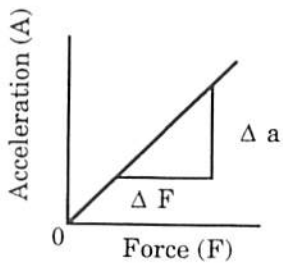
5 A lamp placed on a table has a mass of 2 kilograms. What force does the table exert on the lamp?
(1) 0. N (2) 2 kg (3) 20. N (4) 40. N

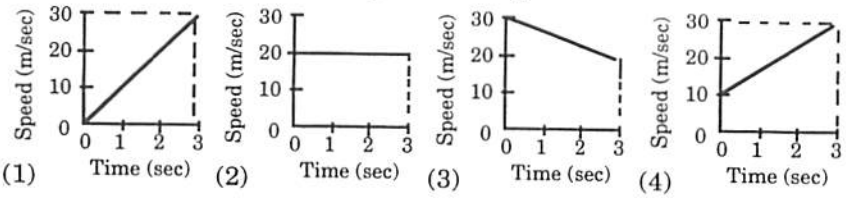
6 Two frictionless blocks, having masses of 8.0 kilograms and 2.0 kilograms, rest on a horizontal surface. If a force applied to an 8.0 kilogram block gives it an acceleration of 5.0 m/s^2, then the same force will give the 2.0 kilogram block an acceleration of
(1) 1.2 m/s^2 (2) 2.5 m/s^2 (3) 10. m/s^2 (4) 20. m/s^2

7 A car on which there is no accelerating force
(1) must be at rest
(2) may be in motion
(3) is speeding up
(4) is slowing down

8 The graph shows the relationship between the acceleration of an object and the unbalanced force producing the acceleration. The ratio ($\Delta F/\Delta a$) of the graph represents the object's
(1) mass
(2) momentum
(3) kinetic energy
(4) displacement



9 Which object had the retarding force acting on it?

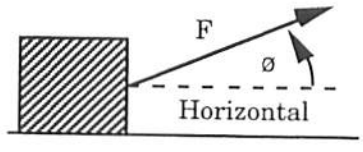


10 An 800. newton person is standing in an elevator. If the upward force of the elevator on the person is 600. newtons, the person is
(1) at rest
(2) accelerating upward
(3) accelerating downward
(4) moving downward at constant speed

11 A table exerts a 2.0 newton force on a book lying on the table. The force exerted by the book on the table is
(1) 20. N (3) 0.20 N
(2) 2.0 N (4) 0. N

12 A force F newtons gives an object with mass M, an acceleration of A. The same force F will give a second object with mass of 2 M, an acceleration of
(1) A/2 (2) 2A (3) A (4) A/4

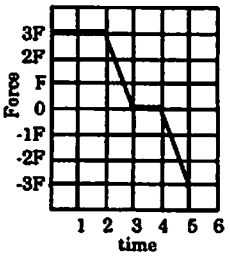
13 The diagram represents a constant force F acting on a box located on a frictionless horizontal surface. As the angle between the force and the horizontal increases, the acceleration of the box will
(1) decrease
(2) increase
(3) remain the same



14 An elevator containing a man weighing 800 newtons is rising at a constant speed. The force exerted by the man on the floor of the elevator is
(1) less than 80 N (3) 800 N
(2) between 80 and 800 N (4) more than 800N

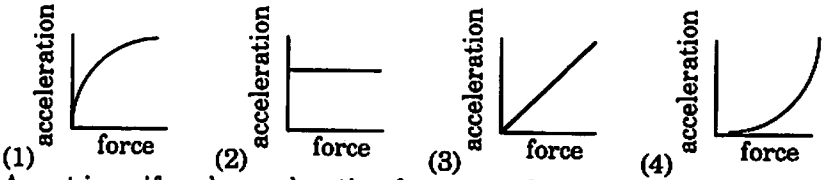
15 When an object is moving with constant velocity, which is true?
(1) An unbalanced force is acting.
(2) The object is being accelerated.
(3) The object is undergoing a change in momentum.
(4) The vector sum of all the forces acting on the object is zero.

16 The graph represents the net force acting on an object as a function of time. During which time interval is the velocity of the object constant?
(1) 0 to 2
(2) 2 to 3
(3) 3 to 4
(4) 4 to 5



17 An object accelerates at 2.5 meters per second squared, when an unbalanced force of 10 newtons acts on it. What is the mass of the object?
(1) 1.0 kg (2) 2.0 kg (3) 3.0 kg (4) 4.0 kg

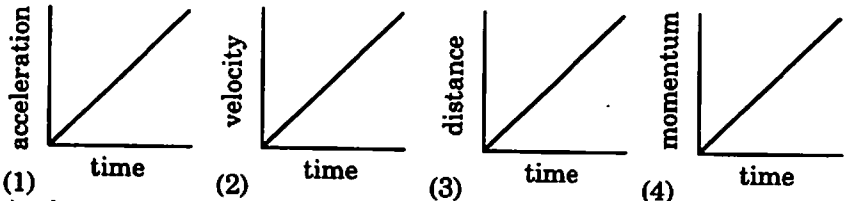
18 Which graph best represents the relationship between the acceleration and the unbalanced force applied to an object?



19 A cart is uniformly accelerating from rest. The net force acting on the cart is
(1) decreasing (2) zero (3) constant (4) increasing

20 An object weighing 4 N rests on a horizontal table. The force of the tabletop on the object is
(1) 0.0 N (3) 4.0 N downward
(2) 4.0 N horizontally (4) 4.0 N upward

21 Which graph best represents an object in equilibrium?



22 As the vector sum of all the forces on an object increases, the acceleration of the object
(1) decreases (2) increases (3) remains the same

23 If the mass of a moving object was doubled, its inertia would be
(1) halved (2) doubled (3) unchanged (4) quadrupled

The force of friction decreases as the angle increases since:

$$F_f = \text{Force of friction} = (\mu)F_1 = (\mu)W \cos \text{Ø}$$

F_2 is pushing the block down the ramp. It is calculated from:

$$\sin \text{Ø} = F_2 / \text{weight} \quad \text{or} \quad F_2 = W \sin \text{Ø}$$

As the angle increases, the component of the force pushing the block down the ramp increases. F_2 increases; F_1 decreases. When one tries to push the block up the ramp, friction acts in a downhill direction. The uphill force to move the block must overcome F_2 and friction (F_f).

The block will slide down by itself, if $F_2 > F_f$. The force necessary to push the block up is $F_2 + F_f = F$.

When the force applied is greater than the force of friction, the object will accelerate according to Newton's 2nd Law.

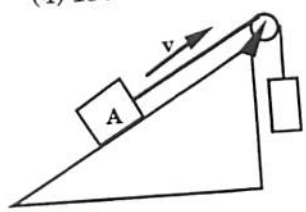
Questions

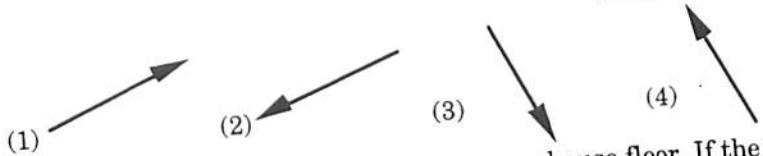
1 A 500 - newton box rests on a horizontal surface. A force of 50 newtons parallel to the surface is required to start the box moving. What is the maximum coefficient of static friction between the box and the surface?
(1) 0.1 (2) 10 (3) 0.5 (4) 25,000

2 In order to keep an object weighing 20. newtons moving at constant speed along a horizontal surface, a force of 10. newtons is required. The force of friction between the surface and the object is
(1) 0 N (2) 10. N (3) 20. N (4) 30. N

3 A constant unbalanced force acts on a 15.0 kilogram mass moving along a horizontal surface at 10.0 meters per second. If the mass is brought to rest in 1.50 seconds, what is the magnitude of the force of friction?
(1) 10.0 N (2) 100. N (3) 147 N (4) 150. N

4 Block A is pulled with constant velocity up an incline as shown in the diagram. Which arrow best represents the direction of the force of friction acting on block A?

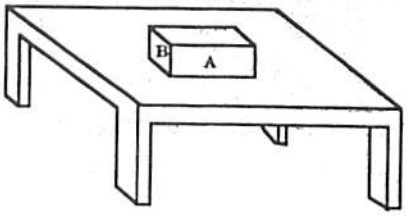




5 An empty wooden crate is slid across a warehouse floor. If the crate were filled, the coefficient of kinetic friction between the crate and the floor would
(1) decrease (2) increase (3) remain the same

6 An empty wooden crate is slid across a warehouse floor. If the crate were filled, the force of kinetic friction between the crate and the floor would
(1) decrease (2) increase (3) remain the same

34 In the diagram at the right, surface A of the wooden block has twice the area of surface B. If it takes F newtons to keep the block moving at a constant speed across the table when it slides on surface A, what force is needed to keep the block moving at constant speed when it slides on surface B?



(1) F (2) $2F$ (3) $\frac{1}{2}F$ (4) $4F$

35 The table at the right lists the coefficients of kinetic friction for four materials sliding over steel. A 10.-kilogram block of each of the materials in the table is pulled horizontally across a steel floor at constant velocity. Which block would require the *smallest* applied force to keep it moving at constant velocity?

(1) brass (3) steel
(2) copper (4) wood

Material	μ_k
brass	0.44
copper	0.36
steel	0.57
wood	0.32

CHAPTER 3 REVIEW QUESTIONS

1. A person standing on a horizontal floor feels two forces: the downward pull of gravity and the upward supporting force from the floor. These two forces

   (A) have equal magnitudes and form an action/reaction pair.
   (B) have equal magnitudes but do not form an action/reaction pair.
   (C) have unequal magnitudes and form an action/reaction pair.
   (D) have unequal magnitudes and do not form an action/reaction pair.
   (E) None of the above

2. A person who weighs 800 N steps onto a scale that is on the floor of an elevator car. If the elevator accelerates upward at a rate of 4.9 m/s², what will the scale read?

   (A) 400 N
   (B) 800 N
   (C) 1000 N
   (D) 1200 N
   (E) 1600 N

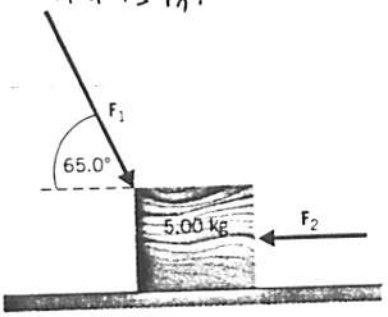
3. A frictionless inclined plane of length 20 m has a maximum vertical height of 5 m. If an object of mass 2 kg is placed on the plane, which of the following best approximates the net force it feels?

   (A) 5 N

Extra Review

11. Two forces, $\mathbf{F}_1$ and $\mathbf{F}_2$, act on the 5.00-kg block shown in the drawing. The magnitudes of the forces are $F_1 = 45.0$ N and $F_2 = 25.0$ N. What is the horizontal acceleration (magnitude and direction) of the block?

What is F_N?



14. Two skaters, an 82-kg man and a 48-kg woman, are standing on ice. Neglect any friction between the skate blades and the ice. The woman pushes on the man with a force of 45 N due east. Determine the accelerations (magnitude and direction) of the man and the woman.

15. A water-skier of mass 49 kg is being pulled due south by a horizontal towrope. The rope exerts a force of 228 N, due south. The water and air exert a combined frictional force of 165 N that is directed due north. What is the magnitude and direction of the skier's acceleration?

39. A woman stands on a scale in a moving elevator. Her mass is 60.0 kg, and the combined mass of the elevator and scale is an additional 815 kg. Starting from rest, the elevator accelerates upward. During the acceleration, there is a tension of 9410 N in the hoisting cable. What is the reading on the scale during the acceleration?

40. A person exerts a horizontal force of 267 N in attempting to push a freezer across a room, but the freezer does not move. What is the static frictional force that the floor exerts on the freezer?

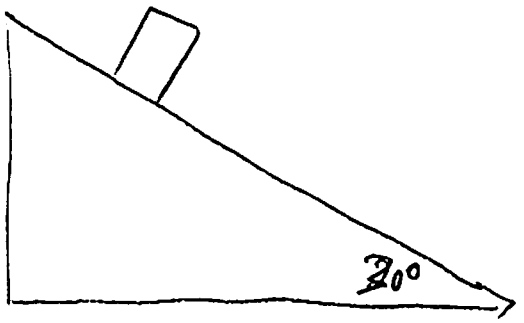
41. A block whose weight is 45.0 N rests on a horizontal table. A horizontal force of 36.0 N is applied to the block. The coefficients of static and kinetic friction are 0.650 and 0.420, respectively. Will the block move under the influence of the force, and, if so, what will be the block's acceleration? Explain your reasoning.

50. A water-skier (mass = 89 kg) is being pulled at a constant velocity. The horizontal pulling force is 350 N. Find (a) the magnitude of the total resistive force exerted on the skier by the water and air and (b) the magnitude of the upward force exerted on the skier by the water.

72. A student is skateboarding down a ramp that is 6.0 m long and inclined at 18° with respect to the horizontal. The initial speed of the skateboarder at the top of the ramp is 2.6 m/s. Neglect friction and find the speed at the bottom of the ramp.

•80. A 205-kg log is pulled up a ramp by means of a rope that is parallel to the surface of the ramp. The ramp is inclined at 30.0° with respect to the horizontal. The coefficient of kinetic friction between the log and the ramp is 0.900, and the log has an acceleration of 0.800 m/s². Find the tension in the rope.

$m = 40kg$



Find a_x if

a) no other forces act

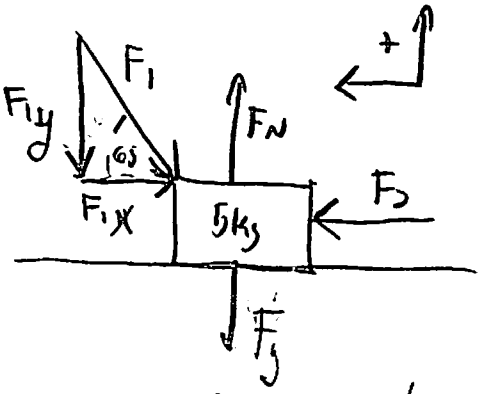
b) $F_{app} = 800N$ up hill

c) $F_{app} = 200N$ down hill

d) $\mu_K = 0.2$

Extra Review Answer Key

11)



$F_1 = 45N$

$F_2 = 25N$

$F_{1x} = 45N \cos 65$

$= 19N$

$F_{1y} = 45N \sin 65°$

$= 40.8N$

$F_{Net_x} = F_2 - F_{1x}$

$= 25N - 19N$

$= 6N$

$ma_x = 6N$

$a_x = \frac{6N}{5kg} = 1.2 \frac{m}{s^2}$ left

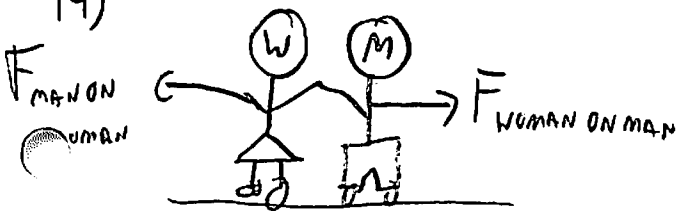
$F_{Net_\perp} = (F_N) + (-F_g) + (F_{1y})$

$0 = F_N - F_g - F_{1y}$

$F_N = F_g + F_{1y} = 49N + 40.8N$

$F_N = 89.8N$

14)



By Newton's 3rd law

$|F_{man\ on\ woman}| = |F_{woman\ on\ man}| = 45N$

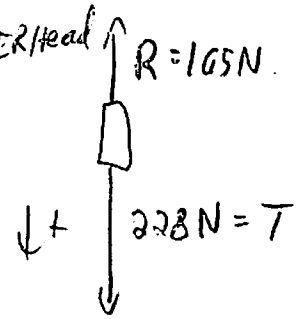
$F_{net\ on\ man} = F_{woman\ on\ man} = 45N\ East$

$\therefore a_{man} = \frac{45N\ East}{82kg} = 0.55 \frac{m}{s^2}$ east (MAN)

$F_{net\ on\ woman} = F_{man\ on\ woman} = 45N\ west$

$\therefore a_{woman} = \frac{45N\ west}{48kg} = 0.94 \frac{m}{s^2}$ west (WOMAN)

15)



$m = 49kg$

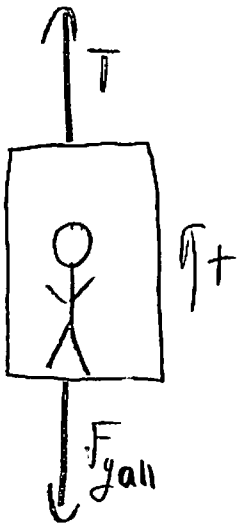
$\therefore F_{net} = 228N - 165N$

$= 63N$

$\therefore a_{\square} = 63N / 45kg$

$a = 1.4 \frac{m}{s^2}$ south

39



Given
$T = 9410N$
$m_w = 60kg$
$m_{ele} = 815kg$

$F_{g\,all} = (m_{woman} + m_{elevator})\,g$
$= (875kg)(9.8\,m/s^2)$
$= 8575N$

If the woman is in elevator, she must have same acceleration

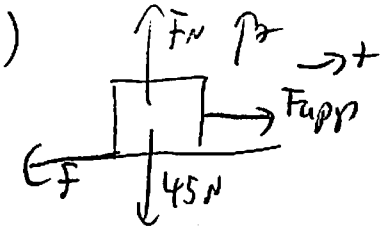
For elevator
$F_{ny} = ma_y$
$F_{net} = T - F_{g\,all}$
$= 9410N - 8575N$
$= 835N$
$ma = 835N$ $\quad a = 0.954\,m/s^2$
$(875kg)\,a = 835N$

For woman
$F_{net} = F_N - F_{g\,woman}$
$ma = F_N - m_w g$
$(60kg)(0.954\,m/s^2) = F_N - (60kg)(9.8\,m/s^2)$
$\boxed{F_N = 645.2N}$ $\Rightarrow F_N$ = reading on scale.

40) If $F_{app} < f_{s\,MAX}$ → no move. & $f_s = F_{app}$.

In this case → no move so $F_{app} < f_{s\,MAX}$ $\therefore \boxed{f_s = 267N}$

41)



$F_{net_\perp} = ma_y$
$F_N + (-F_g) = ma_y$ (0)
$F_N = F_g = 45N$
$\mu_K = 0.42$
$\mu_S = 0.65$
$F_g = 45N$
$m = 4.6kg$

$f_K = \mu_K F_N =$
$= (0.42)(45N)$
$= 18.9N$

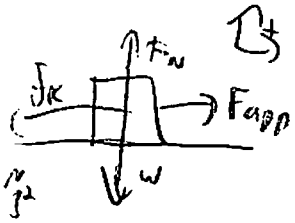
$f_{s\,MAX} = \mu_S F_N$
$= (0.65)(45N)$
$= 29.25N$

$F_{app} = 36N$
→ since $F_{app} > f_{s\,max}$ ⇒ moves!
$F_{net_x} = ma_x$
$\therefore F_{net_x} = F_{app} - f_K$
$= 36N - 18.9N$
$ma_x = 17.1N$
$\boxed{a_x = \frac{17.1N}{4.6kg} = 3.72\,m/s^2}$

50) CONSTANT VELOCITY! $a = 0$, $F_{net_x} = 0$

$m = 89\,kg$ $\therefore F_{app} = f_K = 350N$

a) $\boxed{f_K = 350N}$



$F_{net_y} = ma_y$ $F_{net_x} = ma_x$

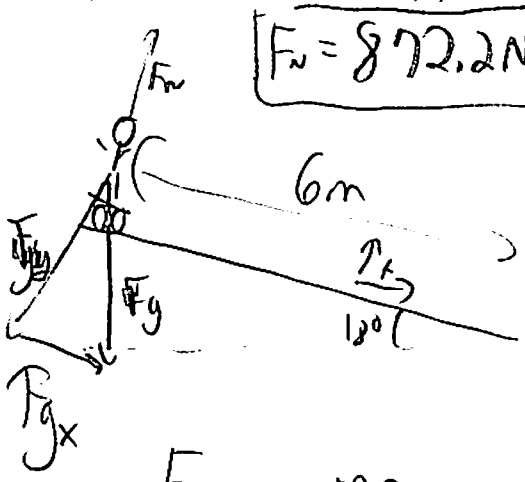
$F_N - F_g = 0$ $F_{app} - f_k = 0$

$F_N = F_g$ $F_{app} = f_K$

b) $F_N = F_g = (89kg)(9.8\frac{m}{s^2})$

$\boxed{F_N = 872.2N}$

72)



$V_0 = 2.6\frac{m}{s}$

$\Delta s = 6m$.

$\therefore V_f^2 = V_0^2 + 2a\Delta s$

$= (2.6\frac{m}{s})^2 + 2(3.03\frac{m}{s^2})(6m)$

$= 6.76 + 36.36$

$V_f^2 = 43.12$

$\boxed{V_f = 6.6\frac{m}{s}}$

$F_{net_x} = ma_x$ (since only weight acts, & F_N must doesn't affect acceleration)

$+F_{gx} = ma_x$

$\therefore ma_x = mg\sin\theta$

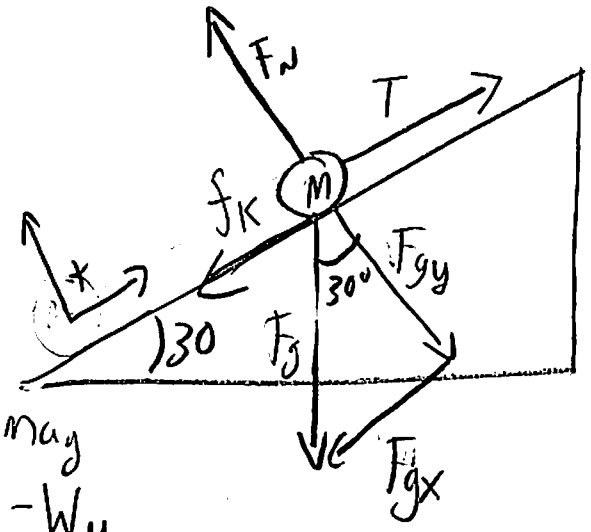
$a_x = g\sin\theta$

$= (9.8\frac{m}{s^2})(\sin 18)$

$= 3.03\frac{m}{s^2}$

80)

$\mu_K = 0.9$



$M = 205 kg$

$F_g = Mg = (205kg)(9.8 m/s^2)$
$= 2009N$

$F_{gx} = F_g \sin 30$
$= 1004.5N$

$F_{gy} = F_g \cos 30$
$= 1739.8N$

$a = 0.80 m/s^2$ (up incline assume) problem should be specific!

$F_{net_y} = ma_y$

$F_{Net_y} = F_N - W_y$

$\emptyset = F_N - W_y$

$F_N = W_y = 1739.8N$

$f_K = \mu_K F_N = (0.9)(1739.8N)$
$= 1565.8N$

$F_{net_x} = ma_x$

$F_{Net_x} = T - F_{gx} - f_K$

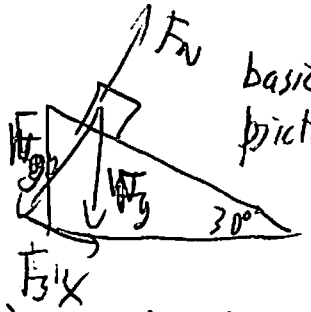
$ma_x = T - F_{gx} - f_K$

$(205kg)(0.80 m/s^2) = T - 1004.5N - 1565.8N$

$T = 164N + 1004.5N + 1563.8N$

$\boxed{T = 2734.3N}$

(*)



$m = 40kg$

a) No other forces

$F_{net_x} = ma_x$

$\rightarrow F_{Net_x} = F_{gx} = mg \sin\theta$
$= 196N$

$\therefore a = 4.9 m/s^2$

b) If $F_{app} = 800N$ up.

$F_{net_x} = ma_x$

$\therefore -F_{app} + F_{gx} = ma_x$

$-800N + 196N = ma_x$

$F_{net} = -604N$

$a_x = 15.1 m/s^2$

c) If $F_{app} = 200N$ down

$\rightarrow F_{net} = F_{gx} + F_{app}$
$= 196N + 200N$
$= 396N$

$a_x = 9.9 m/s^2$

d) $\mu_K = 0.2$

$\therefore F_{net_y} = 0$

so $F_N = F_{gy} = mg\cos\theta = 339.5N$

$f_K = \mu_K F_N$
$= (0.2)(339.5N)$
$= 67.9N$

$\rightarrow F_{Net_y} = F_{gx} - f_K$
$= 196N - 67.9$
$= 128.1N$

$\boxed{a_x = 3.2 m/s^2}$