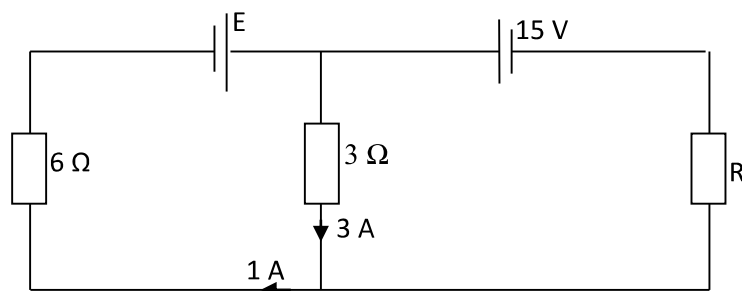1. (a) State Newton's law of gravitation and Coulomb's law.

   (b) Bring out two ways in which the force experienced in a gravitational field may differ from the force experienced in an electric field.

2. A simple oscillating pendulum has as amplitude 0.05 m and period 2.0 s.

   (a) Calculate the velocity of the pendulum as it passes through the equilibrium position.

   (b) The expression for the displacement of the pendulum is $y = Asin\omega t$. Sketch a graph of acceleration, a, against time, t, for a complete oscillation. Note $a = -\omega^2 y$

3. Figure 1 shows an electric circuit with two power sources connected to resistors.

   Determine

   (a) The current through R

   (b) The value of R

   (c) The emf, E.

4. (a) What is meant by photoelectric effect?

   (b) Briefly outline observations of the photoelectric effect which cannot be explained by classical physics.

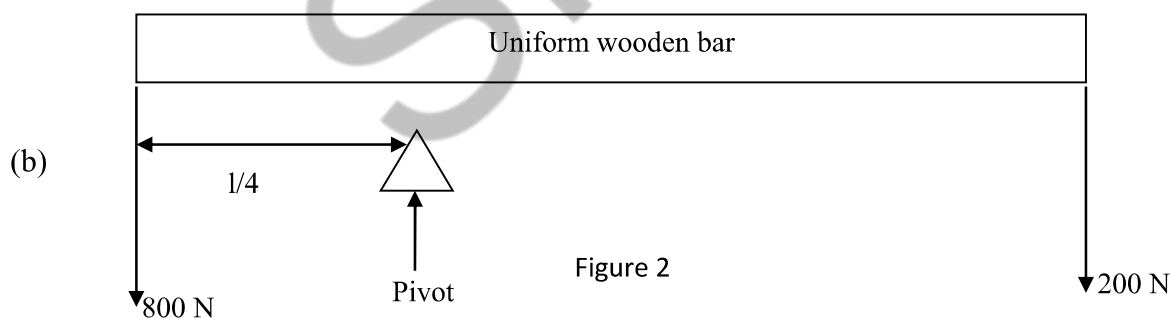5. (a) State the conditions necessary for a body to be in equilibrium on a plane

Figure 2

(b)

   Figure 2 shows a uniform wooden bar length, l, in equilibrium.

   Determine the weight of the bar.

6. (a) (i) Use examples to explain why and how waves are classified.

   (b) Describe an experiment to measure the speed of sound in free air. Your account should include a diagram, procedure, observations, precautions and how the observations are used to obtain a conclusion.

   (b) As an ambulance sounding a siren approaches a control point, the frequency of the siren is measured to be 360 Hz and as it passes and moves away the frequency is presumed to be 320 Hz. Explain why

there is this difference and calculate the speed of the ambulance given that the speed of sound in air is 340 ms⁻¹.

(d) From the kinetic theory of ideal gases, the pressure, P, of a fixed mass of an ideal gas trapped in a container is given by $P = \frac{1}{3}\rho\overline{c^2}$ where $\overline{c^2}$ is the mean square speed of the gas particles.

(i) State the assumptions used to derive the equation

(ii) Hence derive the equation.

(e) Describe an experiment to determine the specific latent heat of vaporization of water. Your account should include diagram, procedure, observations, precautions and how the observations are used to obtain a conclusion.

(f) 8.0 kg of hot liquid A initially at 90^0 are mixed with 3.0 kg of water initially at 22^0 C in an insulated container. If the specific heat capacity of the liquid A is half that of water:

Determine

(i) The equilibrium temperature reached by the system

(ii) The ratio of the change of temperature of the liquid A to that of water when equilibrium is reached.

7. The equation $P = P_0 e^{-kh}$ is called the law of atmospheres. K is a constant given by $k = \frac{\rho g}{P_0}$ where ρ is the density of air at stp and g is the gravitational field strength. Table 1 which follows gives some values of height above sea level with their corresponding atmospheric pressure P.
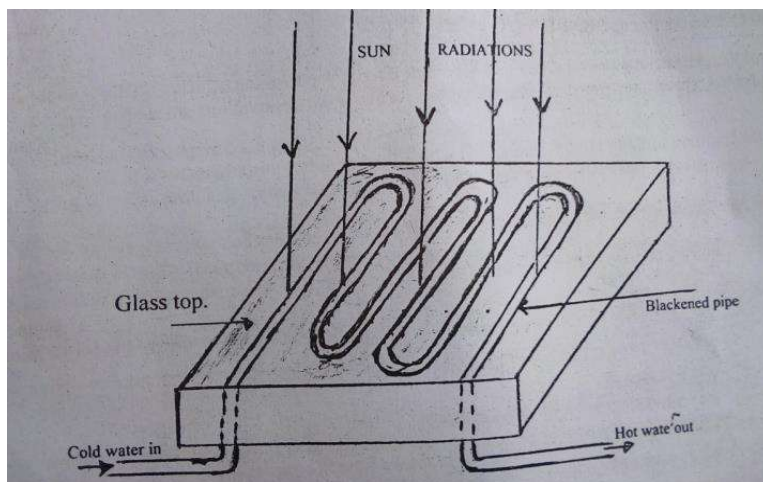
h/km	P/10⁴ Nm⁻²
9.6	4.346
11.7	2.691
18.0	1.094
28.1	0.221
34.9	0.0993
40.0	0.0602
44.8	0.173
51.0	0.0138

(a) Plot a suitable graph from which values of K and P_0 can be determined

(b) Determine the values of K, P_0 and hence ρ

(c) What is the pressure at a height of 65 km above sea level?

8. (a) (i) A small container ship called "THE ACHUKA" needs to enter and berth a port in Cameroon. What does the captain of the ship need to know about the weather in this locality in which the port is located?

(ii) Explain how weather forecast can be done from a distance.

(b) Below is an example of a solar panel. Study the diagram carefully and answer the questions that follow.

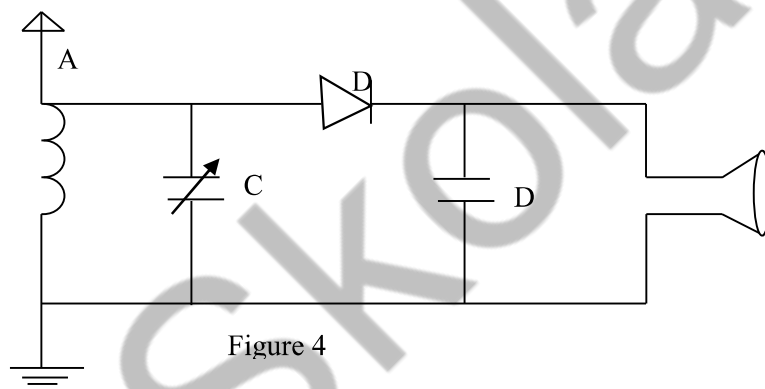Explain why the panel should have the following features
(i) The pipes are blackened   (ii) The top of the panel is covered with glass
(iii) The walls are highly insulated and blackened.
c) (i) Draw a cross section of a hydro – electric power plant
(ii) Explain the energy changes that take place in the plant.

9.   (a) (i) Name four functions of a mobile
         (ii) State the meaning of the following words SMS, MMS and SIM
     (b) Figure 4 shows a simple circuit receiver. Using A to E identify the components that best fits with the following
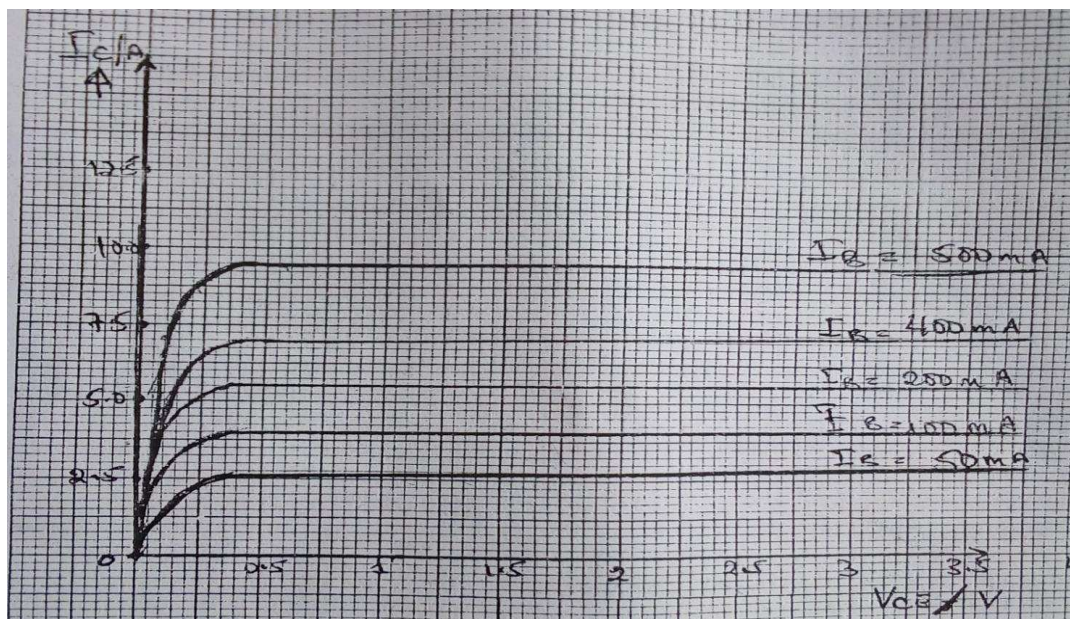

Figure 4

(i) Which part of the circuit has all the transmitted signal?
(ii) Which component is used to select a particular signal?
(iii) Which component is used to remove the radio signal?
(iv) The component that generates input signals into the radio receiver
c) (i) Define the term bandwidth
(ii) Distinguish between analogue and digital transmission stating clearly the advantages of one over the other.

10.

(a) (i) With the help of the band theory only, distinguish between an insulator and a semiconductor?

(ii) Use the graph in the figure above to plot another graph of collector current, I_C against the base current, I_B.

Obtain the current gain for the transistor.
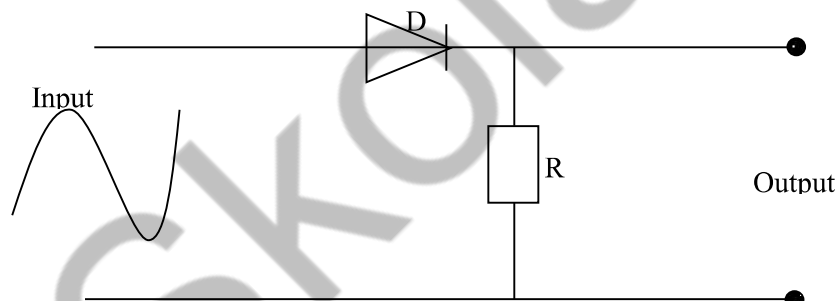
(iii) Explain the term thermal runway.

Figure 6

The input into figure 6 is an alternating voltage. Draw the output voltage for the circuit.

11. (a) (i) Draw and describe the basic structure of the human ear.
(ii) Consider the ear to be a pipe closed at one end, and that the length of the human auditory canal is approximately 28 mm. If the velocity of sound in air is 340 m/s then what is the frequency of the fundamental note in the ear?
(iii) The ossicles in the ear act as a lever. What does this mean?
(b) Optical fibres are considered to be the major breakthrough in many fields of study including medicine.
(i) State the concept under which optical fibres is very useful.
(ii) Draw a diagram under which optical fibre is very useful.
(iii) Describe an application of optical fibres in medicine.