Worksheet 5.1

1) Calculate the centripetal force acting on a 925 kg car as it rounds an unbanked curve with a radius of 75 m at a speed of 22 m/s.

(6.0×10^3 N)

2) A small plane makes a complete circle with a radius of 3282 m in 2.0 min. What is the centripetal acceleration of the plane?

(9.0 m/s^2)

3) A car with a mass of 833 kg rounds an unbanked curve in the road at a speed of 28.0 m/s. If the radius of the curve is 105 m, what is the average centripetal force exerted on the car? (6.2×10^3 N)

4) An amusement park ride has a radius of 2.8 m. If the time of one revolution of a rider is 0.98 s, what is the speed of the rider? (18 m/s)

5) An electron ($m=9.11 \times 10^{-31}$ kg) moves in a circle whose radius is 2.00×10^{-2} m. If the force acting on the electron is 4.60×10^{-14} N, what is its speed?

(3.18×10^7 m/s)

6) A 925 kg car rounds an unbanked curve at a speed of 25 m/s. If the radius of the curve is 72 m, what is the minimum coefficient of friction between the car and the road required so that the car does not skid?

(0.89)

7) A 2.7×10^3 kg satellite orbits the Earth at a distance of 1.8×10^7 m from the Earth's centre at a speed of 4.7×10^3 m/s. What force does the Earth exert on the satellite? (3.3×10^3 N)

8) A string can withstand a force of 135 N before breaking. A 2.0 kg mass is tied to the string and whirled in a horizontal circle with a radius of 1.10 m. What is the maximum speed that the mass can be whirled at before the string breaks? (8.62 m/s)

9) A 932 kg car is traveling around an unbanked turn with a radius of 82 m. What is the maximum speed that this car can round this curve before skidding:

a) if the coefficient of friction is 0.95? (28 m/s)

b) if the coefficient of friction is 0.40? (18 m/s)

Worksheet 5.2

1) You are riding your bike on a track that forms a vertical circular loop. If the diameter of the loop is 10.0 m, what is the minimum speed required for you to make it around the loop? (7.00 m/s)

2) You are swinging a bucket of water in a vertical circle. Assuming that the radius of the rotation of the water is 0.95 m, what is the minimum velocity of the bucket at the top of its swing if the water is not to spill? (3.1 m/s)

3) A student has a weight of 655 N. While riding a roller coaster they seem to weigh 1.96×10^3 N at the bottom of a dip that has a radius of 18.0 m. What is the speed of the roller coater at this point? (18.7 m/s)

4) A string requires 186 N of force to break. A 1.50 kg mass is tied to the string and whirled in a vertical circle with a radius of 1.90 m. What is the maximum speed that this mass can be whirled at without breaking the string? (14.7 m/s)

5) A 2.2 kg object is whirled in a vertical circle whose radius is 1.0 m. If the time of one revolution is 0.97 s, what is the tension in the string (assume uniform speed)

a) at the top? (71 N)

b) at the bottom? (114 N)

6) A 915 kg car goes over a hill of circular arc. If the radius of the curve is 43 m, how fast can the car travel without leaving the road at the top of the arc? (21 m/s)

7) What is the maximum speed for a car rounding a 125 m curve on a highway under very icy (no friction) conditions if the banking angle is 20.0^{o}.

(21.1 m/s)

Yowsers!) An airplane traveling at a speed of 115 m/s makes a complete horizontal turn in 2 minutes. What is the banking angle?

(31.6^{o} to the horizontal))

$m_{Earth} = 5.98\text{x}10^{24}$ kg $m_{Moon} = 7.35\text{x}10^{22}$ kg

Worksheet 5.3

1) Two students are sitting 1.50 m apart. One student has a mass of 70.0 kg and the other has a mass of 52.0 kg. What is the gravitational force between them? (1.08x10-^{7} N)

2) What gravitational force does the moon produce on the Earth if their centers are 3.84x10^{8} m apart? (1.99x10^{20} N)

3) if the gravitational force between two objects of equal mass is 2.30x10-8 N when the objects are 10.0 m apart what is the mass of each object? (186 kg)

4) Calculate the gravitational force on a 6.50x10^{2} kg spacecraft that is 4.15x10^{6} m above the surface of the Earth. (2.34x10^{3} N)

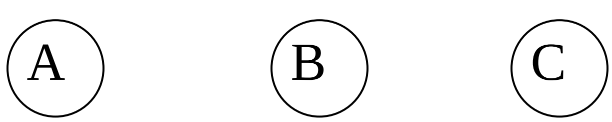
5) The gravitational force between two objects that are 2.1x10^{-1} m apart is 3.2x10^{-6} N. If the mass of one object is 55 kg, what is the mass of the other object? (38 kg)

6) If two objects, each with a mass of 200 kg, produce a gravitational force of 3.7x10^{-6} N, what is the distance between them? (0.85 m)

7) What is the gravitational force on a 70.0 kg object standing on the Earth's surface? (686 N)

8) Three 10.0 kg objects are placed in a straight line 5.00x10-1 m apart. What is the net gravitational force on the center object due to the other two objects? (0N)

9) Three objects A, B, and C are placed 0.50 m apart along a straight line. A and B have masses of 10.0 kg and C has a mass of 15.0 kg, what is the net gravitational force on B due to A and C? (1.33x10^{-8} N)



10) The force of gravity between two small masses A and B when placed very near each other is 3.24x10^{-7} N. What will the force between these objects be if both of their masses are doubled and the distance between them is tripled? (1.44x10^{-7} N)

Worksheet 5.4

1) Calculate the gravitational field strength on the surface of Mars. Mars has a radius of 3.43×10^6 m and a mass of 6.37×10^{23} kg. (3.61 N/kg)

2) At what distance from Earth's surface is the acceleration due to gravity 7.33 m/s^2? (9.97×10^5 m)

3) On the surface of Planet X an object has a mass of 22.5 kg and a weighs 63.5 N. What is the gravitational field strength on the surface?
(2.82 N/kg)

4) On the surface of Planet Y, which has a mass of 4.83×10^{24} kg, a 30.0 kg object weighs 50.0 N. What is the radius of the planet? (1.39×10^7m)

Worksheet 5.5

5) What is the gravitational potential energy (relative to infinite) of a 5.00×10^3 kg satellite that is in orbit with a radius of 9.90×10^6 m around the Earth? (-2.0×10^{11} J)

6) How much work is done against gravity in lifting the satellite in problem #5 to its orbital height? (1.11×10^{11} J)

7) A 1750 kg meteorite is 15000 m above the surface of the moon, heading directly towards the moon at 1.00×10^3 m/s. What is its speed on impact?
(1.02×10^3 m/s)

8) What is the gravitational potential energy of a 10.0 kg object when it is sitting on Earth's surface? (-6.25×10^8 J)

9) What is the escape velocity of a 1300 kg shuttle taking off from the moon? (2.37×10^3 m/s)

10) What is the mass of a planet that has an escape speed of 9.0×10^3 m/s and a radius of 7.2×10^6 m? (4.37×10^{24} kg)

11) A 12500 kg satellite is in orbit at an altitude of 3.60×10^6 m. What is its **total** energy?
HINT: Total Energy = $E_p + E_k$ (-2.50×10^{11} J)