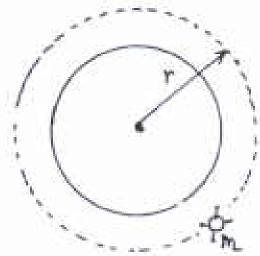
Name________________________

**Phys 121, Section 2**
**Quiz #3 — Fall 2000**




$r = 5610$ km  $m = 540$ kg
$T = 1.66$ hr

1. A 540 kg satellite orbits the planet Ŋösñíḅøŗ in a circular orbit with radius 5610 km. The period of the orbit is 1.66 hr.

a) Find the (tangential) speed of the satellite; express the answer in units of $\frac{\text{m}}{\text{s}}$.

$$v = \frac{\text{Circumference}}{\text{Period}} = \frac{2\pi r}{T}$$

$$= \frac{2\pi\,(5610 \text{ km})}{(1.66 \text{ hr})}\left(\frac{1 \text{ hr}}{3600 \text{ s}}\right)\left(\frac{10^3 \text{ m}}{1 \text{ km}}\right) = \boxed{5.898 \times 10^3 \tfrac{\text{m}}{\text{s}}}$$

b) Find the centripetal acceleration of the satellite as it orbits.

$$a_{cent} = \frac{v^2}{r} = \frac{(5.898 \times 10^3 \tfrac{\text{m}}{\text{s}})^2}{(5610 \times 10^3 \text{ m})} = \boxed{6.20 \tfrac{\text{m}}{\text{s}^2}}$$

c) Find the centripetal force on the satellite as it orbits.

$$F_{cent} = \frac{mv^2}{r} = m\left(\frac{v^2}{r}\right) = (540 \text{ kg})(6.20 \tfrac{\text{m}}{\text{s}^2}) = \boxed{3.35 \times 10^3 \text{ N}}$$

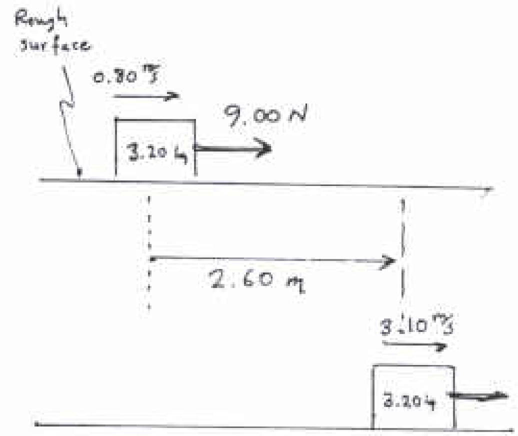
d) Find the mass of the planet Ŋösñíḅøŗ. (Note: The force which acts on the satellite is the gravitational attraction of the planet!)

If mass of planet $= M$ then

$$F_{cent} = F_{grav} = G\frac{Mm}{r^2} = \frac{mv^2}{r} \qquad \text{So} \qquad \frac{GM}{r} = v^2$$

or:
$$M = \frac{rv^2}{G} = \frac{(5610 \times 10^3 \text{ m})(5.898 \times 10^3 \tfrac{\text{m}}{\text{s}})^2}{(6.67 \times 10^{-11} \text{ N m}^2/\text{kg}^2)} = \boxed{2.93 \times 10^{24} \text{ kg}}$$

**2.** A 3.20 kg block is dragged along a *rough* surface by a horizontal appled force of 9.00 N. Starting from when the block had a speed of 0.800 $\frac{m}{s}$, the block is dragged for 2.60 m, after which its speed is 3.10 $\frac{m}{s}$.




**a)** What is the work done by the applied force?

$$W_{app.f.} = (9.00\,N)(2.60\,m)(1)$$
$$= \boxed{23.4\ J}$$

**b)** What is the change in kinetic energy of the block?

$$\Delta KE = \tfrac{1}{2}mv_f^2 - \tfrac{1}{2}mv_0^2 = \tfrac{1}{2}m\,(v_f^2 - v_0^2)$$
$$= \tfrac{1}{2}(3.20\,kg)\left((3.10\tfrac{m}{s})^2 - (0.80\tfrac{m}{s})^2\right) = \boxed{14.4\ J}$$

**c)** What was the work done by friction?

Only the applied force and friction do work:

$$W_{net} = W_{app.f.} + W_{fric} = 23.4\ J + W_{fric} = \Delta KE = 14.4\ J$$

$$W_{fric} = 14.4\ J - 23.4\ J = \boxed{-9.05\ J}$$

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**You must show all your work!**

$$g = 9.80\,\tfrac{m}{s^2} \qquad F_{grav} = G\frac{m_1 m_2}{r^2} \quad \text{where} \quad G = 6.67\times10^{-11}\,\tfrac{N\cdot m^2}{kg^2}$$

$$1\text{ km} = 10^3\text{ m} \qquad 1\text{ hr} = 3600\text{ s} \qquad C = 2\pi r \qquad a_{cent} = \frac{v^2}{r} \qquad F_{cent} = \frac{mv^2}{r}$$

$$W = Fs\cos\theta \qquad KE = \tfrac{1}{2}mv^2 \qquad PE_{grav} = mgh$$

$$W_{net} = \Delta KE \qquad \Delta E = E_f - E_0 = \Delta PE + \Delta KE = W_{non\text{--}cons}$$