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MAIN EXAMINATION

JANUARY – APRIL 2015 TRIMESTER

FACULTY OF SCIENCE

DEPARTMENT OF NATURAL SCIENCES (PHYSICS)

PHY 204: WAVES AND VIBRATION

Date: April 2015	**Duration: 2 Hours**
Instructions: Answer Question ONE and any other TWO Questions	

Q1 a) Define the following terms as used in waves and vibrations.

i) Amplitude
ii) Wavelength
iii) Periodic time

(3 marks)

b) A simple pendulum undergoes simple harmonic motion when θ is small as show in figure 1.

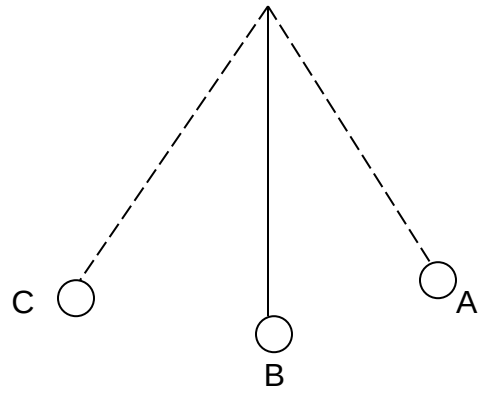

Fig.1

i) At what point will the pendulum bob move with minimum velocity, maximum velocity, maximum acceleration, minimum acceleration.

(4 marks)

ii) At what point will the pendulum bob posses the maximum kinetic energy and the maximum potential energy respectively?

(2 marks)

c) State the difference between

i) Mechanical wave and electromagnetic wave. **(2 marks)**

ii) Longitudinal wave and transverse wave. **(2 marks)**

d) An alarm is placed in a good vacuum and then activated. No sound is heard. Explain.

(2 marks)

e) Explain how Doppler effect with microwave is used to determine the speed of an automobile.

(2 marks)

f) State the condition necessary for beats of sound to be heard.

(2 marks)

g) State three laws of vibrations of a fixed string. (sometimes referred to as sonometer).

(3 marks)

h) State the principle of superposition.

(2 marks)

i) Plane sound waves of frequency 100Hz fall normally on a smooth wall. At what distances from the wall will the air particles have
   i) a maximum amplitude of vibration
   ii) a minimum amplitude of vibration (take velocity of sound in air = 340mls)

(6 marks)

Q2. An object oscillates with simple harmonic motion along the x-axis. Its position varies with time according to the equation.

2^x = (400m) cos ($\pi + \pi/4$)

where t is in seconds and the angles use in radian's

a) Determine A, f and T of the motion.
(A; Amplitude; f-frequency; T is period)

(4 marks)

b) Calculate the velocity and acceleration of the object at time t.

$\left[Note \quad v = \frac{dx}{dt} \ and \ a = \frac{dv}{dt} \right]$ **(2 marks)**

c) Using the result in (b), determine the position, velocity and acceleration when t = 1.00 seconds.

(6 marks)

d) Determine the maximum velocity and maximum acceleration of the object.

(4 marks)

e) Find the displacement of the object between t = 0 and t = 1.00 sec.

(4 marks)

Q3. a) Each of the following is an expression for speed of a wave.

$V = \sqrt{\frac{T}{m}} \qquad V = \sqrt{\frac{\gamma p}{\ell}} \qquad V = \sqrt{\frac{E}{\ell}} \qquad V = \sqrt{\frac{1}{\mu\varepsilon}}$

i) State a situation to which each of the expression applies.

(4 marks)

ii) Give in each case, the meaning of the symbols used.

(8 marks)

b) i) A taut string for which $\mu = 5.00x10^{-2} kgm^{-1}$ is under tension, T. of 80.0N. How much power, *p* must be supplied to the string to generate sinusoidal waves of frequency 60Hz and amplitude of 6.00cm?

(5 marks)

ii) If the string was to transfer energy at a rate of 1000W, what amplitude is required if all parameters remain the same?

(3 marks)

Q4. a) Two observes A and B are provided with sources of sound of frequency 500Hz. A remains stationary and B moves away from A at a velocity of 1.8m/s. How many beats per second are observed by A and by B. (Take velocity of sound to be 330 m/s)

(10 marks)

b) The sound level intensity of a rock band is 105dB 10m away from the hand. What will be the sound level intensity 60m away" (Assume that sound is coming from a source point and is emitted equally is all direction and $I_0 = 1.0 \times 10^{-12}$ Wm^{-2} at the threshold of hearing?.

(10 marks)

$$B = 10\log\left[\frac{I}{I_0}\right] and\ I = \frac{P}{4\pi r^2}$$

Q5. a) Show that the net force of an object connected to a vertical spring is the same as that of an object connected to a horizontal spring. (Note net force $F_N = - K_x$)

(5 marks)

b) A massless sping is caused to oscillate with a simple harmonic motion on a horizontal, frictionless air track from an equilibrium position x. Show that

i) The total mechanical energy $E = ½ KA^2$ **(10 marks)**

ii) Maximum velocity $V_{max} = \omega\gamma$. **(5 marks)**

[Note x = A cos (wt + μ)]

END