

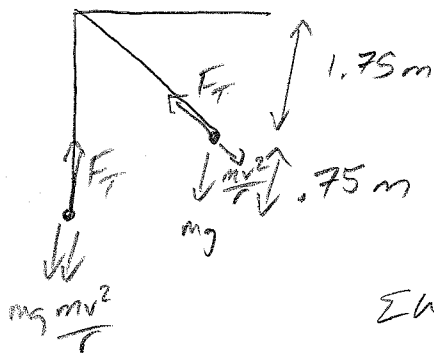
Physics 10154 - Exam #7D

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 1.2-kg pendulum bob is attached to a massless 2.5 meter string and held at rest with the string horizontal. The bob is then released and allowed to fall in a vertical circle.

a) What is the tension in the string when the pendulum is 75 cm above its lowest point?

b) What is the tension in the string when the pendulum is at its lowest point?



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

$$0.75 = 2.5 - 2.5 \cos \theta$$

$$\text{so } \cos \theta = 0.7, \theta = 45.6^\circ$$

$$\Sigma W_F: mgh = \frac{1}{2}mv^2 - 0$$

$$v = \sqrt{2gh} = \sqrt{2(9.8)(1.75)} = 5.86 \text{ m/s}$$

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

$$= \frac{(1.2)(5.86)^2}{2.5} + (1.2)(9.8) \cos 45.6^\circ$$

$$= 16.5 + 8.2 = \boxed{25 \text{ N}}$$

$$b) mgh = \frac{1}{2}mv^2$$

$$v = \sqrt{2(9.8)(2.5)} = 7.0 \text{ m/s}$$

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

$$F_T = (1.2)(9.8) + \frac{(1.2)(7)^2}{2.5}$$

$$= 11.8 + 23.5 = \boxed{35 \text{ N}}$$

2. A satellite moves in a circular orbit around the Earth with a speed of 5600 m/s. Determine

a) The satellite's altitude above the surface (in miles).

b) The satellite's orbital period (in hours).

$$v = \sqrt{\frac{GM}{r}}$$

$$r = \frac{GM}{v^2} = \frac{(6.67 \times 10^{-11})(5.98 \times 10^{24})}{(5600)^2}$$

$$= 1.272 \times 10^7$$

$$h = r - R_E$$

$$= 1.272 \times 10^7 - 6.38 \times 10^6$$

$$= 6.3 \times 10^6 \text{ m} = \boxed{3900 \text{ mi}}$$

$$b) T = \frac{2\pi r}{v} = \frac{2\pi (1.272 \times 10^7)}{5600}$$

$$= 14300 \text{ s}$$

$$= \boxed{4.0 \text{ hrs}}$$