**SHOW EQUATIONS AND WORK FOR EACH PROBLEM**

V = d/t F = m x a W = m x g V = gt

a = (Vf – Vi)/t d = ½ at2  = m x v

m1v1= m2v2 PE = mgh KE = ½ mv2

1. It takes 6 seconds for a stone to fall to the bottom of a mine shaft. How deep is the shaft?

2. An apple falls from a tree and hits the ground 5 m below. If it takes 1 second to hit the ground, what is the instantaneous speed of the apple the moment it strikes the ground?

3. A rocket covers 2500 m in 10 s starting from lift off. What is the rocket’s acceleration?

4. What horizontal force will accelerate a 400 kg crate across a factory floor at 0.5 m/s/s?

5. A gun propels a 0.01 kg bullet out its nozzle with a force of 100 N. What is the bullet’s acceleration?

6. Two billiard balls having the same mass roll toward each other, each moving at the same speed. What is the combined momentum of the two billiard balls?

7. What is the average momentum of a 70 kg runner who covers 400 m in 50 s?

8. A 4 kg ball has a momentum of 12 kg m/s. What is the ball’s speed?

9. A 1000 kg car moving at 10 m/s brakes to a stop in 5 s. What is the average braking force?

10. A 5000 kg freight car runs into a 10,000 kg freight car at rest. They couple upon collision and move with a speed of 2 m/s. What was the initial speed of the 5000 kg car?

11. An astronaut whose total mass is 100 kg ejects 0.1 kg of gas at a speed of 50 m/s from her propulsion pistol in order to move. What is her recoil speed?

12. Two identical motion carts roll without friction towards each other on a level track. One rolls at 2 m/s and the other rolls at 1m/s. After the cars collide, they couple and roll together. What would be their speed?

13. A ball is moving at 4 m/s and has a momentum of 48 kg m/s. What is the ball’s mass?

14. A 2 kg mass has 40 joules of potential energy with respect to the ground. Approximately how far is it located above the ground?

15. How much kinetic energy (joules) does a 0.5 kg motion cart have when moving 2 m/s?

16. A large 50 kg stone is wedged on top of a cliff 100 m high ready to fall. What is the stone’s potential energy?

17. A 1 kg ball dropped from a height of 2 m rebounds only 1.5 m after hitting the ground. What is the amount of energy (joules) lost to heat?

18. How much does a 100 kg person weigh?

V = d/t F = m x a W = m x g V = gt

a = (Vf – Vi)/t d = ½ at2  = m x v

m1v1= m2v2 PE = mgh KE = ½ mv2

1. It takes 6 seconds for a stone to fall to the bottom of a mine shaft. How deep is the shaft?

d = ½ at2  d = ½ (10 m/s/s)(6 s)2  d = 5 x 26 = 180 m

2. An apple falls from a tree and hits the ground 5 m below. If it takes 1 second to hit the ground, what is the instantaneous speed of the apple the moment it strikes the ground?

V = gt V = 10 m/s/s x 1 s = 10 m/s

3. A rocket covers 2500 m in 10 s starting from lift off. What is the rocket’s acceleration?

a = Vf – Vi = (250 m/s - 0 m/s) / 10 s = 25 m/s/s

t

V = d/t V = 2500 m / 10 s = 250 m/s

4. What horizontal force will accelerate a 400 kg crate across a factory floor at 0.5 m/s/s?

f = ma f = 400 kg x 0.5 m/s/s = 200 N

5. A gun propels a 0.01 kg bullet out its nozzle with a force of 100 N. What is the bullet’s acceleration?

f

a = f / m = 100 N / 0.01 kg = 10,000 m/s/s or 1.0 x 104 m/s2

a

m

6. Two billiard balls having the same mass roll toward each other, each moving at the same speed. What is the combined momentum of the two billiard balls?

m1v1= m2v2 They cancel each other out. Therefore, momentum is zero overall.

7. What is the average momentum of a 70 kg runner who covers 400 m in 50 s?

v = d/t v = 400 m / 50 s = 8 m/s

 = m x v = (70 kg)(8 m/s) = 560 kg m/s

8. A 4 kg ball has a momentum of 12 kg m/s. What is the ball’s speed?

 = m x v v =  / m = 12 kg m/s / 4 kg = 3 m/s



m

v

9. A 1000 kg car moving at 10 m/s brakes to a stop in 5 s. What is the average braking force?

a = v/t = 10 m/s / 5 s = 2 m/s/s f = ma f = 1000 kg x 2 m/s/s = -2000 N

10. A 5000 kg freight car runs into a 10,000 kg freight car at rest. They couple upon collision and move with a speed of 2 m/s. What was the initial speed of the 5000 kg car?

m1v1= m2v2 v1= m2v2 / m1 = (5000 kg + 10,000 kg)(2 m/s/s) / 5,000 kg = 6 m/s

11. An astronaut whose total mass is 100 kg ejects 0.1 kg of gas at a speed of 50 m/s from her propulsion pistol in order to move. What is her recoil speed?

m1v1= m2v2 v2 = m1v1 / m2 = (0.1 kg)(50 m/s/s) / 100 kg = 5 kg m/s / 100 kg = 0.05 m/s

12. Two identical motion carts roll without friction towards each other on a level track. One rolls at 2 m/s and the other rolls at 1m/s. After the cars collide, they couple and roll together. What would be their speed?

m1v1 = m2v2 m2 = 2m1 v2 = ½ v1

= but since the mass is now twice as great, v2 = 0.5 m/s

2 m/s

1 m/s

13. A ball is moving at 4 m/s and has a momentum of 48 kg m/s. What is the ball’s mass?

 = m x v m =  / v = 48 kg m/s / 4 m/s = 12 kg



m

v

14. A 2 kg mass has 40 joules of potential energy with respect to the ground. Approximately how far is it located above the ground?

PE = mgh h = PE / mg = 40 J / (2 kg)(10 m/s/s) = 2 m

15. How much kinetic energy (joules) does a 0.5 kg motion cart have when moving 2 m/s?

KE = ½ mv2 = ½ (0.5 kg)(2 m/s)2 = 1 joule

16. A large 50 kg stone is wedged on top of a cliff 100 m high ready to fall. What is the stone’s potential energy?

PE = mgh = (50 kg)(10 m/s2)(100 m) = 50,000 joules or 5.0 x 104 J

17. A 1 kg ball dropped from a height of 2 m rebounds only 1.5 m after hitting the ground. What is the amount of energy (joules) lost to heat?

PEtotal = mgh = (1 kg)(10 m/s2)(2 m) = 20 joules

PErebound = mgh = (1 kg)(10 m/s2)(1.5 m) = 15 joules

PEtotal - PErebound = 20 J - 15 J = 5 Joules lost to heat

18. How much does a 100 kg person weigh?

W = m x g = (100 kg)(10 m/s/s) = 1000 N