THE UNITED REPUBLIC OF TANZANIA
NATIONAL EXAMINATIONS COUNCIL
DIPLOMA IN EDUCATION EXAMINATION

PHYSICS

731

TIME: 3 Hours 10 Minutes

26 May 1999 A.M.

INSTRUCTIONS

1. This paper is made up of sections A and B, consisting of EIGHT questions in total. You are advised to read carefully the instructions for each section.
2. Spend the first ten minutes in reading through the paper and selecting those questions which you wish to answer.
3. The marks in brackets indicate the relative credit given to each question or part thereof.
4. You are advised to spend not more than 1 hour 48 minutes on section A and 1 hour 12 minutes on section B.
5. Use the following information whenever necessary.

   Electronic charge = 1.6×10^{-19} coulombs

   Speed of electromagnetic waves in air = 3×10^{8} m/s.

This paper consists of 4 printed pages.

SECTION A

This section consists of five questions out of which you are to attempt only three including question ONE. You are advised to spend not more than fifty minutes on question one. This section carries a total weight of 58 marks.

1. (a) (i) Distinguish between vector and scalar quantities. (1 mark)
(ii) What is meant by the term couple? (1 mark)

(b) The maximum safe angular velocity at which a solid disk can be spun is proportional to its radius R, the breaking stress S and the density p of the material. Find the form of the relationship. (4 marks)

(c) (i) Find the work done in pushing back the atmosphere when a mass of 1g of water at its boiling point is turned to 1601 cm^3 of steam? (4 marks)
(ii) It is known that the specific latent heat of vaporization of water is 2268J, state if all the latent energy is used in pushing back the atmosphere, if not explain the use of the remaining energy. (4 marks)

(d) (i) Draw a labelled diagram showing the essential features of the cathode ray oscilloscopes (CRO). Briefly explain the function of each component. (4 marks)
(ii) An alternating potential difference (P.D.) of $V = V_o \sin \omega t$ is applied to the Y plates of a CRO. Draw the trace as seen on the screen with the time base: switched off; at suitable time base applied to the X plates. (4 marks)

(e) The crystal spacing of NaCl is 2.82×10^{-10}m. For the first order Bragg diffracted image, the Bragg angle is 15°53'. Find the wavelength, λ, for the rays, and the second order Bragg angle. What is the longest λ that this crystal can analyse? (4 marks)

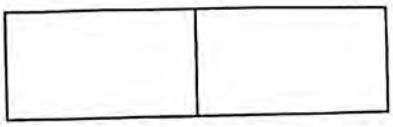
2. (a) State the assumptions of the kinetic theory of gases. (b) How does the theory represent the temperature of a gas? (c) How does it account for the fact that the gas exerts a pressure on the walls of the container? (the derivation of the expression for pressure is not required.) Near 0K, the specific heat capacity of mercury, c is not constant, but obeys the relation $c = aT^3 + bT$.
where T is the absolute temperature,
$a = 15.12 \times 10^{-7}$ kJ/kg.K^4 and
$b = 5.88 \times 10^{-6}$ kJ/kg.K.
By means of a graph, or otherwise (integration), find the heat required to raise the temperature of 5.0 g of mercury from 1 K to 20 K. (10 marks)

3. (a) Account for the following facts, with reference to the physical principles involved:
(i) A small transient deflection is obtained when a coil of wire (connected to a sensitive galvanometer and lying flat on the table) is turned off. (4 marks)
(ii) A beaker of mercury can easily be stirred with a glass rod, but when placed between the pole of a powerful electromagnet, there is considerable resistance to stirring. (4 marks)

(b) A solenoid with a soft iron laminated core is often placed in series with a gas discharge lamp operating from the AC mains. Explain why this solenoid is necessary and why it has a soft iron laminated core. (8 marks)

4. (a) (i) What is an n type semi conductor? (2 marks)

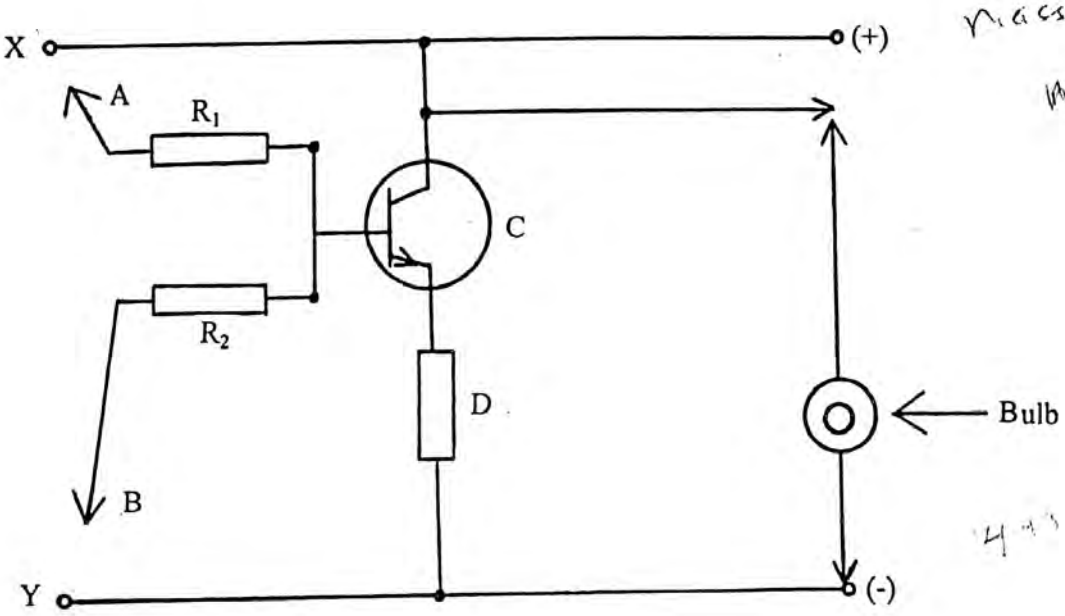
(ii) When an n type and p type semi conductors are joined, they form a crystal as in the figure below.



Label the figure, and from the labelling draw the symbol of the substance so formed. (4 marks)

What is the name of the substance drawn? (2 marks)

(b) Study the circuit below carefully. Points A and B are wire leads. Assume that the batery is connected as indicated:



(i) What is the name of the components C and D? (2 marks)

(ii) What will happen to the bulb when the wire leads are free as seen?

(iii) What will happen to the bulb when all the leads are connected at X?

(iv) What will happen to the bulb when all the leads are connected at Y?

(v) What will happen to the bulb when one lead is connected at X and the other at Y? (6 marks)

5. (a) Why is it considered that all electric charges are multiples of e? (6 marks)

(b) An electron having 450 eV of energy moves at right angles to a uniform magnetic field of flux density 1.50×10^{-3}T. Show that the path of the electron is a circle and find its radius. (10 marks)

SECTION B

This section consists of three questions out of which you are to attempt only TWO including question SIX. You are advised to spend not more than forty minutes on question six. This section carries a total weight of 42 marks

6. (a) (i) Differentiate between physics laboratory regulations and physics safety precautions. (4 marks)
(ii) State three physics laboratory regulations and three physics safety precautions. (2 marks)
(iii) What is the most common hazard which can be caused by glass ware in the physics laboratory? (2 marks)

(b) (i) What is a scheme of work?
Discuss the importance of a scheme of work. (3 marks)
(ii) List the main parts of a scheme of work. (3 marks)

(c) (i) List the stages which are followed when an experiment is being done in the laboratory. (5 marks)
(ii) List four liquids or chemicals which are necessary to be stored in the physics laboratory and state the respective experiments which use them. (5 marks)

7. (a) Suppose you are required to introduce form I students the topic "Density" within one period of 40 minutes:
(i) What is the prerequisite for this topic? (2 marks)
(ii) Write lesson notes which you would use for this purpose. (4 marks)

(b) A class of form III pupils has a practical lesson in which the pupils are required to verify Hookes Law using rubber bands. Write a set of instructions including the diagram which the pupils will have to follow during the experiment. (10 marks)

8. (a) What is a "kit" as referred to physics equipment? (4 marks)

(b) State the advantages and disadvantages of a physics kit. (4 marks)

(c) (i) With the aid of diagrams, where necessary, describe how you would make a hydrometer. (4 marks)
(ii) Where and how could you use a hydrometer in teaching physics? (4 marks)