Dynamics Review

1. An object has a mass of 100 kg.
   (a) What is its weight on Earth?
   (b) What is its weight on the moon? (g_{moon} = 1.63 N/kg)

2. A 0.02 N push accelerates a table-tennis ball along a table at 8 m/s^2 north. Calculate the mass of the ball?

3. What is the acceleration of a train with a mass of 3.2×10^9 kg that pushes itself forward with 2.4×10^{10} N of force?

4. A race car has a mass of 710 kg. It starts from rest and travels 40.0 m in 3.0 s. The car is uniformly accelerated during the entire time. Calculate the net force is acting on the car?

5. Suppose that a 1000 kg car is traveling at 25 m/s. Its brakes can apply a force of 5000 N. What is the minimum distance required for the car to stop?

6. A rocket of mass 1.0×10^3 kg is being fired to a height of 5.0×10^3 m. The rocket engine shuts off when the rocket reaches a height of 1.0×10^3 m. The rocket continues to rise to a height of 5.0×10^3 m. Ignore air resistance.
   (a) Draw a free-body diagram to show the forces acting on the rocket
      (i) while the engine is on.
      (ii) after the engine shuts off.
   (b) Calculate the velocity of the rocket when it was at a height of 1.0×10^3 m.
   (c) Calculate the acceleration of the rocket when the engine was on
   (d) What force did the engine exert on the rocket?

7. A 0.10 g spider is descending on a strand that supports it with a force of 5.6×10^{-4} N. What is the acceleration of the spider? Ignore any air resistance.

8. 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 rotors?
   (b) What is the tension in the cable that connects the car to the helicopter?

9. A 70 kg person is standing on a scale in an elevator. Suddenly, the cable breaks and the elevator falls accelerating at a rate of 5 m/s^2. What is the reading on the scale?

10. A 25 N force pushes on a 5.0 kg block resting on a frictionless horizontal surface. The force is directed downwards at an angle of 20° with the horizontal.
    (a) Draw a free-body diagram for the block.
    (b) Calculate
       (i) the x-component of the applied force.
       (ii) the acceleration of the block.
       (iii) the normal force on the block.

11. A 70.0 kg box is pulled by a 400. N force at an angle of 30.° to the horizontal. The force of friction is 75.0 N. Calculate the acceleration of the box.

12. A 2.0 kg mass accelerates down a frictionless 15° ramp.
    (a) Draw a free-body diagram for the block.
    (b) Calculate
        (i) the value of the x-component of the force of gravity.
        (ii) the acceleration of the block down the ramp.

13. A block of mass 5.0 kg is placed on a plane, inclined to the horizontal at an angle of 15º. Calculate the frictional force required to make the block slide down the plane at a constant speed?

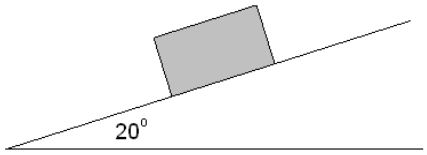
14. A 1200 kg car traveling at 20 m/s slams on its brakes and skids to a stop. The coefficient of kinetic friction between the tires and the road is 0.6. Calculate
    (a) the time it takes the car to stop.
    (b) the distance the car skids.

15. A 200 g box is slid across a table with an initial velocity of 2 m/s. It slides 1.5 m before stopping. What is the coefficient of friction between the car and the table?

16. A 65 kg box is pulled across a rough surface at constant velocity by a 250 N force at an angle of 35° with the horizontal. Calculate the coefficient of kinetic friction.

17. A 50.0 kg sled is pulled across a frozen lake with a force of 180 N at an angle of 30.0° with the horizontal. The coefficient of kinetic friction between the sled and the snow is 0.20. Calculate the acceleration of the sled.

18. A box is placed on an inclined plane of 20.° with the horizontal.



    (a) The box remains stationary. Calculate the coefficient of static friction between the box and the inclined plane?
    (b) The angle of the incline is increased to 30.° causing the box to accelerate down the slope at a rate of 2.0 m/s^2. Calculate the coefficient of kinetic friction.

Numerical Answers:

1. (a) 980 N, (b) 163 N
2. 0.003 kg
3. 7.5 m/s^2
4. 6300 N
5. 125 m
6. (b) 280 m/s (c) 39.2 m/s2 (d) 3.9×10^4 N
7. 4.2 m/s^2 down
8. (a) 7.2×10^4 N (b) 2.1×10^4 N
9. 336 N
10. (b)(i) 23.5 N (ii) 4.7 m/s^2 (iii) 57.6 N
11. 3.88 m/s^2
12. (b)(i) 5.1 N (ii) 2.6 m/s^2
13. 12.7 N
14. (a) 3.4 s, (b) 34 m
15. 0.14
16. 0.41
17. 1.52 m/s^2
18. (a) 0.36 (b) 0.34