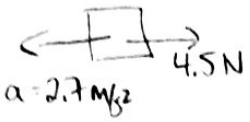
Physics 11

More Force Problems

Name: Key

Date:

1. What force would be required to accelerate an 8.4 kg object at 2.7 m/s² with a force of friction of4.5N? (Answer: 27N)



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

$ma = F_{app} - 4.5N$

$F_{app} = 8.4kg(2.7 m/s^2) + 4.5N = 27N$ ✓

2. What is the mass of an object that accelerates from 15.0 m/s to 23.5 m/s over 12.0 seconds with an applied force of 32.0 N and a force of friction of 12.0 N? (Answer: 28.2kg)

Kinematics

$V_i = 15 m/s$

$V_f = 23.5 m/s$

$t = 12s$

$a = ?$

$a = \frac{V_f - V_i}{t} = \frac{23.5 - 15}{12} = 0.70\bar{8}\ m/s^2$

Dynamics

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

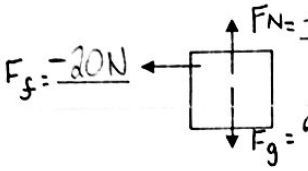
$ma = 32N - 12N$

$m = \frac{32 - 12}{0.70\bar{8}}$

$= 28.2kg$ ✓

3. A 20 kg box is sliding towards the right across the floor with an acceleration of -1.0 m/s². Calculate and fill in all the blanks in the force diagram. (Answer: $F_N = 2.0 \times 10^2 N$; $F_g = -2.0 \times 10^2 N$; $F_f = -20N$)

$g = -9.8 N/kg$



no applied force in this problem → $F_{net} = F_f$

$ma = F_f$

$F_f = (20kg)(-1.0 m/s^2)$

$F_f = -20N$ ✓ (same direction as accel.)

4. What force would be required to accelerate a 5.0 kg mass from rest to a speed of 2.5 m/s, if the time of acceleration was only 0.30 s and a coefficient of friction of 0.40? (Answer: 61N)

$V_i = 0$

$V_f = 2.5 m/s$

$t = 0.30s$

$a = \frac{V_f - V_i}{t} = \frac{2.5}{0.3} = 8.\bar{3}\ m/s^2$

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

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

$= ma + \mu F_N$

$= (5)(8.\bar{3}) + (0.4)(5)(9.8)$

$= 61.2N \rightarrow 61N$ ✓

5. A smooth wooden block is placed on a smooth wooden tabletop. You find that you must exert a force of 14.0N to keep the 40.0N block moving at a constant velocity. ← $F_{net} = 0$

F_{app}

a. What is the coefficient of sliding friction for the block and the table? (Answer: 0.350)

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

$0 = 14N - \mu(40N)$

$\mu = \frac{-14}{-40} = 0.350$ ✓

b. If a 20.0N brick is placed on the block, what force will be required to keep the block and brick moving at a constant velocity? (Answer: 21.0N)

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

$0 = F_{app} - (0.350)(60N)$

$F_{app} = 21.0N$ ✓

Key

6. A 2kg mass stretches a spring to 20cm. What mass will stretch the spring to 35cm? (Answer: 3.5kg)

$F = K\Delta X$

$K = \frac{F}{\Delta X}$

$= \frac{2kg \times 9.8 N/kg}{20cm}$

$= 0.98 N/cm$

$F = K\Delta X$

$mg = (0.98 \frac{N}{cm})(35cm)$

$m = \frac{0.98 \times 35}{9.8}$

$= 3.5 kg$ ✓

7. What is the force of friction acting on a 5.0 kg object that accelerates from an initial velocity of 2.0 m/s to a velocity of 8.45 m/s in 10.5 sec. The applied force acting on the object is 24.0 N. (Answer: -21N)

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

$ma = F_{app} - F_f$

$F_f = 24N - (5kg)(0.61 m/s^2)$

$= 20.9 \rightarrow -21 N$ ✓ app direction to acceleration

$a = ?$

$v_i = 2 m/s$

$v_f = 8.45 m/s$

$t = 10.5 s$

$a = \frac{v_f - v_i}{t}$

$= \frac{8.45 - 2}{10.5}$

$= 0.61 m/s^2$

8. Calculate the force of gravity between the Earth and a 70 kg satellite that is 4.56×10^5 m above the Earth's surface. Earth's radius = 6.38×10^6 m mass = 5.98×10^{24} kg (Answer: $6.0 \times 10^2 N$)

$F_g = \frac{GMm}{r^2} = \frac{(6.67 \times 10^{-11} N\frac{m^2}{kg^2})(5.98 \times 10^{24} kg)(70 kg)}{(6.38 \times 10^6 m + 4.56 \times 10^5 m)^2}$

$= 597.48 N \rightarrow 6.0 \times 10^2 N$ ✓

9. What is the applied force acting on a 2.65 kg object that accelerates from rest to a velocity of 4.5 m/s in 2.5 seconds. The force of friction acting on the object is 4.35 N. (Answer: 9.1N)

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

$ma = F_{app} - 4.35N$

$(2.65kg)(1.8 m/s^2) + 4.35N = F_{app}$

$F_{app} = 9.1 N$ ✓

$v_i = 0$

$v_f = 4.5 m/s$

$t = 2.5 s$

$a = ? = \frac{4.5 m/s}{2.5} = 1.8 m/s^2$

10. A 52N sled is pulled across a cement sidewalk at a constant speed. A horizontal force of 36N is exerted.

a. What is the coefficient of sliding friction between the sidewalk and the metal runners of the sled? (Answer: 0.69)

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

const speed $a = 0 \rightarrow 0 = 36N - F_f$

$36N = \mu F_N$

$36N = \mu(52N)$

$\mu = 0.69$ ✓

b. Suppose the sled now runs on packed snow. The coefficient of friction is now only 0.12. If a person weighing 650N sits on the sled, what force is needed to slide the sled across the snow at a constant speed? (Answer: 84N)

$F_{net} = ma = 0$

$F_{app} = F_f$

$= \mu F_N = 0.12(650N + 52N) = 84 N$ ✓