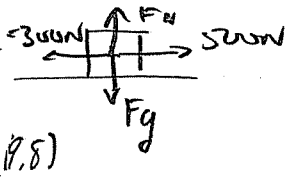
# PHYSICS 12

NAME: _____

## Newton's 3 Laws

1. Unless acted on by an external net force, an object will stay at rest or
   A. come to rest.
   B. decelerate at a constant rate.
   C. slow down from a given speed.
   (D.) continue to move in a straight line at a constant speed.

2. A 65.0 kg block is being accelerated along a level surface. The applied force is 500 N and the friction force is 300 N. What is the coefficient of friction between the block and the surface?
   A. 0.31
   (B.) 0.47
   C. 0.78
   D. 1.30

$F_f = \mu F_N$ 


$\mu = \frac{F_f}{F_N} = \frac{300N}{(65kg)(9.8)}$

3. A 4.00 kg block is accelerated along a level surface at 3.00 m/s$^2$. The applied force is 20.0 N. What is the coefficient of friction between the block and the surface?
   (A.) 0.20
   B. 0.31
   C. 0.51
   D. 0.67

$F_{net} = F_{app} - F_f$

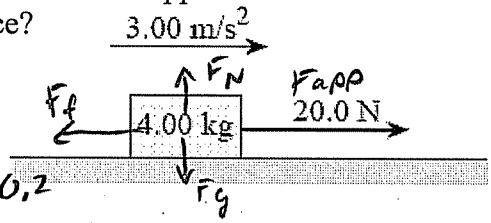
$ma = F_{app} - F_f$

$(4kg)(3m/s^2) = 20N - F_f$

$F_f = 8N$

$F_f = \mu F_N$

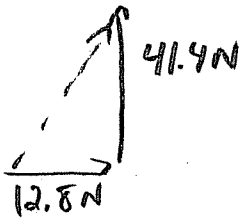
$\mu = \frac{8N}{4(9.8)} = 0.2$




4. A 6.0 kg block is held at rest on a horizontal, frictionless air table. Two forces are pulling on this block in the directions shown in the diagram below. What will be the magnitude of the acceleration on the 6.0 kg block at the moment it is released?

Break into components

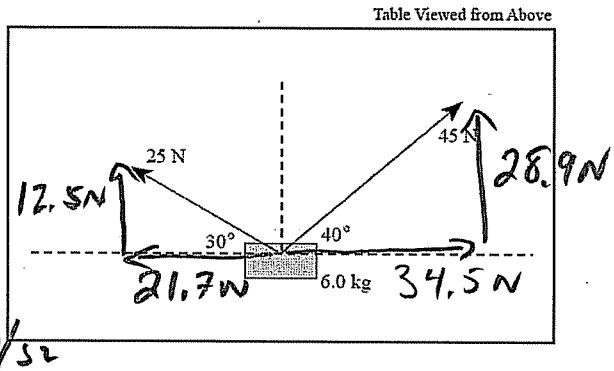
net force vectors




$41.4^2 + 12.8^2 = c^2$

$c = 43.3\ N$

$a = \frac{F}{m} = \frac{43.3N}{6kg} = 7.22\ m/s^2$

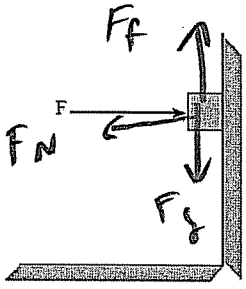



5. What minimum horizontal force F will **just** prevent the 5.0 kg block from sliding if the coefficient of friction between the wall and the block is 0.65?
   A. 6.4 N
   B. 32 N
   C. 49 N
   (D.) 75 N

$F = F_N$, $F_f = F_g$

$= (5)(9.8)$

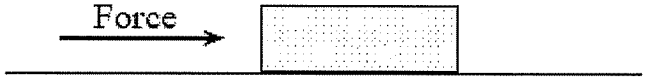
$= 49\ N$




$F_f = \mu F_N$

$\frac{49}{.65} = F_N = 75.4N = F$

6. A constant force is applied to an object on a frictionless surface, as shown in the diagram below. The resulting motion has
   A. constant velocity.
   B. constant momentum.
   C. constant acceleration.
   D. constant kinetic energy.




$F_{net} = ma$

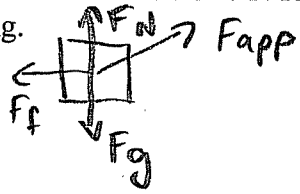
7. What is the frictional force due to air resistance on a 0.50 kg object falling vertically with an acceleration of 8.5 m/s$^2$?
   A. 0.65 N
   B. 4.3 N
   C. 4.9 N
   D. 9.2 N

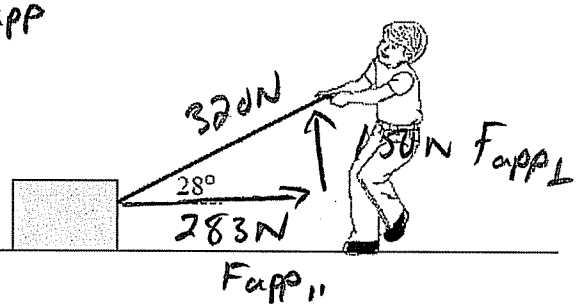

$F_{net} = F_g - F_{air}$ $\quad F_{air} = .65N$

$ma = mg - F_{air}$

$(.5)(8.5) = (.5)(9.8) - F_{air}$

8. A 60 kg block rests on the ground. A student exerts a 320 N force on the block by pulling on a rope, but friction prevents the block from moving.
   a) Draw and label a free body diagram showing all forces acting on the block.




   b) Calculate the force of friction on the block.

$F_{net} = F_{appII} - F_f$ $\quad F_f = F_{appII}$

$0 = F_{appII} - F_f$ $\quad = 283N$

   c) Calculate the normal force exerted by the ground on the block.

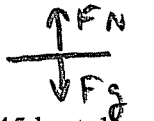
$F_{net} = F_g - F_N - F_{appL} = 0$ $\quad$ So $F_g = F_N + F_{appL}$ $\quad F_N = 438N$

$(60)(9.8) = F_N + 150$

   d) Calculate the minimum coefficient of friction between the block and the ground.

$F_f = \mu F_N$ $\quad \mu = \frac{F_f}{F_N} = \frac{283N}{438N} = .64$

9. A 75 kg man stands on a scale while accelerating upwards in an elevator. If the scale reads 850 N, what is the magnitude of the acceleration of the elevator?



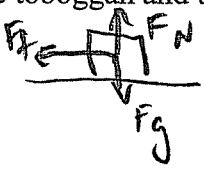

$F_{Net} = F_N - F_g$

$ma = F_N - F_g$

$(75)(a) = 850N - 75(9.8)$

$75a = 115$, $a = 1.53 m/s^2$

10. A 45 kg toboggan and rider decelerate on level snow at 0.53 m/s$^2$. What is the coefficient of friction between the toboggan and the snow?
    A. 0.012
    B. 0.054
    C. 0.22
    D. 0.53



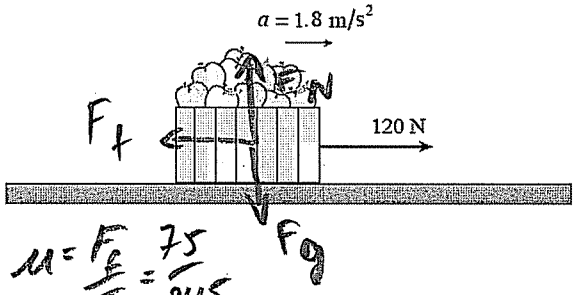

$F_{net} = F_f$ $\quad (45)(.53) = F_f$ $\quad F_f = 23.9$

$F_N = F_g$ $\quad = 45(9.8)$ $\quad = 441N$

$F_f = \mu F_N$ $\quad \mu = \frac{F_f}{F_N} = \frac{23.9N}{441N}$ $\quad = .054$

11. Which of the following is **not** a statement of one of Newton's laws of motion?
    A. For every action force, there is an equal and opposite reaction force.
    B. If no net force acts on an object, the object will remain at rest, or continue to move at a constant velocity.
    C. The acceleration of freely falling objects is proportional to their mass. $a = g$
    D. If a net force does act on an object, the object will accelerate in the direction of the net force.

12. A student exerts a 120 N horizontal force on a 25 kg carton of apples, causing it to accelerate over level ground at 1.8 m/s$^2$. Find the coefficient of friction between the carton and the ground.




A. 0.31
B. 0.38
C. 0.49
D. 0.67

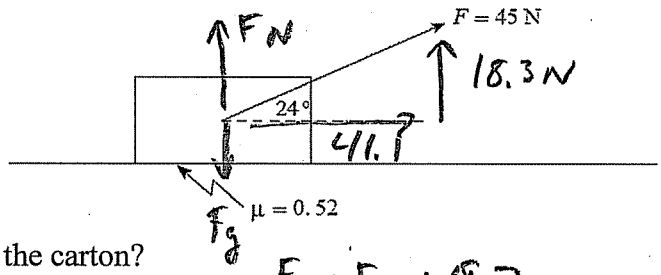
$F_{net} = 120N - F_f$
$ma$
$25(1.8) = 120N - F_f$
$F_f = 75N$
$F_N = F_g = 245N$
$\mu = \frac{F_f}{F_N} = \frac{75}{245}$

13. A net force $F$ acts on an object of mass $m$, causing it to accelerate at 4.0 m/s$^2$. If the same net force $F$ acts on an object of mass $2m$, its acceleration will be

A. 1.0 m/s$^2$
B. 2.0 m/s$^2$
C. 4.0 m/s$^2$
D. 8.0 m/s$^2$

$F = m(4) = 4m$
$F = 2m(a)$
$4m = 2m(a)$ $a = 2$

14. A student drags a 7.0 kg carton of apples across the floor by exerting a 45 N force in the direction shown. The coefficient of friction between the carton and the floor is 0.52.




a) What is the magnitude of the normal force acting on the carton?

$F_g = F_N + 18.3$
$F_N = (7)(9.8) - 18.3$
$= 50.3N$

b) What friction force acts on the carton?

$F_f = \mu F_N$
$= .52(50.3) = 26.2N$

c) What is the acceleration of the carton?

$F_{net} = F_{app} - F_f$
$ma = 41.1 - 26.2$
$7a = 14.9$
$a = 2.13 m/s^2$

15. Force $F$ gives mass $m_1$ an acceleration of 4.0 m/s$^2$. The same force $F$ gives mass $m_2$ an acceleration of 2.0 m/s$^2$. What acceleration would force $F$ give to the two masses $m_1$ and $m_2$ if they were glued together?

A. 1.0 m/s$^2$
B. 1.3 m/s$^2$
C. 3.0 m/s$^2$
D. 6.0 m/s$^2$

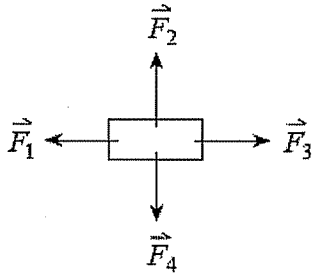
Assume $m_1 = 1kg$ then $F = m_2 a$ | $F = (m_1 + m_2)a$
So $F = 4N$ | $4N = m_2(2)$ | $4N = 3a$
$m_2 = 2kg$ | $a = \frac{4}{3} m/s^2$

16. A 72 kg skydiver drops from a helicopter and is accelerating downwards at 8.6 m/s$^2$. Find the friction force acting on him.

A. 86 N
B. 620 N
C. 710 N
D. 1 300 N

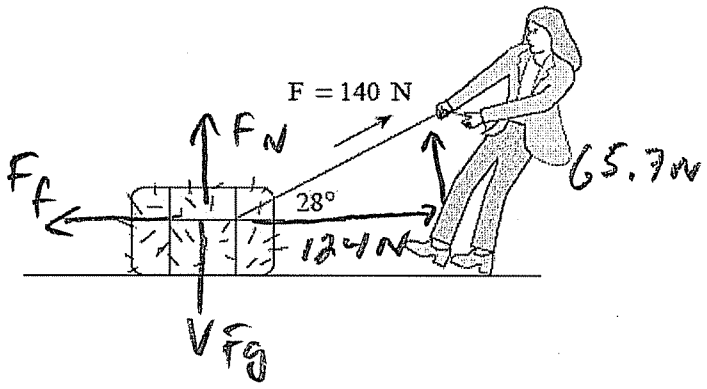

$F_{net} = F_g - F_f$
$ma = mg - F_f$
$(72)(8.6) = (72)(9.8) - F_f$
$F_f = 86.4N$

17. The free body diagram shown left represents a crate being dragged towards the **left** over a rough surface. Which of the vectors represent the normal force and the friction force acting on the crate?




| | NORMAL FORCE | FRICTION FORCE — opposes motion |
|---|---|---|
| A. | $\vec{F}_1$ | $\vec{F}_2$ |
| B. | $\vec{F}_2$ ✓ | $\vec{F}_3$ ✓ |
| C. | $\vec{F}_3$ | $\vec{F}_4$ |
| D. | $\vec{F}_4$ | $\vec{F}_1$ |

18. A girl applies a 140 N force to a 35 kg bale of hay at an angle of 28° above horizontal. The friction force acting on the bale is 55 N. What will be the horizontal acceleration of the bale?




$F_{net} = F_{applied} - F_f$

$ma = 124N - 55N$

$(35kg)a = 69N$

$a = 1.97 m/s^2$

**Answers: 1. D, 2. B, 3. A, 4. 7 m/s², 5. D, 6. C, 7. A, 8b. 280 N, c. 440 N, d. .64, 9. 1.53 m/s², 10. B, 11. C, 12. A, 13. B, 14a. 50.3 N, b. 26 N, c. 2.2 m/s², 15. B, 16. A, 17. B, 18. 1.96 m/s²**