S 5 PHYSICS TESTS/QUIZ TERM1

QUIZ: 1

1.. In simple harmonic motion, the restoring force must be proportional to the:
a. amplitude b. frequency c. velocity d. displacement e. displacement squared

2. An oscillatory motion must be simple harmonic if:
a. the amplitude is small
b. the potential energy is equal to the kinetic energy
c. the motion is along the arc of a circle
d. the acceleration varies sinusoidally with time
e. the derivative, dU/dx, of the potential energy is negative

3 . In simple harmonic motion, the magnitude of the acceleration is:
a. constant
b. proportional to the displacement
c. inversely proportional to the displacement
d. greatest when the velocity is greatest
e. never greater than g

4. The speed of a sinusoidal wave on a string depends on:
a. the frequency of the wave
b. the wavelength of the wave
c.. the length of the string
d. the tension in the string
e. the amplitude of the wave

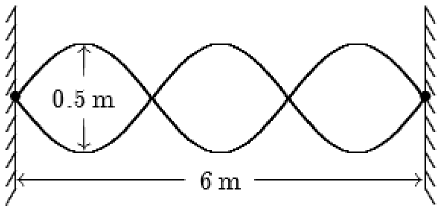
5. The sum of two sinusoidal traveling waves is a sinusoidal traveling wave only if:
a. Their amplitudes are the same and they travel in the same direction.
b. Their amplitudes are the same and they travel in opposite directions.
d. Their frequencies are the same and they travel in opposite directions.
e. Their frequencies are the same and their amplitudes are the same.

6. Fully constructive interference between two sinusoidal waves of the same frequency occurs only if they:
a. Travel in opposite directions and are in phase
b. Travel in opposite directions and are 180◦ out of phase
c. Travel in the same direction and are in phase
d. Travel in the same direction and are 180◦ out of phase
e. Travel in the same direction and are 90◦ out of phase

7. A standing wave:
a. Can be constructed from two similar waves traveling in opposite directions

b. Must be transverse
c. Must be longitudinal
d. Has motionless points that are closer than half a wavelength
e. Has a wave velocity that differs by a factor of two from what it would be for a traveling wave

8. A standing wave pattern is established in a string as shown. The wavelength of one of the Component traveling waves



a. 0.25m   b. 0.5m   c. 1m   d. 2m   **e.** 4m

9. A tuning fork produces sound waves of wavelength λ in air. This sound is used to cause resonance in an air column, closed at one end and open at the other. The length of this column CANNOT be:

a. $\lambda/4$ b. $\lambda/2$ c. $3\lambda/4$ d. $5\lambda/4$ e. $7\lambda/4$

10. A 0.20-kg object attached to a spring whose spring constant is 500N/m executes simple harmonic motion. If its maximum speed is 5.0m/s, the amplitude of its oscillation is:

a. 0.0020m   b. 0.10m   c. 0.20m   d. 25m   e. 250m

11. It is impossible for two particles, each executing simple harmonic motion, to remain in phase with each other if they have different:

a. masses **b.** periods c. amplitudes d. spring constants   e. kinetic energies

TEST1

1. a. Define a wave and outline at least four properties of it.

b. What is a wavefront

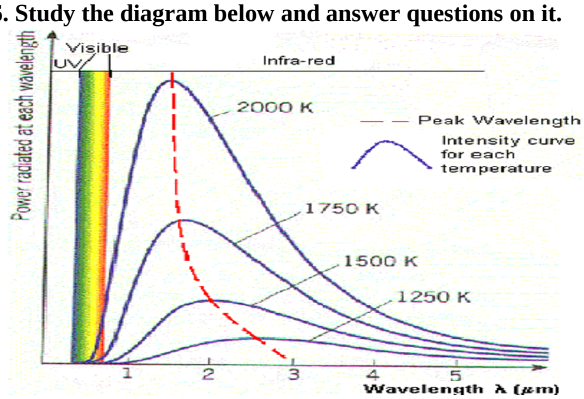
2. What is a photon as it is applied in quantum theory?

3. State postulates of Planck's quantum theory.

4. The laser in a compact disc player. It uses light with a wavelength of 3.9×10^2 nm. Calculate the energy of a single photon of this light.

5. Discuss what is the black body radiation.

6. Study the diagram below and answer questions on it.



a. Describe the variation of peak wavelength with temperature

b. How is Intensity vary with temperature?

c. Why a body continuously heated its colour changes from red hot to yellow hot then to white hot.

7. The wavelength of a body was found to be $7x\ 10^{-7}m$. Determine the temperature at which the body was heated.

Soln From wein's displacement.

8. a. Who proposed the wave theory of light?

b. . State Huygens' principle.

9. Describe the photoelectric effect and discuss why the wave theory of light cannot account for it .

10. (a) Explain the concept of wave-particle duality of light.

(b)Copy and complete carefully **each space** of the following table using **yes** or **no** where necessary.

Phenomena	Can be explained in terms of waves	Can be explained In terms of particles
Reflection of light		
Refraction of light		
Interference of light		
Diffraction of light		
Polarization of light		
Photoelectric effect		
Compton effect		

11. (a) Write down an expression of the linear momentum and its SI units of a visible photon that has a wavelength λ. Remember that a photon doesn't have a rest mass.

b. Considering X-ray photon of mass m hitting the surface of a metal and considering if a part of its energy is gained by a surface electron and is then emitted; derive the Einstein's equation of energy of the photon $E = mc^2$, that describes how energy E and mass m are related with speed c of light.

c. Photon A has twice the energy of photon B. How are their momenta related?

12. Explain how photoelectric effect can be applied in Automatic doors.

13.a. What is Compton Effect? Write its formulae and give the meaning of each term
b. State the principle of complementarity and give example.

c Outline 6 ways in which a photon can interact with matter

d. Discuss the difference between Coherent and incoherent scattering as applied to photo interaction.

14. a. Enumerate different fields in which electron microscope is used

b. Give 2 advantages of electron microscope over compound microscopes, and 2 disadvantages of the same device (electron microscope

15. Calculate the de Broglie wavelength of an electron travelling through space at a speed of 10^7 m $s^{-1.}$ State whether or not these electrons can be diffracted by solid materials (atomic spacing in solid materials ~ 10^{-10} m).

16. Imagine a 65 kg person running at a speed of 3.0 m s^{-1} through an opening of width 0.80 m. According to the de Broglie equation, the wavelength of this person is:

17. The Einstein equation for photoelectric effect can be written $E = \Phi + K.E\,\text{max}$

a. State the meaning of each term in the equation

b. What does Einstein's explanation imply about the nature of light?

c. The work function for lithium is 4.6 × 10-19 J. if photoelectric emission is to occur.

i. What is the condition for photoelectric emission to occur?

ii. Calculate the lowest frequency of light that will cause photoelectric emission.

iii. What is the maximum energy of the electrons emitted when the light of frequency 7.3×10^{14}Hz is used?

v. Determine the potential required to stop the electrons.

18. a) The following phenomena prove that light can behave like either a particle or a wave: Reflection of light, refraction of light, interference of light, photoelectric effect, Compton effect

i. What phenomena best prove that light is a particle instead of wave

ii. What phenomena best prove that light is a wave instead of particle?

b) When electromagnetic radiation with a wavelength of 350 nm falls on a metal, the maximum kinetic energy of the ejected electrons is 1.20 eV

i. What is the frequency of this electromagnetic radiation? The speed of light in vacuum is $3x10^8$ m/s

ii. Determine the work function for this metal in joules then in electron volts

Planck's constant h=$6.626x10^{-34}$ kg m^2/s or h=$6.626x10^{-34}$ Js

19. What potential difference must be applied to stop the fastest photoelectrons emitted by a nickel surface under the action of ultraviolet light of wavelength 200nm? The work function of the nickel is5.01eV.

Commented [T1]:

TEST2

1. Define the term simple harmonic motion and state its characteristics.

2. A light spiral spring is loaded with a mass of 50 g and it extends by 10 cm. Calculate the period of small vertical oscillations**.**

3. A simple pendulum has a period of 2.0 s and amplitude of swing 5.0 cm. Calculate the maximum magnitude of (a) velocity of the bob (b) acceleration of the bob.

4**.** The displacement of an object undergoing simple harmonic motion is given by the equation $x(t) = 3.00\sin(8\pi t + \frac{\pi}{4})$ where x is in meters, t in seconds and the argument of the sine function in radians.

a. What is the amplitude of motion?

b. What is the frequency of oscillation?

c. What are the position, velocity and acceleration of the object at $t = 0s$?

5. A 0.500-kg cart connected to a light spring for which the force constant is 20.0 N/m oscillates on a horizontal, frictionless air track.

a. Calculate the total energy of the system
b. the maximum speed of the cart if the amplitude of the motion is 3.00 cm.
c. What is the velocity of the cart when the position is 2.00 cm?
d. Compute the kinetic and potential energies of the system when the position is 2.00 cm.

6. A $1.4kg$ mass is attached to a horizontal spring on the top of a table. The mass is pulled $12cm$ from the equilibrium position and released. It then undergoes simple harmonic motion making 2.2 oscillations each second.

Determine: a) the equation of the motion

b) The total energy

c) The maximum acceleration of the mass and indicate where this occurs)

d) The maximum velocity of the mass (and indicate where this occurs)

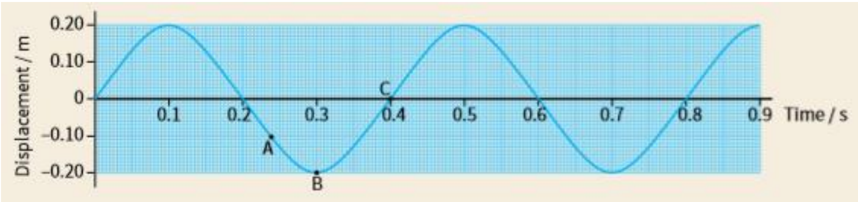
e) The acceleration of the mass when it is $7cm$ from the equilibrium position

f) The velocity of the mass when it is $7cm$ from the equilibrium position.

7. a) Joan has two simple pendula, one has a length of $1m$, and the other one is longer. She sets them both swinging at the same time. After the one meter pendulum has completed 12 oscillations, the longer one has only completed 11. What is the length of the longer pendulum?

b) What happen to the period of a simple pendulum when its length is halved?

8. A. Figure below shows the displacement –time graph for an oscillating mass.



a. Use the graph to determine the following:

i. Amplitude ii. Period iii. Frequency iv. angular frequency v. displacement at A

vi. velocity at B vii. Velocity at C

b. A pendulum oscillates with frequency 1.5 Hz and amplitude 0.10 m. If it is passing through its equilibrium position when t = 0,

i. Write an equation to represent its displacement x in terms of amplitude x_0, angular frequency ω and time t.

ii. Determine its displacement when t = 0.50 s.

9. .A small bob of mass m is suspended by a light inextensible thread of length l from a fixed point. It is then drawn aside slightly at a small angle θ and released, and it oscillates to and fro in a vertical plane along the arc of a circle.

a) Draw this system of thread-bob when it is drawn aside slightly.
b) What is the name given to that system thread-bob?
c) From your diagram, deduce an expression for the period of oscillations of the system.

10. A small piece of cart of mass 80 g is attached to the end of a light string of length 100 cm and it is allowed to hang freely. The lead is displaced to 1.5 cm above its rest position, and released. (a) Calculate the period of the resulting motion, assuming it is simple harmonic.

(b) Calculate the maximum speed of the lead piece. (Take g = 9.81 ms^{-2})

11. Two simple harmonic motions are described by equations $y_1 = 2\sin\left(3t + \frac{\pi}{4}\right)$ and $y_2 = 3\sin\left(3t + \frac{\pi}{3}\right)$. Find the equation of motion resulting from their superposition.

TEST3

1. Briefly and precisely,
    a. Describe and explain types of damped oscillations with an aid of sketch diagrams.
    b. Explain why a car shock absorber needs to be critically damped system rather than an over-damped system.
    c. Explain why soldiers must not march in time when crossing the bridge.
    d. Explain two examples of resonance where the effect is useful and where it should be avoided.
2. Write the differential equation of damped oscillations, and give the meaning of each constant term.
3. a) *The amplitude A depends on how close ω_D is to natural frequency ω_0".* Explain this statement.
    b) What are the conditions for a system to be at resonance?
    c) State at least 3 advantages and 3 disadvantages of resonance of a system.
4. Solve the following initial value problem and determine the nature frequency, amplitude and the phase angle of the solution. $\frac{d^2y}{dt^2} + y = 0,\ y(0) = 5,\ \frac{dy}{dt} = -5$.
5. A damped oscillator was forced to remain in motion with its driving angular frequency where the motion is described by $4\frac{d^2y}{dt^2} + \frac{dy}{dt} + 80y = 24cos4t$. Determine:
    a) The driving angular frequency.
    b) The driving angular frequency at resonance.
    c) The amplitude at resonance.
    d) The damping angular frequency.
    e) The amplitude of the system as the driving force is applied.

6. In a damped oscillator with *m* =250 g, *k* = 85 N/m, and b =70 g/s.
a. Calculate the frequency of the damped oscillation.
b. What is the ratio of the amplitude of the damped oscillations to the initial amplitude at the end of 10 cycles?

7. Write the differential equation of damped oscillations, and give the meaning of each constant term.

8. a) For forced oscillations, the amplitude is given by $A = \frac{F_0}{\sqrt{m^2\left(\omega_D^2 - \omega_0^2\right)^2 + \left(\frac{c\omega_D}{m}\right)^2}}$ where ω_0 is the natural angular frequency and ω_D is the driving angular frequency of external force. *"The amplitude A depends on how close ω_D is to natural frequency ω_0".* Explain this statement.
    d) What are the conditions for a system to be at resonance?

9. Solve the following initial value problem and determine the nature frequency, amplitude and the phase angle of the solution. $\frac{d^2y}{dt^2} + 25y = 0,\ y(0) = -2,\ \frac{dy}{dt} = 10\sqrt{3}$.

10. A forced oscillation of a system is described by $2\frac{d^2y}{dt^2} + \frac{3}{2}\frac{dy}{dt} + 4y = 12\cos(4t)$ .Determine:
    a) The driving angular frequency.

b) The natural angular frequency.
c) The amplitude at resonance.
d) The damping angular frequency.
e) The amplitude of the system as the driving force is applied.