AP PHYSICS

Name: ______________________________

Period: ________ Date: ___________________

DEVIL PHYSICS

BADDEST CLASS ON CAMPUS

AP EXAM		CHAPTER TEST	
50 Multiple Choice • 45 Single Response • 5 Multi-Response	90 min, 1 point each	25 Multiple Choice • 22 Single Response • 3 Multi-Response	45 min
Free Response • 3 Short Free Response • 2 Long Free Response	90 min • 13 min ea, 7 pts ea • 25 min ea, 12 pts ea	Free Response • 2 Short Free Response • 1 Long Free Response	45 min • 12 min ea, 7 pts ea • 20 min ea, 12 pts ea

CHAPTER 11 TEST REVIEW -- MARKSCHEME

MULTIPLE CHOICE

1. Which of the following is/are characteristics of simple harmonic motion?

   I. The acceleration is constant.

   II. The restoring force is proportional to the displacement.

   III. The frequency is independent of the amplitude.

   a. II only
   b. I and II only
   c. I and III only
   d. II and III only
   e. I, II, and III

2. A block attached to an ideal spring undergoes simple harmonic motion. The acceleration of the block has its maximum magnitude at the point where

   a. the speed is the maximum
   b. the potential energy is the minimum
   c. the speed is the minimum
   d. the restoring force is the minimum
   e. the kinetic energy is the maximum
   f. the displacement is the minimum

3. A block attached to an ideal spring undergoes simple harmonic motion about its equilibrium position ($x = 0$) with amplitude A. What fraction of the total energy is in the form of kinetic energy when the block is at position $x = ½ A$?

   a. 1/3
   b. 3/8
   c. 1/2
   d. 2/3
   e. 3/4
   f. 0

4. A student measures the maximum speed of a block undergoing simple harmonic oscillations of amplitude A on the end of an ideal spring. If the block is replaced by one with twice the mass but the amplitude of its oscillations remains the same, then the maximum speed of the block will
   a. decrease by a factor of 4
   b. decrease by a factor of 2
   c. decrease by a factor of $\sqrt{2}$
   d. remain the same
   e. increase by a factor of 2
5. A spring-block simple harmonic oscillator is set up so that the oscillations are vertical. The period of the motion is T. If the spring and block are taken to the surface of the Moon, where the gravitational acceleration is 1/6 of its value here, then the vertical oscillations will have a period of
   a. T/6
   b. T/3
   c. $T/\sqrt{6}$
   d. T
   e. $T\sqrt{6}$
6. A linear spring of force constant k is used in a physics lab experiment. A block of mass m is attached to the spring and the resulting frequency f of the simple harmonic oscillations is measured. Blocks of various masses are used in different trials, and in each case, the corresponding frequency is measured and recorded. If f^2 is plotted versus $1/m$, the graph will be a straight line with slope
   a. $\frac{4\pi^2}{k^2}$
   b. $\frac{4\pi^2}{k}$
   c. $4\pi^2 k$
   d. $\frac{k}{4\pi^2}$
   e. $\frac{k^2}{4\pi^2}$
7. A simple pendulum swings about the vertical equilibrium position with a maximum angular displacement of 5° and a period T. If the same pendulum is given a maximum angular displacement of 10°, then which of the following best gives the period of the oscillations?
   a. $\frac{T}{2}$
   b. $\frac{T}{\sqrt{2}}$
   c. T
   d. $T\sqrt{2}$
   e. 2T
8. If the length of a pendulum with period 10 seconds were halved, what would be its new period?
   a. 3.2 s
   b. 5.0 s
   c. 7.1 s
   d. 10 s
   e. 13 s

9. A massless vertical spring is displaced 0.15 m when a 3.25 kg mass is attached. When used horizontally, what is the total energy if the spring has an amplitude of 0.25 m?

   a. 0.65 J

   b. 1.0 J

   c. 3.4 J

   d. 6.6 J

   e. 9.8 J

10. Which of the following could be the fundamental frequency for a vibration that has an overtone frequency of 990 Hz?

   a. 330 Hz

   b. 660 Hz

   c. 1485 Hz

   d. 1980 Hz

   e. 1990 Hz

11. The intensity of a spherical wave is 21 W/m^2 at a distance of 16 meters away from a constantly emitting source. What will it be from 3 meters away?

   a. 1000 W/m^2

   b. 600 W/m^2

   c. 112 W/m^2

   d. 3.9 W/m^2

   e. 0.74 W/m^2

12. Which of the following values would NOT be sufficient to determine the force of tension in a string vibrating at its fundamental frequency?

   a. Wavelength, frequency, and mass

   b. Mass, wave velocity, and string length

   c. Wave velocity, mass, and wavelength

   d. String length, mass and frequency

   e. Wave velocity, string length, and frequency

13. In seismology, the P wave is a longitudinal wave. As a P wave travels through the Earth, the relative motion between the P wave and the particles is

   a. perpendicular

   b. parallel

   c. first perpendicular, then parallel

   d. first parallel, then perpendicular

   e. it is dependent on the wave source

14. A wave moves on a string with wavelength λ and frequency f. A second wave on the same string has wavelength 2λ and travels with the same velocity. What is the frequency of the second wave?

   a. 0.5f

   b. f

   c. 2f

   d. 4f

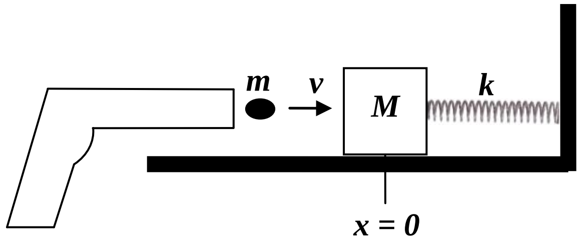
   e. cannot be determined from the information given

15. The intensity of a wave is
    a. proportional to the amplitude squared and inversely proportional to the frequency squared
    b. inversely proportional to the amplitude squared and proportional to the frequency squared
    c. proportional to both the amplitude squared and the frequency squared
    d. inversely proportional to both the amplitude squared and the frequency squared
    e. proportional to the amplitude squared and the frequency
16. If one doubles the tension in a violin string, the fundamental frequency of that string will increase by a factor of
    a. 1.4
    b. 1.7
    c. 2
    d. 4
    e. the fundamental frequency does not change
17. Two masses, A and B, are attached to different but identical springs. Mass A vibrates with amplitude of 8.0 cm at a frequency of 10 Hz and mass B vibrates with amplitude of 5.0 cm at a frequency of 16 Hz. How does the maximum speed of A compare to the maximum speed of B?
    a. Mass A has the greater maximum speed
    b. Mass B has the greater maximum speed
    c. Mass A has a greater speed at the maximum displacement while mass B has the greater speed at the equilibrium point
    d. They are equal
    e. There is not enough information to determine
18. A 0.30 kg mass is suspended vertically on a spring. In equilibrium the mass stretches the spring 2.0 cm downward (upward really isn't an option). The mass is then pulled an additional distance of 1.0 cm down and released from rest. What is its equation of motion?
    a. $y = (0.01m)\sin(22.1t)$
    b. $y = (0.01m)\cos(22.1t)$
    c. $y = (0.02m)\sin(22.1t)$
    d. $y = (0.03m)\cos(22.1t)$
    e. $y = (0.03m)\sin(22.1t)$
19. An object in simple harmonic motion obeys the following position versus time equation: $y = (0.50m)\sin\left(\frac{\pi}{2}t\right)$. What is the maximum speed of the object?
    a. 0.13 m/s
    b. 0.17 m/s
    c. 0.26 m/s
    d. 0.39 m/s
    e. 0.79 m/s

20. A mass attached to the free end of a spring executes simple harmonic motion according to the equation $y = (0.50m)\sin(18\pi t)$ where y is in meters and t is in seconds. What is the period of the vibration?
    a. 9.0 s
    b. 18 s
    c. 1/9 s
    d. 1/18 s
    e. cannot be determined from this equation
21. What is the wave speed if a wave has a frequency of 12 Hz and a wavelength of 3.0 m?
    a. 0.25 m/s
    b. 4.0 m/s
    c. 9.0 m/s
    d. 15 m/s
    e. 36 m/s
22. What is the frequency of a 2.5 m wave traveling at 1400 m/s?
    a. 178 Hz
    b. 560 Hz
    c. 1.78 kHz
    d. 3.5 kHz
    e. 5.6 kHz
23. The velocity of propagation of a transverse wave on a 2.0 m long string fixed at both ends is 200 m/s. Which one of the following is NOT a resonant frequency of this string?
    a. 25 Hz
    b. 50 Hz
    c. 100 Hz
    d. 150 Hz
    e. 200 Hz
24. A string of linear density 1.5 g/m is under tension of 20 N. What should its length be if its fundamental resonance frequency is 220 Hz?
    a. 0.26 m
    b. 0.96 m
    c. 1.1 m
    d. 1.2 m
    e. 1.6 m
25. Find the first three harmonics of a string of linear mass density 2.00 g/m and length 0.600 m when it is subjected to tension of 50.0 N.
    a. 66 Hz, 132 Hz, 198 Hz
    b. 132 Hz, 198 Hz, 264 Hz
    c. 132 Hz, 264 Hz, 396 Hz
    d. 264 Hz, 528 Hz, 792 Hz
    e. 264 Hz, 396 Hz, 528 Hz

FREE RESPONSE

26. A bullet of mass *m* is fired horizontally with speed *v* into a block of mass *M* initially at rest, at the end of an ideal spring on a frictionless table. At the moment the bullet hits, the spring is at its natural length, *L*. The bullet becomes embedded in the block, and simple harmonic oscillations result.



a. Determine the speed of the block immediately after the impact by the bullet.

$\mathbf{v}' = \frac{\mathbf{mv}}{\mathbf{m+M}}$

$\mathbf{mv} + \cancel{\mathbf{MV}} = (\mathbf{m}+\mathbf{M})\mathbf{v}'$

$\frac{\mathbf{mv}}{(\mathbf{m+M})} = \mathbf{v}'$

b. Determine the amplitude of the resulting oscillations of the block.

$A = \frac{mv}{\sqrt{k(m+M)}}$

$\cancel{(\mathbf{m}+\mathbf{M})}\frac{(\mathbf{mv})^2}{(\mathbf{m+M})^{\cancel{2}}} = \mathbf{kA}^2$

KE = PE

$\frac{(\mathbf{mv})^2}{\mathbf{k(m+M)}} = \mathbf{A}^2$

$\frac{\cancel{1}}{\cancel{2}}\mathbf{mv}^2 = \frac{\cancel{1}}{\cancel{2}}\mathbf{kA}^2$

$\sqrt{\frac{(\mathbf{mv})^2}{\mathbf{k(m+M)}}} = \mathbf{A}$

$(\mathbf{m}+\mathbf{M})\left(\frac{\mathbf{mv}}{(\mathbf{m+M})}\right)^2 = \mathbf{kA}^2$

$\frac{\mathbf{mv}}{\sqrt{\mathbf{k(m+M)}}} = \mathbf{A}$

c. Compute the frequency of the resulting oscillations.

$f = \frac{1}{2\pi}\sqrt{\frac{k}{(m+M)}}$

$f = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$

$m = (\mathbf{m}+\mathbf{M})$

$f = \frac{1}{2\pi}\sqrt{\frac{k}{(m+M)}}$

d. Derive an equation which gives the position of the block as a function time (relative to $x = 0$ at time $t = 0$).

$x = \left(\frac{mv}{\sqrt{k(m+M)}}\right)\sin\left(t\sqrt{\frac{k}{(m+M)}}\right)$

$x = \left(\frac{mv}{\sqrt{k(m+M)}}\right)\sin\left(t\sqrt{\frac{k}{(m+M)}}\right)$

$x = A\sin(2\pi f t)$

$x = \left(\frac{mv}{\sqrt{k(m+M)}}\right)\sin\left[(\cancel{2\pi})\left(\frac{1}{\cancel{2\pi}}\sqrt{\frac{k}{(m+M)}}\right)(t)\right]$

27. A horizontal string fixed at both ends with length 1.5 meters vibrates with a wave velocity of 1320 m/s at its fundamental frequency.

a. What is the fundamental frequency?

440 Hz

$\lambda = 2L = 3m$

$v = \lambda f$

$\frac{v}{\lambda} = f = \frac{1320}{3} = 440Hz$

b. What is the frequency of the fourth overtone, and how many nodes and antinodes will it have?

2200 Hz, 5 antinodes, 6 nodes

4^{th} overtone = 5^{th} harmonic

$f_{5th} = (5)(440) = 2200Hz$

5^{th} harmonic means 5 antinodes and there is always 1 more node than antinode

c. In terms of interference, to what do the nodes and antinodes correspond?

Nodes correspond to points of destructive interference

Antinodes correspond to points of constructive interference

d. How many grams must the string be to have a tension of 10^5 N?

86 g

$F_T = \frac{mv^2}{L}$

$\frac{F_T L}{v^2} = m = \frac{(10^5)(1.5)}{1320^2} = 0.086kg = 86g$

28. A string of length 2.5 m is fixed at both ends. When the string vibrates at a frequency of 85 Hz, a standing wave with five loops is formed.

a. Determine the distance between two adjacent nodes.

0.50 m

a loop occurs between two nodes, $\frac{2.5m}{5\ loops} = \frac{0.5m}{loop}$, so distance between nodes is 0.5 m

b. Determine the wavelength of the waves that travel on the string.

1.0 m

5 loops = 2.5 complete wavelengths

$\lambda = \frac{2.5m}{2.5waves} = 1.0m$

c. Determine the wave velocity.

85 m/s

$v = \lambda f = (1.0m)(85s^{-1}) = 85m/s$

d. Determine the fundamental frequency of this string.

17 Hz

five loops means it is the fifth harmonic so n = 5

$f_n = nf_0$

$\frac{f_n}{n} = f_0 = \frac{85}{5} = 17Hz$

29. .

a. (__/X)