

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.

F = m * v^2 / r = 925 kg * (22 m/s)^2 / 75 m = (6.0 x 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?

2.0 min = 120 s, a_c = 4 * pi^2 * 3282 m / (120 s)^2 = (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?

F_c = m * v^2 / r = 833 kg * (28.0 m/s)^2 / 105 m = (6.2 x 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?

v_c = 2 * pi * r / T = 2 * pi * 2.8 m / 0.98 s = (18 m/s)

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

F = m * a -> 4.6 * 10^-14 N / 9.11 * 10^-31 kg = a = 5.05 * 10^16 m/s^2 = v^2 / (2.00 * 10^-2 m) -> v = (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?

F_c = F_N * mu, F_c = 925 kg * 25 m/s^2 / 72 m = 9.8 * 925 * mu = (0.89)

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

F_c = 2.7 * 10^3 kg * (4.7 * 10^3 m/s)^2 / 1.8 * 10^7 m = (3.3 x 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?

F_c = 135 N = 2.0 kg * v^2 / 1.10 m -> v = (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)

0.95
F_f = 932 * 9.8 * 0.95 = 932 kg * v^2 / 82 m
v = 27.6 m/s

0.40
932 * 9.8 * 0.40 = 932 * v^2 / 82
v = 17.9 m/s