Physics 20 Lessons 1 to 18 Review

1. An aeroplane travels 1800 km at a speed of 1000 km/h. It then encounters a headwind that slows it to 850 km/h for the next 2300 km. What was the average speed of the plane for this trip? (910 km/h)

2. A linebacker starts from rest and accelerates at a constant rate for 2.0 s to make a tackle 7.0 m away. What was the acceleration and the speed when making the tackle? (3.5 m/s^2, 7 m/s)

3. A car travelling 80 km/h decelerates at 1.5 m/s^2. Calculate (a) the distance it goes before it stops, (b) the time it takes to stop, and (c) the distance it travels during the first and third seconds. (160m, 15 s, 21.3 m, 18.3 m)

4. A helicopter is ascending vertically with a speed of 8.0 m/s; at a height of 120m above the earth, a package is dropped from a window. How much time does it take for the package to reach the ground? (5.8 s)

5. A delivery truck travels 8 blocks north, 6 blocks east, and 10 blocks south. What is its final displacement from the origin? (6.3 blocks @ 18^o S of E)

6. An aeroplane is travelling 1000 km/h in a direction 37^o east of north. (a) Find the components of the velocity vector in the northerly and easterly directions. (b) How far north and how far east has the plane travelled after 2.0 h? (1597 km north, 1203 km east)

7. A swimmer is capable of swimming 1.8 m/s in still water. (a) If she swims directly across a 200 m wide river whose current is 0.80 m/s, how far downstream will she land? (b) At what upstream angle must the swimmer aim if she is to arrive at a point directly across the stream? (89m, 26^o)

8. A motorboat whose speed in still water is 9.5 km/h must aim at a 55^o angle upstream in order to travel directly across the stream. (a) What is the speed of the current? (b) What is the resultant speed of the boat with respect to the shore? (7.8 km/h, 5.4 km/h)

9. If a boat is to cross a river directly to the opposite side when the current is 12 km/h, at what angle upstream must the boat head. The boat's speed in still water is 20 km/h. (37^o upstream)

10. A 5000-kg helicopter accelerates upwards at 0.50 m/s^2 while lifting a 2000-kg car. (a) What is the lift force exerted by the air on the propellers? (b) What is the tension in the cable that connects car to helicopter? (7.2×10^4 N, 2.1×10^4 N)

11. How much force is needed to accelerate a 6.0-g bullet from rest to 500 m/s over a distance of 0.70 m? (1100 N)

12. What is the average force exerted by a shot putter on a 7.0 kg shot if the shot is moved through a distance of 2.7 m and is released with a speed of 14 m/s? (250 N)

13. What is the acceleration of a freely falling 65 kg sky-diver if air resistance exerts a force of 250 N? (5.96 m/s^2)

14. Two masses, 1.0 kg and 3.2 kg, are suspended over a pulley. Assuming the pulley is massless and frictionless, calculate the acceleration of the system and the tension in the cord. (5.1 m/s^2, 14.9 N)

15. A roller coaster reaches the top of the steepest hill with a speed of 1.4 m/s. It then descends the hill which is at an average angle of 45^o and is 50 m long. What will its speed be when it reaches the bottom? (26 m/s)

16. A wet bar of soap slides freely down a ramp 10 m long inclined at an angle of 8^o. How long does it take to reach the bottom? Neglect friction. (3.8 s)

17. A space explorer is moving through space far from any planet or star and notices a large rock, taken as a specimen from an alien planet, floating around the cabin of the ship. Should the explorer push it gently or kick it toward the storage compartment? Why?

18. Explain why a rope climber must pull downward on the rope in order to move upward. Discuss the force exerted by the climber's arms in relation to the weight of the climber during the various stages of each "step" up the rope.

19. Explain the relationship between mass and weight.

20. Draw a force diagram showing the weight and normal forces on a laundry basket in each of the following situations:
    a. at rest on a horizontal surface
    b. at rest on a ramp inclined 12° above the horizontal
    c. at rest on a ramp inclined 25° above the horizontal
    d. at rest on a ramp inclined 45° above the horizontal

21. If the basket in item 22 has a mass of 5.5 kg, find the magnitude of the normal force for the situations described in (a) through (d).

22. Explain how placing an object on an inclined plane instead of on a horizontal surface affects the forces acting on the object.

23. A massive metal object on a rough metal surface may undergo contact welding to that surface. Discuss how this affects the frictional forces that arise between object and surface.

24. Imagine an astronaut in space at the midpoint between two stars of equal mass. If all other objects are infinitely far away, how much does the astronaut weigh? Explain your answer.

25. Although the frictional force between two surfaces may decrease as the surfaces are smoothed, it will increase if the surfaces are made extremely smooth and flat. Explain.

26. Analyse the motion of a rock dropped in water in terms of its speed and acceleration. Assume that a resistive force acting on the rock increases as the velocity increases.

27. A sky diver falls through the air. As the speed of the sky diver increases, what happens to the sky diver's acceleration? What is the acceleration when the sky diver reaches terminal speed?

28. A 2.00 kg block is in equilibrium on an incline of angle 0= 60.0°. Find F_N of the incline on the block. (9.81 N)

29. A 5.4 kg bag of groceries is in equilibrium on an incline of angle 0 = 15°. Find the normal force of the incline on the bag. (51 N)

30. A 95 kg clock initially at rest on a horizontal floor requires a 650 N horizontal force to set it in motion. After the clock is in motion, a horizontal force of 560 N keeps it moving with a constant speed. Find μ_s and μ_k between the clock and the floor. (0.70, 0.60)

31. A box slides down a 30.0° ramp with an acceleration of 1.20 m/s^2. Determine the coefficient of kinetic friction between the box and the ramp. (0.436)

32. A car is travelling at 50.0 km/h on a flat highway.
    a. If the coefficient of friction between the road and the tires on a rainy day is 0.100, what is the minimum distance needed for the car to stop? (98.5 m)
    b. What is the stopping distance when the surface is dry and the coefficient of friction is 0.600? (16.4 m)

33. A 3.00 kg block starts from rest at the top of a 30.0° incline and slides 2.00 m down the incline in 1.50 s.
    a. Find the acceleration of the block. (1.78 m/s^2)
    b. Find the coefficient of kinetic friction between the block and the incline. (0.37)
    c. Find the frictional force acting on the block. (9.4 N)
    d. Find the speed of the block after it has slid a distance of 2.00 m. (2.67 m/s)

34. A hockey puck is hit on a frozen lake and starts moving with a speed of 12.0 m/s. Exactly 5.00 s later, its speed is 6.00 m/s.
    a. What is its average acceleration? (-1.2 m/s^2)
    b. What is the average value of the coefficient of kinetic friction between puck and ice? (0.12)
    c. How far does the puck travel during this 5.00 s interval? (45 m)