Solutions

Physics 1308-H01 Exam #2, Fall, 2010

Instructions: Do real good. Show your work for all problems. Partial credit will be assigned for things that make sense. $g=9.80\ m/s^2$, $G = 6.67\times10^{-11}\ Nm^2/kg^2$.

Short questions: (7.5 points each, drop the low one)

1. What is the difference between centripetal force and centrifugal force?

Centripetal force is the real force pointing towards the center. Centrifugal force is a fictitious force "observed" in the accelerated frame of reference, and acts outwards.

2. A 4.0 kg block, initially moving at 3.0 m/s, slides a distance of 7.5 m on a flat surface before stopping. The coefficient of sliding friction between the block and the surface is (Use Newton's second law)
a) 0.60 (b) 0.062 c) 0.10 d) 0.32

$a = -\frac{v_0^2}{2d} = -0.60\ m/s^2$

$F = ma = -\mu_K N = -\mu_K mg$

So $\mu_K = -\frac{a}{g} = 0.061$

3. An object is released from rest and allowed to fall through air, subject to a drag force which is proportional to its velocity. Describe how the velocity and acceleration of the object change as it falls.

Initally, $a=-g$ and $v=0$. As v increases, the drag force increases, decreasing a until it reaches 0 and the velocity becomes constant at its terminal value.

4. A comet on a very elliptical orbit moves much faster when it is near the sun than when it is far away from the sun. This behavior is described by
a) Kepler's first law (law of ellipses)
(b) Kepler's second law (law of equal areas)
c) Kepler's third law (harmonic law)

5. An object at the center of the earth has a weight which, when compared to the weight it would have at the surface,
a) is much greater b) is somewhat less c) is somewhat greater (d) is zero e) is the same

6. At what distance from the center of the earth will the acceleration of gravity be 0.80g?

$F_g = ma = \frac{GmM_E}{r^2}$ so $a = \frac{GM_E}{r^2}$ but $g = \frac{GM_E}{R_E^2}$

so $\frac{a}{g}\times 0.80 = \frac{R_E^2}{r^2}$, $r = \sqrt{\frac{1}{0.80}}R_E = 1.12\,R_E$

or if assume earth is uniform, $0.80 = \frac{r}{R_E}$ $r = 0.80\,R_E$

7. The centripetal force does no work on an object moving in uniform circular motion. Discuss why this is so based on the general formula for calculating work, and the work-energy theorem.

$W = \int \vec{F}\cdot d\vec{s}$, but $\vec{F} \perp d\vec{s}$, so $W = 0$.

Speed is constant, so the W-E theorem says $W = 0$.