

Arts & Science 2D06

Quiz #2 2006 Oct 19

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

Equations of motion for uniform acceleration: $x = x_0 + v_0t + \frac{1}{2}at^2$, $v^2 = v_0^2 + 2ax$

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

Gravitational potential energy: $U = mgy$ Spring potential energy: $U = (1/2)kx^2$

1. [3] Two identical arrows are fired into a bale of hay and come to a stop inside the bale. The first one strikes the hay at three times the speed of the second one. How much further into the hay will the first one penetrate? Make a reasonable estimate.

- (a) The first arrow goes in $\sqrt{3}$ times farther than the second one
- (b) The first arrow goes in 3 times farther than the second one
- (c) The first arrow goes in 9 times farther than the second one
- (d) Both of them go in the same distance before stopping

Explain your reasoning for your choice:

2. [2] A ball on a string is whirled in a vertical circle *at constant speed*. At the top of the circle, the tension in the string equals the weight of the ball, $T = mg$. At the bottom of the circle, the string tension is therefore

- (a) $T = 0$
- (b) $T = mg$
- (c) $T = 2mg$
- (d) $T = 3mg$

3. [5] A skier starts from rest on a 20° slope and accelerates downhill.

(a) Use energy conservation to find out how fast she would be moving after $d = 30$ meters along the slope, if the slope were frictionless.

(b) Calculate the coefficient of kinetic friction of the skis on the slope, if her actual speed at $d = 30$ m is 12 m/s.

4. [3] A backpack of mass m hangs from a rope sling as shown. Derive the expression for the tension T in the rope as a function of m and θ .

5. [3] A 4.0-kg bag is tied to an unstretched spring hanging from the ceiling as shown, then it is released. The bag falls as the spring stretches. After it stretches downward 45 centimeters the bag stops, then bounces back up again.

What is the spring constant k (Hint: what is the energy at the top and bottom?)

6. [4] Two equal masses $m = 12$ kg are tied together as shown, with one sliding on a horizontal table and the other hanging from the string over a frictionless peg. Their acceleration is $a = 3.0$ m/s².

(a) What is the coefficient of friction μ with the table?

(b) What is the tension in the string?

[20] total marks