(c) A diode is connected to the lamp in the secondary coil of the above transformer in (b).
(i) State and explain the effect of the diode. (2 marks)
(ii) Draw the output waveform. (1 mark)

9. (a) The half life of a radioactive isotope is 400 years.
(i) Define half life (2 marks)
(ii) Radium 226 has a half life of 1620 years. Calculate the time it will take for its activity to drop to ¼ of its initial value. (2 marks)

(b) Uranium – 238 ($^{238}_{92}U$) undergoes successive disintegration to produce Radium 226 ($^{226}_{88}Ra$) with the emission of a number of alpha and beta particles.
(i) Write a nuclear equation of the transformation. (1 mark)
(ii) Determine the number of alpha and beta particles involved in this transformation. (4 marks)
(iii) State two practical uses of radioactive radiations. For each use, state the radiation and property exploited. (6 marks)

(c) Fig. 7 shows part of a radioactive decay series.

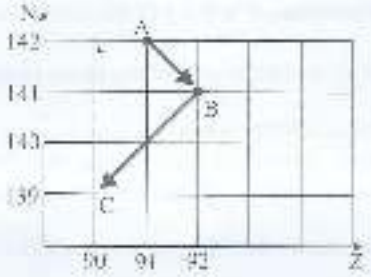

Figure 7

(i) What particle is emitted in each of the stages A to B and B to C? (2 marks)
(ii) State whether or not A and B are isotopes. Explain (2 marks)
(iii) What is the nucleon number of A? (1 mark)

10. (a) Waves may be classified as longitudinal or transverse.
(i) Define each and give an example. (4 marks)
(ii) Describe how you would use a ripple tank to demonstrate the following wave properties:
- Reflection
- Refraction
- Diffraction (6 marks)

(b) Describe an experiment to measure the speed of sound in air, stating precaution(s) which must be taken. (6 marks)

(c) Figure 8 shows the trace of a sound signal from a microphone connected to a cathode ray oscilloscope.

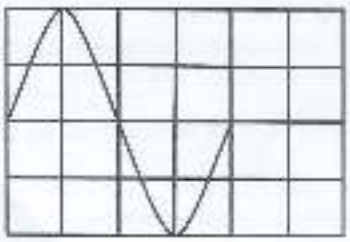

Figure 8

7 (a) A conductor may be ohmic or non ohmic.
Define the underlined words and give one example of each. (4 marks)

(b) Figure 5 below shows a closed electric circuit.

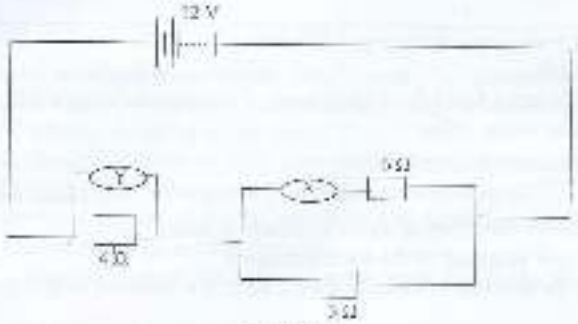

Figure 5

(i) Name the meters X and Y. (2 marks)
(ii) Explain why each is connected as shown. (4 marks)
(iii) Calculate the reading of each meter. (4 marks)
(iv) State the effect on the total current if the 3 Ω resistor burns. (1 mark)

(c) (i) A wire has a resistance R. A similar wire of the same material is twice as long but same cross-sectional area.
Compare the new resistances of the wires. (3 marks)
(ii) State and explain one other factor which determines the resistance of a wire. (2 marks)

8. Figure 6 shows two circuits close to one another. Circuit A has a battery while circuit B has a centre zero galvanometer.

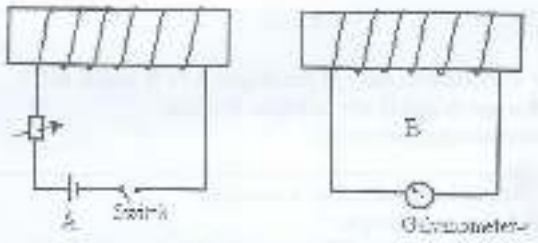

Figure 6

(a) (i) Copy circuit A of Figure 6 and show the direction of current flow and the field lines of the coil. (3 marks)
State and explain what happens to the pointer of the galvanometer in B when.
(ii) The switch in A is closed. (2 marks)
(iii) The switch is kept closed for some time. (2 marks)
(iv) The switch is opened again. (1 mark)
(v) The battery A is replaced by an a.c. source. (2 marks)
(vi) State and explain one thing that can be done to increase the deflection of the pointer of the galvanometer, without introducing any new material. (2 marks)

(b) A transformer is used to operate a 24 V, 48 W lamp from the mains of 240 V. Assume its efficiency is 100%.
(i) Calculate the current in the primary coil. (3 marks)
(ii) Determine the turns ratio (N_p/N_s) of the transformer. (2 marks)

If the Y – gain control is set at 5 Vcm^{-1} and the X – gain (time base) is set at 10 ms cm^{-1}. Determine.

(i) The frequency of the signal. (2 marks)

(ii) Its amplitude. (2 marks)

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11. (a) (i) Define the principal focus and the focal length of a convex lens. (2 marks)

A student wants to produce a real magnified image of an object.

(ii) Explain what is meant by a real image. (1 mark)

(iii) Draw a labelled diagram to show how such an image is produced by a convex lens. (2 marks)

(b) A ray of light travels at a speed of 3×10^8 ms^{-1} in air and enters a glass of refractive index 1.5.

(i) Calculate the speed of light in the glass. (2 marks)

(ii) Draw a diagram to show the path of the ray in air and in the glass. (2 marks)

(c) The occupants of a house at night notice the presence of thieves outside. Explain whether it is advisable to switch on the security light outside or the lights inside the house if the occupants want to see the thieves without being located by the thieves. (4 marks)

(d) An object of height 3 cm is placed 10 cm in front of a convex lens. The image produced is the same size as the object.

(i) Determine the image distance from the lens. (2 marks)

(ii) Calculate the focal length of the lens. (2 marks)

(iii) State two properties of the image formed. (2 marks)

(iv) Name one device which is an application of such an arrangement of lens and object. (1 mark)
