. A rope exerts a constant force of magnitude F_T on the object along its direction of motion the whole time. During segment 2 only, a frictional force of magnitude F_f is also exerted on the object.

Which of the following expressions correctly relates magnitudes F_f and F_T?

a $F_f < F_T$

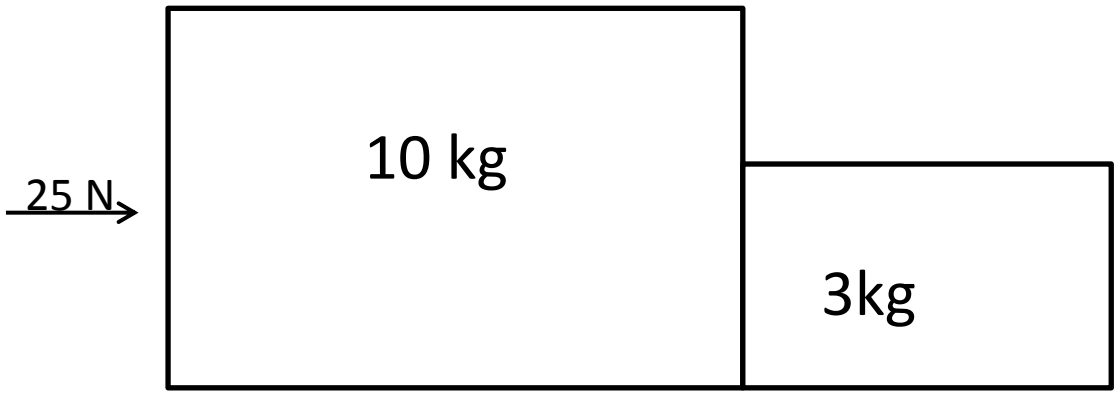
b $F_f = F_T$

c $F_T < F_f < 2\,F_T$

d $F_f = 2\,F_T$

AP Physics 1 Multiple Choice Questions - Chapter 4

1 Consider the two-block system below:



4.4

Calculate the acceleration of the system

a 2.5 m/s^2

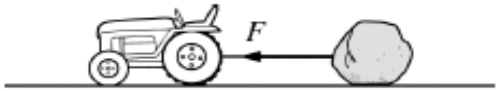
b 3.11 m/s^2

c 1.68 m/s^2

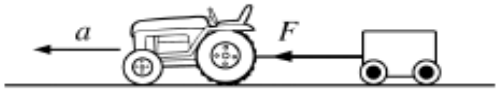
d 2.25 m/s^2

e 1.92 m/s^2

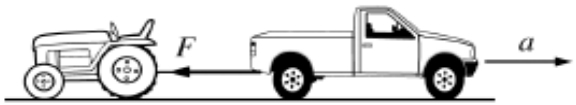
4.4



Boulder: Force F to the left
No acceleration



Wagon: Force F to the left
Acceleration a to the left



Truck: Force F to the left
Acceleration a to the right

2 Each of the figures above shows a tractor attached to an object. The tractor exerts the same constant force F on each object in every case. Which of the following is a true statement about an object and the relative magnitude of the force exerted by the object on the tractor?

a The magnitude of the force exerted by the truck on the tractor is greatest, because the resulting motion is in the direction opposite the tractor's pull

b The magnitude of the force exerted by the boulder on the tractor is least, because no motion results

c The magnitude of the force exerted by the wagon on the tractor is least, because the resulting motion is in the direction of the tractor's pull.

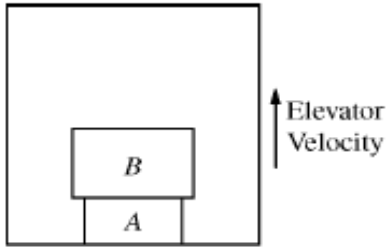
d The magnitude of the force exerted by each object on the tractor is equal, because the tractor exerts an equal force on each object.

3 Block A and block B move toward each other on a level frictionless track. Block A has mass m and velocity $+v$. Block B has mass $2m$ and velocity $-v$. The blocks collide, and during the collision the magnitude of the net force exerted on block A is F. What is the magnitude of the net force exerted on block B, and why does it have that value?

4.4

a $2F$, because the mass of block B is twice that of block A and the blocks have the same acceleration during the collision
b $F/2$, because the mass of block B is twice that of block A and the blocks have the same acceleration during the collision
c F, because the blocks have the same speed immediately before the collision
d F, because the net force is equal to the mutual contact force between the blocks

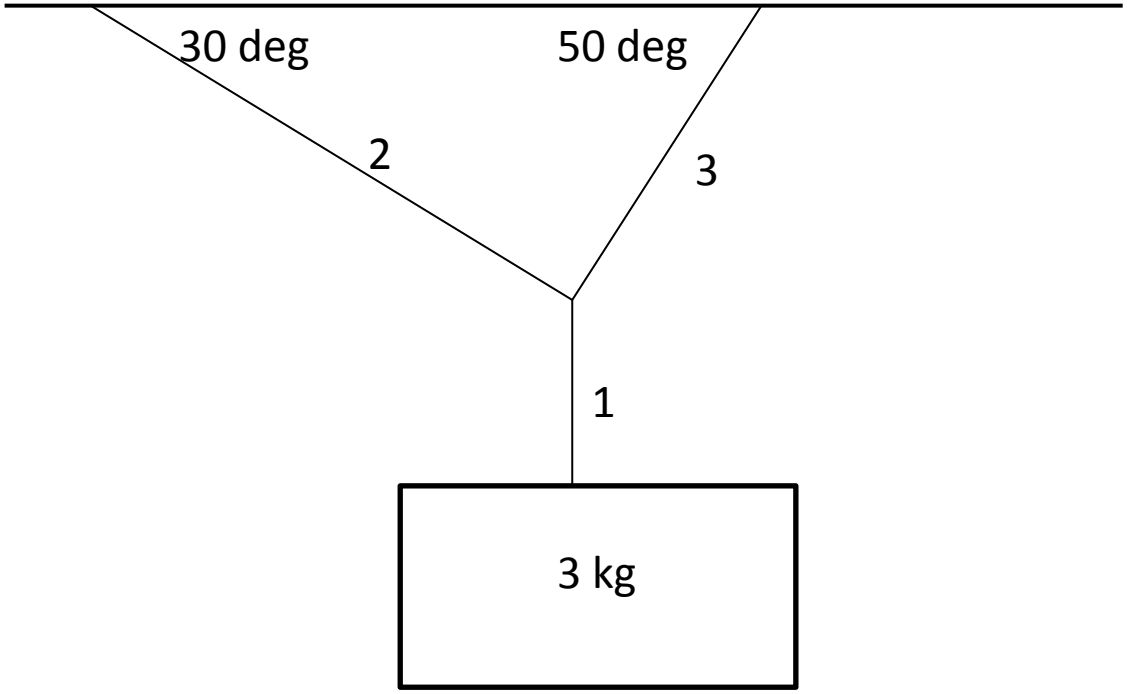
4.4



4 Box A of mass m sits on the floor of an elevator, with box B of mass $2m$ on top of it, as shown in the figure above. The elevator is moving upward and slowing down. F_A is the magnitude of the force exerted on box A by box B, F_B is the magnitude of the force exerted on box B by box A, and F_g is the magnitude of the gravitational force exerted on box B. Which of the following ranks the forces in order of increasing magnitude?

a $F_B = F_A = F_g$
b $(F_B = F_A) < F_g$
c $F_B < (F_A = F_g)$
d $F_g < F_B < F_A$

1 Consider the situation below:



4.5

Calculate the tension in the second rope.

a 17.1 N

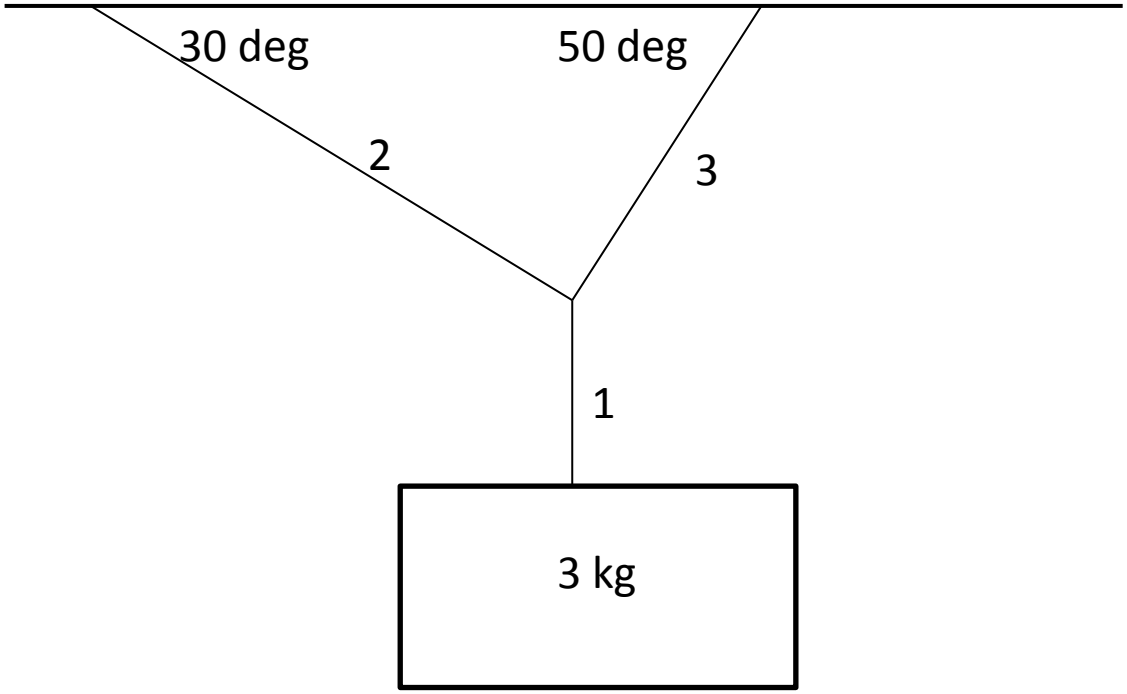
b 25.86 N

c 5.8 N

d 19.2 N

4.5

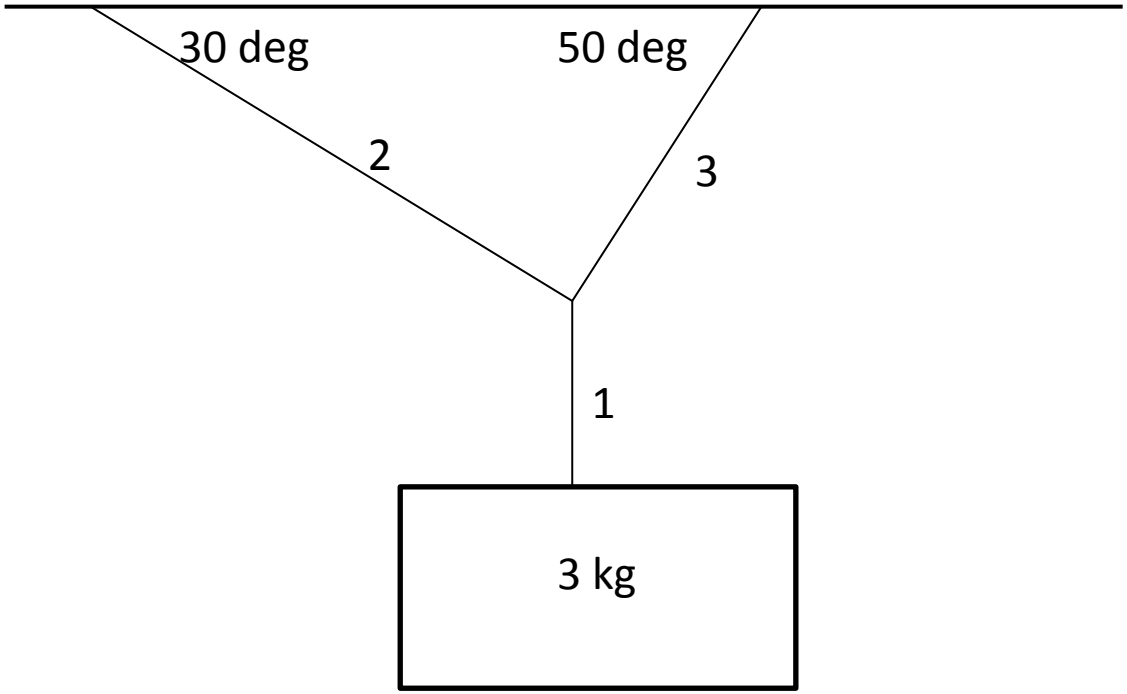
2 Consider the situation below:



Calculate the tension in the first rope.

a 17.1 N
b 25.86 N
c 5.8 N
d 19.2 N

3 Consider the situation below:



4.5

Calculate the tension in the third rope.

a 30.25 N

b 25.86 N

c 23.26 N

d 19.2 N

AP Physics 1 Multiple Choice Questions - Chapter 4

1 A ladder at rest is leaning against a wall at an angle. Which of the following forces must have the same magnitude as the frictional force exerted on the ladder by the floor?

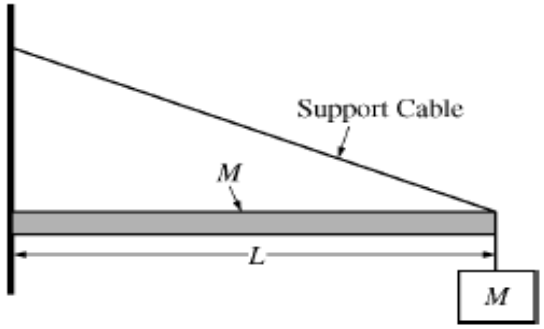
a The force of gravity on the ladder

b The normal force exerted on the ladder by the floor

c The frictional force exerted on the ladder by the wall

d The normal force exerted on the ladder by the wall

	4.6



	4.6

2 The figure above shows a uniform beam of length L and mass M that hangs horizontally and is attached to a vertical wall. A block of mass M is suspended from the far end of the beam by a cable. A support cable runs from the wall to the outer edge of the beam. Both cables are of negligible mass. The wall exerts a force F_w on the left end of the beam. For which of the following actions is the magnitude of F_w the smallest?

a Keeping the support cable and block as shown in the diagram

b Moving the lower end of the support cable to the center of the beam and leaving the block at the outer end of the beam

c Keeping the lower end of the support cable at the outer end of the beam and moving the block to the center of the beam

d Moving both the support cable and the block to the center of the beam

3 An object starts from rest and slides with negligible friction down an air track tipped at an angle Θ with the horizontal. A student records values of the object's position along the track at various times. The value of Θ can best be determined from which of the following?

4.6

a The y-intercept of a graph of position as a function of time
b The y-intercept of a graph of position as a function of the square of time
c The slope of a graph of position as a function of time
d The slope of a graph of position as a function of the square of time

AP Physics 1 Multiple Choice Questions - Chapter 4

1 A block of mass 5 kg sits on a flat rough table with a coefficient of static friction of 0.30. What is the minimum applied force needed to begin moving the block?

4.7

a 49.5 N
b 14.7 N
c 143 N
d 1.5 N

2 A block of mass 10 kg sits on a flat rough table with a coefficient of static friction of 0.45 and a coefficient of kinetic friction of 0.35. A force is 35 N is applied. Does the block move and, if so, what is its acceleration?

4.7

a The block does not move
b $a = 0.45\ m/s^2$
c $a = 0.67\ m/s^2$
d $a = 1.2\ m/s^2$

2 A block of mass 10 kg sits on a flat rough table with a coefficient of static friction of 0.45 and a coefficient of kinetic friction of 0.35. A force is 75 N is applied. Does the block move and, if so, what is its acceleration?

4.7

a The block does not move
b $a = 1.95\ m/s^2$
c $a = 3.09\ m/s^2$
d $a = 4.07\ m/s^2$

AP Physics 1 Multiple Choice Questions - Chapter 4

1 A small cart is rolling freely on an inclined ramp with a constant acceleration of 0.50 m/s^2 in the x-direction. At time t = 0, the cart has a velocity of 2.0 m/s in the +x-direction.

If the cart never leaves the ramp, which of the following statements correctly describes the motion of the cart at a time t > 5 seconds?

a The cart is traveling in the +x direction and is slowing down
b The cart is traveling in the +x direction and is speeding up
c The cart is traveling in the -x direction and is slowing down
d The cart is traveling in the -x direction and is speeding up

4.8

2 A block of mass 15 kg is being pushed across a flat, rough surface and is accelerating at a rate of 2.5 m/s^2. If the coefficient of kinetic friction is 0.25, what is the magnitude of the applied force pushing the block?

a 75.3 N
b 37.5 N
c 152.5 N
d 135.2 N

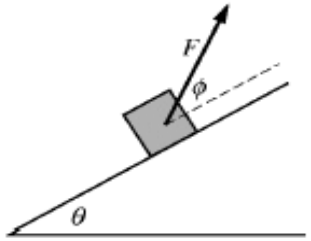
4.8

3 A block of mass 5 kg is subject to a force of 50. N and begins to accelerate across a flat, rough surface at a rate of 1.5 m/s^2. What is the coefficient of kinetic friction between the block and the surface?

a 0.57
b 0.87
c 0.45
d 0.92

4.8

4.9



1 A box of mass *m* is on a rough inclined plane that is at an angle Θ with the horizontal. A force of magnitude *F* at an angle Φ with the plane is exerted on the block, as shown above. As the block moves up the inclined plane, there is a frictional force between the box and the plane of magnitude *f*. What is the magnitude of the net force acting on the box?

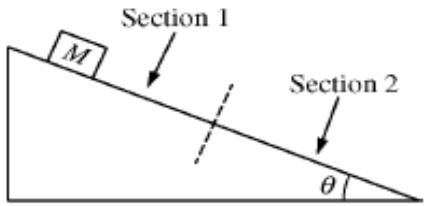
a *F sin* Φ - *mg cos* Θ - f

b *F cos(Φ+ Θ) + mg sin Θ - f*

c *F cos* Φ - *mg sin* Θ - *f*

d *F cos(Φ+ Θ) - mg sin Θ - f*

4.9



2 The inclined plane in the figure above has two sections of equal length and different roughness. The dashed line shows where section 1 ends and section 2 begins. A block of mass *M* is placed at different locations on the incline. The coefficients of kinetic and static friction between the block and each section are shown in the table below.

Coefficient of Friction	Section 1	Section 2
Static	μ_{S1}	$\mu_{S2} (> \mu_{S1})$
Kinetic	μ_k	$2\mu_k$

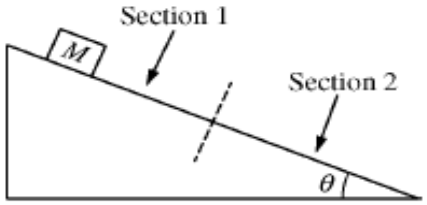
If the block is at rest on section 1 of the incline, what is the magnitude of the force of static friction exerted on the block by the incline?

a μ_{s1} *Mgcos* θ

b μ_{s1} *Mgtan* θ

c *Mgsin* θ

d *Mg/tan* θ



4.9

3 The inclined plane in the figure above has two sections of equal length and different roughness. The dashed line shows where section 1 ends and section 2 begins. A block of mass *M* is placed at different locations on the incline. The coefficients of kinetic and static friction between the block and each section are shown in the table below.

Coefficient of Friction	Section 1	Section 2
Static	μ_{S1}	$\mu_{S2} (> \mu_{S1})$
Kinetic	μ_k	$2\mu_k$

If the block is sliding up section 2, what is the magnitude of the force of friction that is exerted on the block by the incline?

a $2\mu_k Mg\cos\theta$

b $2\mu_k Mg\tan\theta$

c $Mg\sin\theta$

d $Mg/\tan\theta$