

Physics 2 – Summer Session 2009

Quiz # 3

Question 1

The magnitude of the acceleration of an oscillator of amplitude A and angular frequency ω when its displacement is at a maximum is

- (a) ωA
- (b) $\omega^2 A$
- (c) A
- (d) zero
- (e) none of the above

$$F = ma = -kx = -kA \rightarrow a = (k/m)A = \omega^2 A \rightarrow \text{correct answer is (b)}$$

Question 2

The position of a particle is given by $x = 3\cos(\pi t/3)$, where x is in meters and t is in seconds. The maximum speed of the particle is

- (a) 3 m/sec
- (b) 3π m/sec
- (c) $3\pi^2$ m/sec
- (d) π m/sec
- (e) none of the above

$$v = dx/dt = -3\pi/3 \sin(\pi t/3) = -\pi \sin(\pi t/3) \rightarrow v_{\max} = \pi \rightarrow \text{correct answer is (d)}$$

Question 3

A point mass of mass m is initially at the surface of a large sphere of mass M and radius R . The amount of work needed to move it to a position infinitely far away from the sphere is

- (a) GMm/R
- (b) GMm/R^2
- (c) GM/R^2
- (d) Gm/R

$$W = \int F dr \text{ between } r=R \text{ and } r=\text{infinity. } F dr = -(GMm/r^2) dr$$

The integral is just $GMm/R \rightarrow \text{correct answer is (a)}$

Question 4

Planets A and B orbit a star in circular orbits. A is located twice as far from the star as B. Which of the following statements is true?

- (a) A's orbital period is less than B's
- (b) A's orbital period is greater than B's
- (c) The two periods are the same
- (d) Need more information to answer this question

$$F = GmM/R^2 = m\omega^2R \rightarrow \omega^2 = GM/R \text{ (independent of the mass } m)$$

So, if R is larger than ω is smaller. But since $\omega = 2\pi/T$, R larger means T larger.

→ **correct answer is (b)**

Question 5

For an object undergoing simple harmonic motion.....

- (a) the magnitude of the acceleration of the object is proportional to its displacement from its equilibrium position
- (b) the magnitude of the force of the object is proportional to its displacement from its equilibrium position
- (c) neither are true
- (d) both are true

$F = ma = -kx$. Both force and acceleration are proportional to displacement

→ **correct answer is (d)**

Question 6

A pendulum of length L and mass M has frequency f . To increase the frequency to $2f$, you should

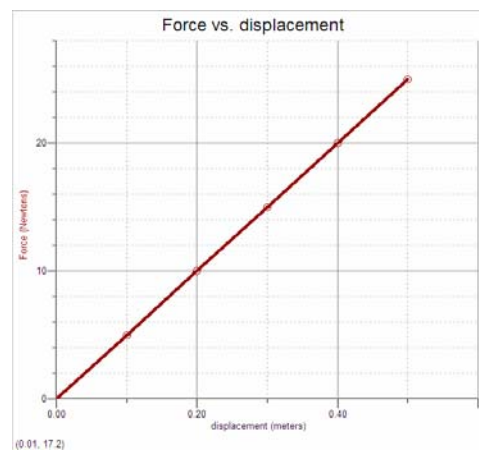
- (a) increase its length to $2L$
- (b) increase its mass to $2M$
- (c) increase its length to $4L$
- (d) decrease its length to $L/2$
- (e) decrease its length to $L/4$

$T = 2\pi \sqrt{L/g} \rightarrow f = (1/2\pi) \sqrt{g/L} \rightarrow$ to double the frequency L must become 4 times smaller → **correct answer is (e)**

Question 7

Consider the *force vs displacement* graph shown for an ideal spring. The work done in stretching the spring from 0.1 m to 0.5 m is

- (a) 1 J
- (b) 4 J
- (c) 6 J
- (d) 12 J
- (e) 24 J



$W = \int F dx$ between $x_1 = 0.1$ m and $x_2 = 0.5$ m.
 $F(x) = Ax$, where $A = 50$ N/m.

Let's check this $F(x=0.4\text{m}) = Ax = 50\text{N/m} * 0.4 \text{ m} = 20 \text{ N}$ (OK)

$W = \frac{1}{2} A (x_2^2 - x_1^2) = \frac{1}{2} 50 (0.25 - 0.01) \text{ J} = 6 \text{ J} \rightarrow$ **correct answer is (c)**