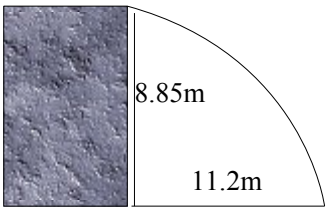
Physics 20

Chapter 7 Review Worksheet

1. An insurance company has asked you to visit an accident scene in the river valley. A car went over a 8.85m cliff and fell so that it hit the ground 11.2 m from the base. The driver was lucky to only receive a few small cuts and bruises. He claims that he was not driving over the posted speed limit of 35 km/h. **Determine** if you will tell the insurance company that he is lying or telling the truth.



$d = v_i t + \frac{1}{2} a t^2$
$t = \text{sqr root}(2d / a)$
$= \text{sqr root}(2 \times 8.85 / 9.81)$
$t = 1.34$ s

$v = d / t$
$= 11.2 / 1.34$
$v = 8.34$ m/s $= 30.0$ km/h
He was not speeding.

2. The school football team has asked you for advice. During kickoffs the ball is not going far enough. The team's kicker shows you his kicks, and you figure out that he consistently kicks the ball so that it leaves his foot moving at 72 km/h.
   a) **Predict** the best angle for him to try to kick the ball so that it will go as far as possible.

45°

Use any method you want to calculate the components, which are equal in this question.

   b) If he does kick it at that angle, **determine** how far it will travel.

72 km/h = 20 m/s
$x = y = \sin 45 (20)$
$x = y = 14$ m/s

$d = v_i t + \frac{1}{2} a t^2$
$0 = v_i t + \frac{1}{2} a t^2$
$t = -2v_i / a$
$= -2(14)/-9.81$
$t = 2.88$s

$v = d / t$
$d = vt$
$= 14(2.88)$
$d = 41$ m

   c) The team is also concerned that it will travel low to the ground and hit them in the back of the heads! **Determine** the maximum height it will reach.

$v_f^2 = v_i^2 + 2ad$
$d = v_f^2 - v_i^2 / 2a$
$= 0 - 14^2 / 2(-9.81)$
$d = 10$ m

3. **Determine** the centripetal acceleration of a car that travels around a curved road which has a diameter of 450m if its speed is a constant 26.0m/s.

$a_c = v^2 / r = 26.0^2 / 225 = 3.00\ m/s^2$

4. **Determine** the maximum speed that a 1.6×10^3kg car can round an unbanked curve if the radius of the curve is 55m and the coefficient of friction is 0.60.

$$F_c = F_f$$
$$\frac{mv^2}{r} = \mu F_N$$
$$\frac{mv^2}{r} = \mu mg \quad \text{<- cancel "m"}$$
$$\frac{v^2}{r} = \mu g \rightarrow v = \sqrt{r \mu g} = \sqrt{55 \, x \, 0.60 \, x \, 9.81} = 18 \, m/s$$

5. **Determine** the tension in a 0.750m string if it is used to twirl a 0.150kg mass in a horizontal circle at a rate of 2.50 revolutions per second.

2.50 rev / sec
T = 1 / 2.50 = 0.400 s

$$F_c = \frac{4\pi^2 mr}{T^2}$$
$$F_c = \frac{4\pi^2 \, x \, 0.150 \, x \, 0.750}{0.400^2}$$
$$F_c = 27.7 \, N$$

6. **Determine** the maximum speed that a 1.75kg mass can travel at the bottom of a vertical circle if it is swung on a string 1.10m long that will break if subjected to a force greater than 262N.

$$F_T = F_g + F_c$$
$$F_T = mg + \frac{mv^2}{r}$$
$$262N = 1.75 \, x \, 9.81 + \frac{1.75 \, v^2}{1.10}$$
$$v = 12.4 \, m/s$$

7. A ball of mass 15g is revolved in a vertical circle on the end of a 1.05m long piece of string. **Determine** the minimum speed needed at the top of the circle so the string doesn't go loose.

$$F_c = F_g$$
$$\frac{mv^2}{r} = mg$$
$$v = \sqrt{rg} = \sqrt{1.05 \, x \, 9.81}$$
$$v = 3.21 \, m/s$$