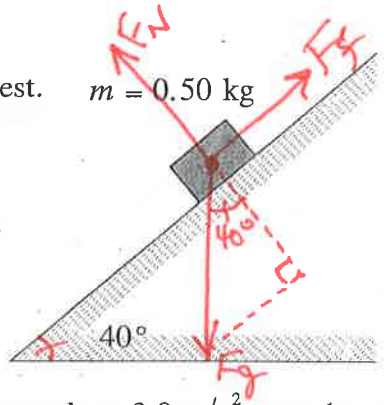
SIMONSON'S

Physics 12 Dynamics - One Object

1. Which of the following are units for gravitational field strength?

A. kg/m
B. $kg \cdot m/s^2$
C. N/kg
D. N/kg^2

2. The block shown in the diagram below remains at rest. What is the friction force acting on the block?

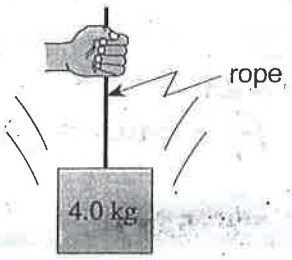


$F_f = F_g \sin 40°$
$= 0.50(9.8)\sin 40°$
$=$

A. 0 N
B. 3.1 N
C. 3.8 N
D. The friction force cannot be calculated.

3. The 4.0 kg block shown below is accelerating downwards at 3.0 m/s^2 near the earth's surface. What is the tension in the rope attached to it?

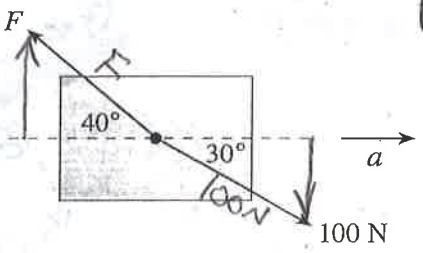
A. 12 N
B. 27 N
C. 39 N
D. 51 N



$F_{NET} = ma$
$F_g - F_T = ma$
$F_T = F_g - ma$
$= mg - ma$
$= m(g-a)$
$= 4.0(9.8-3.0)$
$= 4.0(6.8)$
$= 27.2\ N$

4. The mass shown below is accelerating to the right due to the two forces acting on it. What is the size of the force F ?

A. 32 N
B. 50 N
C. 65 N
D. 78 N

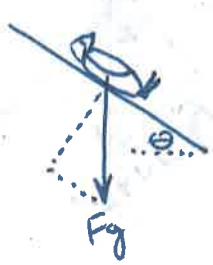


$F \sin 40° = 100 \sin 30°$
$F = \frac{50}{\sin 40°}$
$F = 77.78\ N$

5. A 6.0 kg penguin in a zoo exhibit starts from rest and slides 5.0 m along a very slippery rock slope (ignore friction) into the water in 1.4 s. What angle does the rock slope make with the horizontal?

A. 21°
B. 28°
C. 31°
D. 59°

① $v_0 = 0$, $d = 5$, $t = 1.4$, $a = ?$
$d = v_0 t + \frac{1}{2}at^2$
$a = \frac{2d}{t^2} = \frac{2(5)}{1.4^2}$
$a = 5.102$

② 

$F_{NET} = F_g \sin\theta$
$ma = mg \sin\theta$

$\theta = \sin^{-1}\left(\frac{a}{g}\right)$
$= \sin^{-1}\left(\frac{5.102}{9.80}\right)$
$\theta = 31°$

6. A constant net force acting on an object results in the object having a constant

A. velocity.
B. momentum.
(C) acceleration.
D. kinetic energy.

$\vec{F}_{NET} = m\vec{a}$

7. A curling rock is travelling to the right across the ice as shown in the diagram.

Which of the following best represents the forces acting on the curling rock?

A. 

B. 

C. 

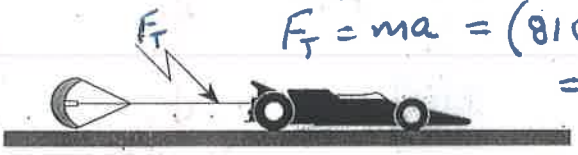
(D.) 

8. An 810 kg dragster is being decelerated by a parachute at 2.5 m/s^2 as shown in the diagram. What is the tension in the cord at this moment?

$F_{NET} = ma$

$F_T = ma = (810)(2.5)$

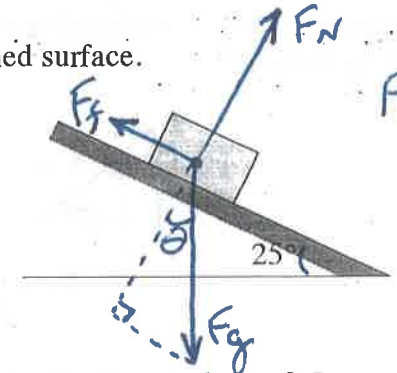
$= 2025\ N$



A. 0 N
(B.) 2.0×10^3 N
C. 5.9×10^3 N
D. 7.9×10^3 N

9. A 5.0 kg block remains stationary on an inclined surface.

What is the friction force acting on the block?



$F_f = F_g \sin\theta$

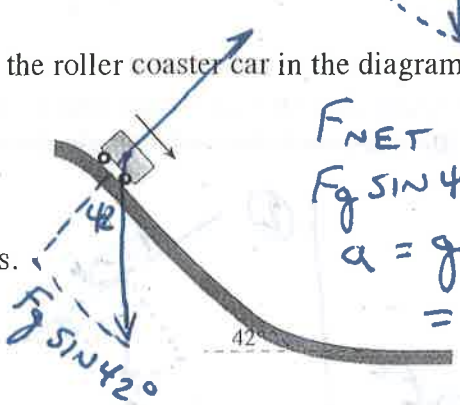
$= mg\sin\theta$

$= 5(9.8)\sin 25^\circ$

$= 20.708\ N$

(A.) 21 N
B. 23 N
C. 44 N
D. 49 N

10. What is the acceleration of the roller coaster car in the diagram below? Ignore friction.



$F_{NET} = ma$

$F_g \sin 42^\circ = ma$

$a = g\sin 42^\circ$

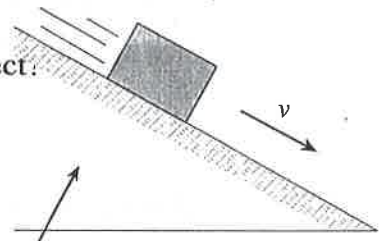
$= 9.80 \sin 42^\circ$

$= 6.557\ \frac{m}{s^2}$

(A.) 6.6 m/s^2
B. 7.3 m/s^2
C. 8.8 m/s^2
D. Depends on car's mass.

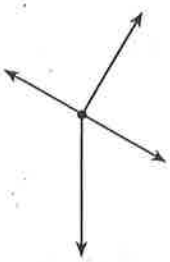
11. An object is sliding down an inclined plane at a constant speed.

Which of the following represents the free-body diagram for the object?



A. 

B. 

C. 

(D.) 

12. A 45 kg woman is standing in an elevator that is accelerating downwards at 2.0 m/s^2. What force (normal force) does the elevator floor exert on the woman's feet during this acceleration?

A. 90 N
(B.) 350 N
C. 440 N
D. 530 N

$F_{NET} = ma$

$F_g - F_N = ma$

$\therefore F_N = F_g - ma$

$F_N = mg - ma$

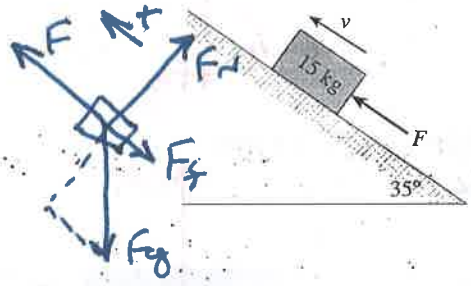
$= 45(9.8 - 2.0)$

$= 351$ N

13. A 15 kg block is pushed up a 35° incline. A friction force of 110 N exists between the block and the incline.

What minimum force F, would be necessary to move the block up the incline at a constant speed?

A. 26 N
B. 84 N
C. 150 N
(D.) 190 N



$F_{NET} = ma$

$F - F_f - F_g \sin\theta = 0$

$F = mg\sin\theta + F_f$

$= 15(9.8)\sin 35° + 110$

$F = 194.3$ N

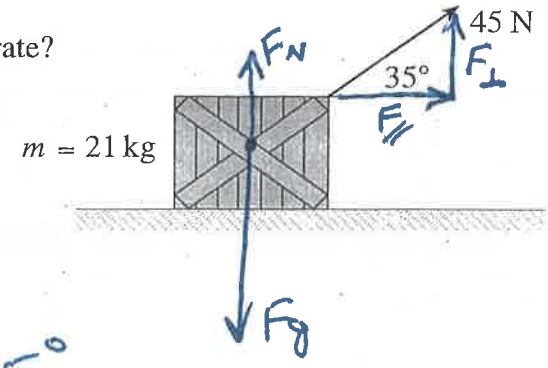
14. A large mass, M, collides with a stationary small mass, m. During the collision, the forces exerted on each mass are measured. Which of the following is correct about the magnitude of the forces? THIRD LAW

A. No force is exerted during the collision.
B. The large mass, M, exerts a greater force on the small mass, m.
C. The small mass, m, exerts a greater force on the large mass, M.
(D.) Both masses exert equal forces on each other during the collision.

15. A force of 45 N is applied at an angle of 35° above the horizontal to pull a 21 kg crate across a floor as shown below.

What is the normal force on the crate?

A. 26 N
B. 170 N
(C.) 180 N
D. 210 N

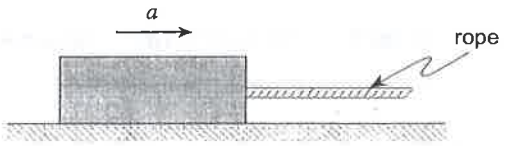


$F_N + F_\perp = F_g$

$F_N = mg - F\sin 35°$

$= 21(9.8) - 45\sin 35° = 179.989$ N $= 180$ N

16. The block in the diagram below is being accelerated to the right across a rough surface by a force applied through the rope.

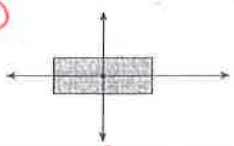


Which of the following best represents a free-body diagram for the block?

A. 

B. 

C. 

D. 

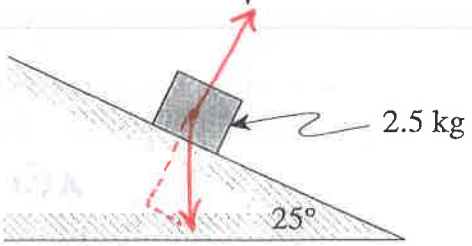
17. What is the normal force on the block in the diagram below?

A. 0.0 N
B. 10 N
C. 22 N
D. 25 N

$F_N = F_g \cos 25°$

$= 2.5(9.8)\cos 25°$

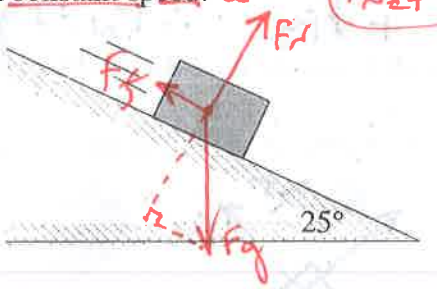
$= 22.2\ N$



18. A 1.5 kg block slides down the incline at a constant speed. $a = 0 \therefore F_{NET} = 0$

What is the net force on this block?

A. 0 N
B. 6.2 N
C. 13 N
D. 15 N



19. A 5.0 kg block is being pulled to the right by a 75 N force.

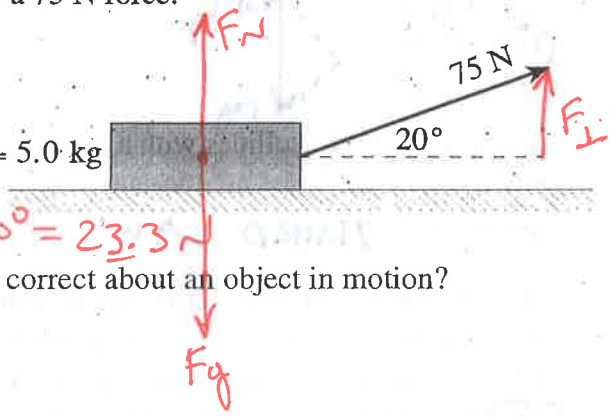
What is the normal force on this block?

A. 23 N
B. 26 N
C. 49 N
D. 75 N

$F_N + F_\perp = F_g$

$F_N = mg - 75\sin 20°$

$= 5(9.8) - 75\sin 20° = 23.3\ N$



20. Which of the following statements is always correct about an object in motion?

A. It has a tendency to accelerate. ✗
B. A net force must be acting on it ✗
C. It has a tendency to keep moving. ✓
D. The net force acting on it must be zero. ✗

1ST LAW: INERTIA.

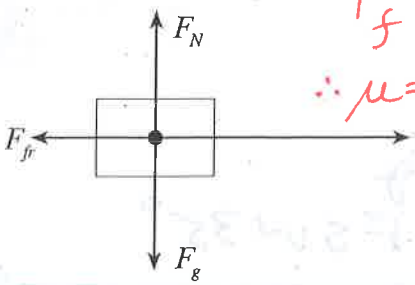
21. The free body diagram shown below is for a block being accelerated across a floor to the right by the force F. Which of the following represents the coefficient of friction for this situation?

A. $\frac{F}{F_g}$

B. $\frac{F_{fr}}{F}$

C. $\frac{F_N}{F_g}$

D. $\frac{F_{fr}}{F_N}$



$F_f = \mu F_N$

$\therefore \mu = \frac{F_f}{F_N}$

22. A 6.0 kg object is projected directly upward with an initial speed of 15 m/s. This object experiences an average air resistance force of 24 N. What is the maximum height reached by this object?

A. 8.2 m
B. 11 m
C. 16 m
D. 19 m

$F_{NET} = ma$

$-F_g - F_f = ma$

$-mg - 24 = ma$

$a = \frac{-6(9.8) - 24}{6}$

$a = -13.8 \frac{m}{s^2}$, $v_0 = 15 \frac{m}{s}$, $v = 0$, $d = ?$

$v^2 = v_0^2 + 2ad$

$d = \frac{v^2 - v_0^2}{2a} = \frac{0^2 - 15^2}{2(-13.8)}$

$d = 8.15$ m

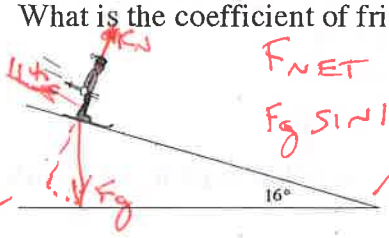
23. A 75 kg Olympic skier takes 20 s to reach a speed of 25 m/s from rest while descending a uniform 16° slope.

What is the coefficient of friction between the skis and the slope surface? **(7 marks)**

t, v, v_0, a?

$v = v_0 + at$

$a = \frac{v - v_0}{t} = \frac{25}{20} = 1.25 \frac{m}{s^2}$

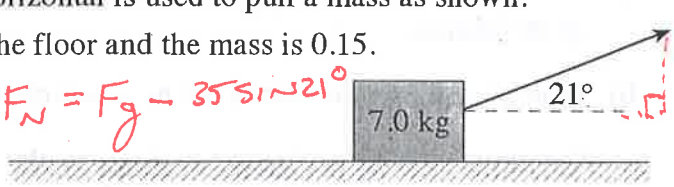


$F_{NET} = ma$

$F_g \sin 16° - \mu mg \cos 16° = ma$

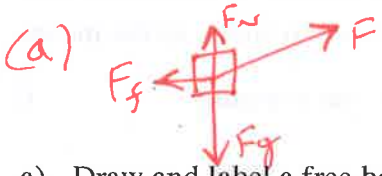
$\mu = \frac{mg \sin 16° - ma}{mg \cos 16°} = \frac{9.8 \sin 16° - 1.25}{9.8 \cos 16°} = 0.154$

24. A 35 N force applied at 21° to the horizontal is used to pull a mass as shown. The coefficient of friction between the floor and the mass is 0.15.



$\mu = 0.15$

a) Draw and label a free body diagram showing the forces acting on the mass. **(2 marks)**



b) What is the acceleration of the mass? **(5 marks)**

$F_N = F_g - 35 \sin 21°$

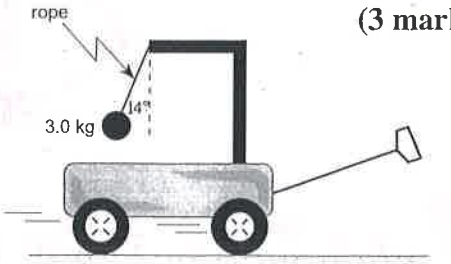
$F_{NET} = ma$

$a = \frac{(F \cos 21° - \mu(F_g - 35 \sin 21°))}{m} = 3.5 \frac{m}{s^2}$

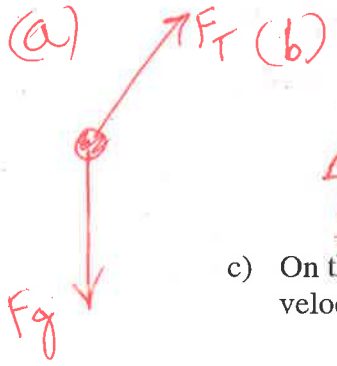
25. A 3.0 kg mass hangs at one end of a rope that is attached to a support on a child's wagon as shown in the diagram. The wagon is pulled to the right. (You may ignore air resistance.)

a) Draw and label a free body diagram showing the forces acting on the mass. **(2 marks)**

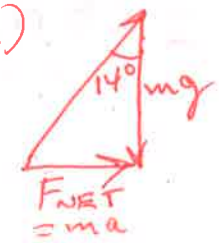
b) What is the acceleration of the wagon? **(3 marks)**



(a)



(b)



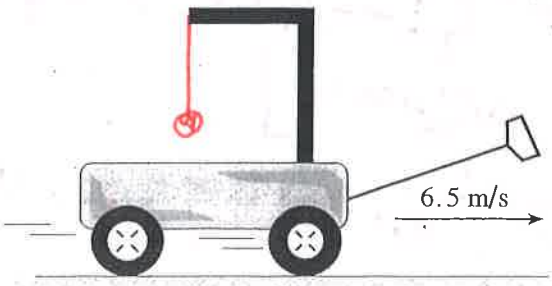
$\tan 14° = \frac{ma}{mg}$

$a = g \tan 14°$

$= 9.8 \tan 14°$

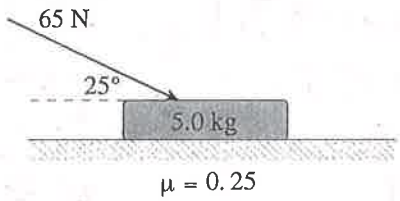
$a = 2.44 \frac{m}{s^2}$

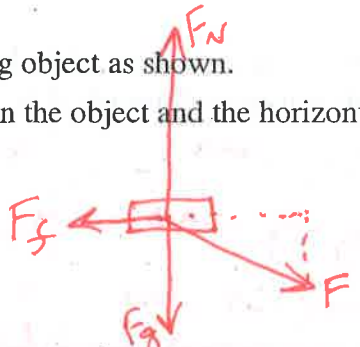
c) On the diagram below, sketch the position of the mass when the cart reaches a constant velocity of 6.5 m/s. **(1 mark)**



26. A 65 N force is applied to a 5.0 kg object as shown.

The coefficient of friction between the object and the horizontal surface is 0.25.





$F_N = F_g + F\sin\theta$

a) Draw and label a free body diagram showing the forces acting on the object. **(2 marks)**

b) What is the acceleration of the object? **(5 marks)**

$F_{NET} = ma$

$F\cos\theta - F_f = ma$

$F\cos\theta - \mu(F_g + F\sin\theta) = ma$

$a = \dfrac{65\cos 25° - 0.25(5.9.8 + 65\sin 25)}{5.0}$

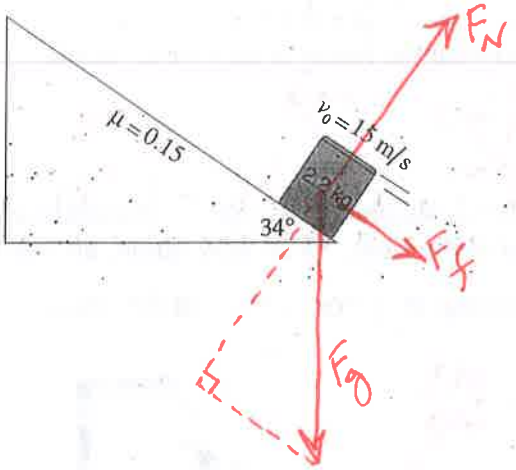
$a = 7.96\ \frac{m}{s^2}$

27. A 2.2 kg can of paint is projected up an inclined plane with an initial velocity of 15 m/s as shown below.

a) Determine the magnitude of the force due to friction which acts on the paint can as it slides up the incline. **(2 marks)**

b) Determine the magnitude of the net force on the paint can as it slides up the incline. **(3 marks)**

c) Determine how far the paint can slides up the incline before stopping. **(2 marks)**



(a) $F_f = \mu F_N$

$= \mu F_g \cos 34°$

$= (0.15)(2.2)(9.8)\cos 34°$

$F_f = 2.68\ N$

(b) $F_{NET} = F_f + F_g \sin 34°$

$= 2.68\ N + (2.2)(9.8)\sin 34°$

$= 14.7\ N\ [DOWN]$

(c) $a = \dfrac{F_{NET}}{m} = \dfrac{-14.7}{2.2} = -6.698\ \frac{m}{s^2}$

$V_0 = 15$

$V = 0$ $\quad d = ?$

$d = \dfrac{v^2 - v_0^2}{2a}$

$= \dfrac{0^2 - 15^2}{2(-6.698)} = 16.8\ m$