

Arts & Science 2D06

Quiz #3 2013 Oct 22

Name:

NB: Mark values are given in brackets [] beside each problem. Write all your answers on the quiz paper. No books or notes allowed. Time to write quiz: 50 minutes.

Solution for quadratic equation: $x = (-b \pm \sqrt{b^2 - 4ac})/2a$

centripetal $a_c = v^2/r$ linear K.E. = $(1/2)mv^2$

Energy conservation $E = K + U$ Gravitational force: $F_g = GMm/r^2$

$G = 6.67 \times 10^{-11} \text{ N m}^2/\text{kg}^2$ (Newton's law of gravity constant)

$M_E = 5.98 \times 10^{24} \text{ kg}$ (mass of Earth) $R_E = 6.37 \times 10^6 \text{ m}$ (radius of Earth)

1. [3] The potential energy of a spring is:

- a) proportional to the square root of the distance stretched.
- b) proportional to the distance stretched.
- c) proportional to the square of the distance stretched.
- d) independent of the distance stretched.

2. [3] Consider two satellites A and B circling around the earth in concentric orbits. A and B have the same mass. The distance of satellite A to the centre of the earth is half that of satellite B . Ignoring air resistance, the ratio of the centripetal force acting on B to that acting on A is:

(Explain/derive your answer in the space provided.)

- a) 1
- b) $\sqrt{1/2}$
- c) $1/2$
- d) $1/4$
- e) none of the above.

3. [5] Suppose that a rotating disk has a non-uniform angular acceleration given by $\alpha = 12t - 3t^2$ rad/s². If the angular speed at 2 seconds is 10 rad/s and the angular displacement at 3 seconds is 6 radians, find equations for the angular displacement and angular speed as functions of time.

4. [5] A ball of mass 0.8 kg is suspended by a (massless) string of length 1.6 m. The ball is released from rest with the string at 40° with respect to the vertical. The ball's motion is then interrupted by a peg located at 1 m below the top, as shown in the figure. Find the largest angle, with respect to the vertical, reached by the string after it hits the peg.

5. [4] Calculate the acceleration due to gravity at a height that is a distance R_E above Earth's surface, where R_E is the radius of the earth.

[20] total marks