

Arts & Science 2D06

Quiz #3 2007 Nov 02

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. = $(1/2)mv^2$ Rotational K.E. = $(1/2)I\omega^2$

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

Elastic collisions, target m_2 stationary: $v_1 = \frac{(m_1 - m_2)}{(m_1 + m_2)}u_1$, $v_2 = \frac{2m_1}{(m_1 + m_2)}u_1$

$G = 6.67 \times 10^{-11}$ N m²/kg² (Newton's law of gravity constant)

$g = 9.8$ m/s² (acceleration of gravity near surface of Earth)

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

1. [2] Two kids, Mary and John, sit on a spinning merry-go-round. Mary is on the outer rim and John is halfway between the center and the rim. Mary's tangential (linear) velocity is: (Explain/derive your answer in the space provided.)

- a) same as John's
- b) twice John's
- c) half of John's
- d) 1/4 of John's
- e) four times John's

2. [3] A cart moving at speed v on a frictionless track, collides with an identical cart at rest. The two carts stick together after they collide. What is their velocity after colliding? (Explain/derive your answer in the space provided.)

- a) v
- b) $0.5 v$
- c) zero
- d) $-0.5 v$
- e) $-v$

3. (a) [3] Find the force due to gravity on the Moon's surface.
(Use $M_{moon} = 7.35 \times 10^{22}$ kg and $R_{moon} = 1.74 \times 10^6$ m)

(b) [2] Find also the acceleration due to gravity on the Moon's surface. How does it compare to the gravitational acceleration on the Earth's surface?

4. [5] A hunter standing in a boat at rest on a lake shoots a rifle horizontally. The bullet has a mass of 50 g and travels at 350 m/s relative to the gun's barrel. The hunter, rifle, and boat together have a mass of 300 kg. What is the speed of the boat right after the rifle is fired?

5. [5] A solid disk ($I = 0.5MR^2$) of radius 1.60 m and mass 2.30 kg rolls without slipping to the bottom of an inclined plane. If the height of the inclined plane is 5 m, what is the angular velocity of the disk when it reaches the bottom?

[20] total marks