Arts & Science 2D06

Quiz #2 2013 Oct 10 Name: Solutions

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

Equations of motion for uniform acceleration: $x = x_0 + v_0 t + \frac{1}{2}at^2$, $v^2 = v_0^2 + 2ax$

$g = 9.8$ m/s^2 centripetal $a_c = v^2/r$ linear K.E. $= (1/2)mv^2$

1. [3] One of the following statements is not one of Newton's three laws of motion. Which one?

no explanation required.

(a) $F = ma$

(b) Forces come in action-reaction pairs.

→(c) All things free-fall with the same acceleration.

(d) An object at rest stays at rest, unless acted on by a force.

2. [3] A student pushes a heavy box across a horizontal floor. The work done by the force of gravity on the box while it is pushed:

(Explain your answer in the space below.)

(a) depends on how hard the student is pushing.

→(b) is equal to zero.

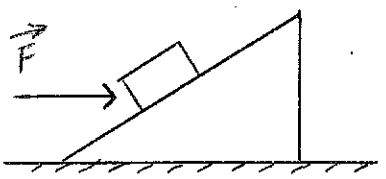
(c) cannot be determined without further information.

(d) depends on the coefficient of static friction.

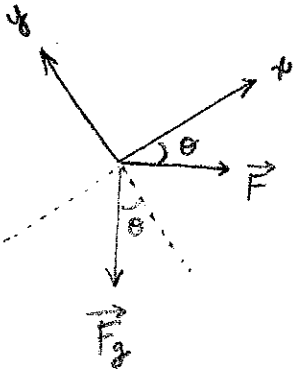
$\Delta y = 0$, while box is pushed.

$\Rightarrow W_{grav} = 0$.

3. [4] A brick of mass 2 kg is on a frictionless incline of 40 degrees, and is being pushed by a horizontal force of 6 N, as shown in the figure. Calculate the brick's acceleration.



$$\sum F_x = ma_x$$



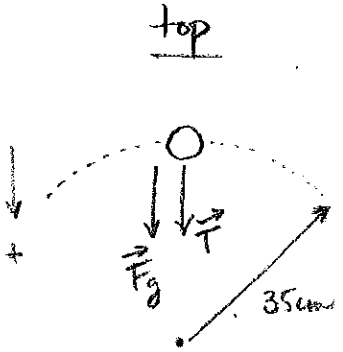
$$F\cos\theta - mg\sin\theta = ma_x$$

$$\therefore a_x = \frac{F\cos\theta}{m} - g\sin\theta$$

$$= \frac{6\cos 40^\circ}{2} - 9.8\sin 40^\circ$$

$$= 2.3 - 6.3 = -4.0\ \text{m/s}^2$$

4. [5] A 0.1-kg tennis ball moves in a vertical circle at the end of a string of length 35 cm. Find the tension in the string at the top of the circle, if the speed there is 2.5 m/s.



$$\sum \vec{F} = ma_c = \frac{mv^2}{R}$$

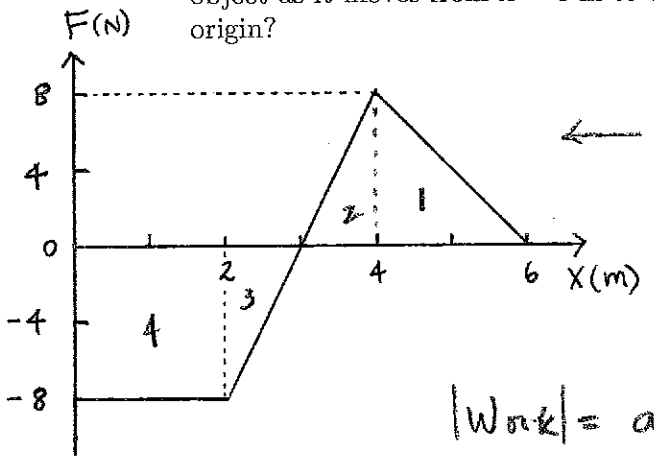
$$T + F_g = \frac{mv^2}{R}$$

$$T = \frac{mv^2}{R} - F_g = \frac{mv^2}{R} - mg$$

$$\therefore \quad T = \frac{(0.1)(2.5)^2}{0.35} - 0.1(9.8)$$

$$= 1.79 - 0.98 = 0.81 \text{ N}.$$

5. [5] A horizontal force experienced by a 0.3-kg object is shown in the figure below. Suppose that before the object begins to feel the force, it is approaching the origin from the right, with a speed of 12 m/s. (a) Determine the work done by this force on the object as it moves from x = 6 m to the origin. (b) What is its kinetic energy at the origin?



|Work| = area under the curve :

1) $W_1 = \frac{8(4-6)}{2} = -8\ J$

2) $W_2 = \frac{8(3-4)}{2} = -4\ J$

3) $W_3 = \frac{-8(2-3)}{2} = +4\ J$

4) $W_4 = (-8)(0-2) = 16\ J$

$\therefore \quad W = -8 - 4 + 4 + 16 = 8\ J.$

[20] total marks