

Physics 10154 - Exam #7B

Answer the following two questions. Be sure to clearly indicate your answer with a circle or box. Show all work. If I cannot see how you arrived at an answer, I will deduct points!

1. A pendulum bob of mass 2.5 kg is attached to a 3.0 meter long massless string. At the bottom of its motion, the bob is moving at a speed of 6.0 m/s.

a) What is the tension in the string at this point?

b) When the string makes an angle of 25° with respect to the vertical, what is the tension in the string?



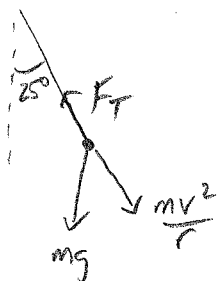
$$a) \Sigma F_{rad} = \frac{mv^2}{r} + mg - F_T = 0$$

$$F_T = \frac{mv^2}{r} + mg$$

$$= \frac{(2.5)(6.0)^2}{3.0} + (2.5)(9.8)$$

$$= 30 + 24.5 = \boxed{55 \text{ N}}$$

b)



Find v :

$$\Sigma W_F = W_{grav} = -mgh = \frac{1}{2}mv^2 - \frac{1}{2}mv_0^2$$

$$-gh = \frac{1}{2}v^2 - \frac{1}{2}v_0^2$$

$$v^2 = v_0^2 - 2gh$$

$$v^2 = (6.0)^2 - 2(9.8)(0.28)$$

$$v = \underline{5.5 \text{ m/s}}$$

$$\Sigma F_{rad} = \frac{mv^2}{r} + mg \cos 25^\circ - F_T = 0$$

$$F_T = \frac{mv^2}{r} + mg \cos 25^\circ = 25.2 + 22.2$$

$$= \boxed{47 \text{ N}}$$

2. A satellite moves in a circular orbit around the Earth with a speed of 3400 m/s.

a) Find the satellite's altitude above Earth's surface, in miles.

b) Find the orbital period of the satellite, in hours.

$$a) \quad v = \sqrt{\frac{GM}{r}} \quad r = \frac{GM}{v^2}$$

$$r = \frac{(6.67 \times 10^{-11})(5.98 \times 10^{24})}{(3400)^2}$$

$$= 3.45 \times 10^7 \text{ m}$$

$$h = r - R_E = 3.45 \times 10^7 - 6.38 \times 10^6$$

$$= \boxed{2.8 \times 10^7 \text{ m}} = \boxed{17,000 \text{ mi}}$$

$$b) \quad T = \frac{2\pi r}{v} = \frac{2\pi(3.45 \times 10^7)}{3400}$$

$$= 6.376 \times 10^4 \text{ s}$$

$$= \boxed{18 \text{ hrs}}$$