HONG KONG ADVANCED LEVEL EXAMINATION
AL PHYSICS
1982 Essay Type Question

1. (a) Describe how you would measure the thermal conductivity of a liquid, which is a poor conductor of heat, pointing out the precautions you would take to ensure an accurate result.

   (b) Explain

   (i) the observed difference between the temperatures of the seawater and the air during the night-time in the autumn in Hong Kong, and

   (ii) the survival of fish in frozen-over ponds during the winter in North China.

2. Give accounts of the physics of the working of

   (a) a Geiger-Muller tube, and

   (b) a cloud chamber,

   in their use to detect ionizing radiations, contrasting the different techniques which would have to be used to distinguish between α, β and γ radiations.

3. Explain form first principles the following phenomena:

   (a) The colours observed when viewing an oil film on water, giving the reasons why the film must be thin, and

   (b) the absence of high frequencies to an observer standing outside and to the side of an open door leading into a room where music is being played. (Consider velocity of sound = 340 m/s.)

4. (a) Carefully distinguish between the characteristics of progressive and stationary transverse waves, drawing diagrams showing the displacements of the propagating medium particles at selected times during a complete period.

   (b) Draw diagrams showing the stationary wave patterns which are excited in

      (i) a guitar string,

      (ii) an open-ended organ pipe and

      (iii) a closed-end organ pipe,

      considering both (1) the fundamental and (2) the first overtone frequencies. Show how these frequencies are related to the appropriate physical dimension of each instrument.

5. Compare qualitatively and briefly explain the differences between the forms of the electromagnetic wave spectra emitted by

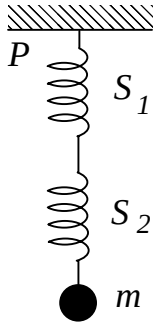
   (a) a hydrogen discharge tube,

   (b) the sun, and

   (c) an X-ray tube.

   (Note: Mathematical derivations are not expected.)

6. (a)



A small body of mass m is suspended form a fixed point P by two springs S_1 and S_2 as shown. The force constants of the springs are f_1 and f_2 respectively. If the body is pulled vertically downwards through a small displacement show that it subsequently moves with simple harmonic motion of period

$$2\pi\left[\frac{(f_1 + f_2)m}{f_1 f_2}\right]^{\frac{1}{2}}.$$

Assume that the masses of the springs are negligible compared with m.

(b) Consider a single spring (of force constant f) set into simple harmonic motion as in part (a).

(i) Sketch two cycles of the time variations of:

(1) the position,

(2) the velocity, and

(3) the acceleration of the suspended body.

(ii) Also sketch two cycles of the time variations of:

(1) the kinetic energy, and

(2) the potential energy of the system.

On your sketches indicate the maximum values attained in each case in terms of the force constant f, the maximum amplitude A and the period T of the oscillation.

- End of Paper -