

Physics 2
0780

CAMEROON GENERAL CERTIFICATE OF EDUCATION BOARD

General Certificate of Education Examination

JUNE 2017

ADVANCED LEVEL

| | |
|---------------|---------|
| Subject Title | Physics |
| Paper No | 2 |
| Paper Code | 0780 |

Two and a half hours

Answer ALL questions

Section I is designed to be answered in 1 hour, Section II in 30 minutes and Section III in 1 hour.

You are advised to divide your time accordingly.

You are reminded of the necessity for good English and orderly presentation in your answers.

In calculations you must show all the steps in your working, giving your answer at each stage.

Calculators and formulae booklet are allowed.

SECTION I

(One hour)
Answer all Question

1. The energy stored in an air filled parallel plate capacitor whose area of overlap is 'A' is given by the equation $E = \frac{V^2 A \epsilon_0}{2d}$, Where d is the separation between the plates, V, is the potential difference across the plates and ϵ_0 , is the permittivity of free space. Show that this equation is homogenous. (6 marks)

2. An object is placed 30.0 cm from a converging lens of focal length 15.0 cm and 30.0 cm from a diverging lens of the same focal length as the converging lens. Calculate the magnifications of the lenses and describe the images formed by the:
(i) converging lens
(ii) diverging lens relative to the objects. (6 marks)

3. Figure 1 shows how capacitors, X, Y, and Z are connected to a battery in an electric circuit.

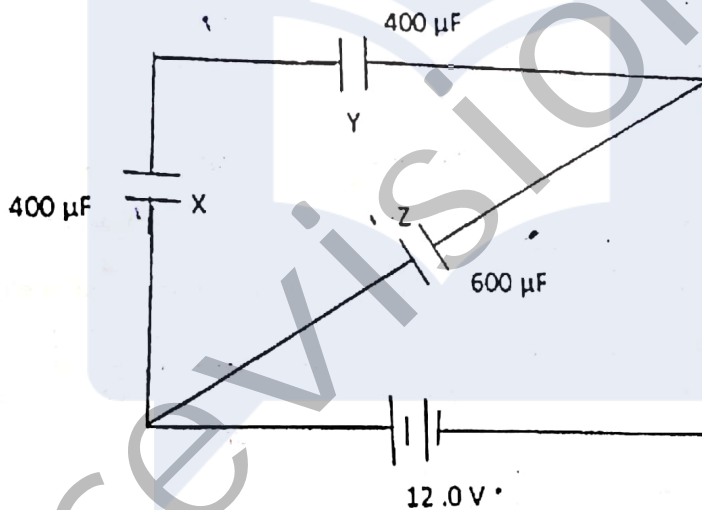


Figure 1

Calculate the:

- (a) Voltage across the capacitor Y
 - (b) Energy stored in the capacitor X
- (6 marks)

4. (a) Explain what is meant by the wave -particle duality.
(b) Estimate the de Broglie's wave length for an electron emitted by thermionic emission into a vacuum from a hot cathode and accelerated by a pd of 3.0×10^4 V (7 marks)

5. (i) Forces may generally be classified as **contact forces** or **action at a distance forces**. Explain the meaning of the phrases in bold.
(ii) Give an example of each type of force in 5 (i). (5 marks)

Answer EITHER 6 (a), (b) and (c) OR 6 (d), (e) and (f).

EITHER 6 (a), (b) and (c)

- (a) Distinguish between an ideal gas and a real gas (4 marks)
- (b) One form of the equations for an ideal gas is $PV = nRT$(i)
 where P , is the pressure of the gas V , is the volume occupied by the molecules, n , is the number of moles
 R , is the molar gas constant and T is the absolute temperature of the gas.
 Another expression relating pressure for an ideal gas is
 $P = \frac{1}{3} \rho c^2$ (ii)
 Where ρ , is the density and c is the speed of a molecule.
- (i) State the four assumptions of the kinetic theory of matter used to derive equation (ii) (4marks)
- (ii) By considering the equations for the ideal gas, show how the average kinetic energy is related to the absolute temperature. (4 marks)
- (c) (i) State the second law of thermodynamics (2 marks)
- (ii) A system delivers an amount of heat Q_h to an engine which does mechanical work, W , and releases Q_o to the atmosphere. Considering the first law of thermodynamics, use the symbols Q_h , Q_o and W to work out an expression for the efficiency of the engine. (4 marks)
- (iii) Explain why the efficiency is less than 100 %. (2 marks)

OR 6 (d), (e) and (f).

- 6 (d) (i) Compare a moving coil instrument and an oscilloscope as current measuring devices. (2 marks)
- (ii) Why is a.c system preferred to d.c system for long distance transmission of electrical energy? (2 marks)
- (e) A thin wire of mass 5.0 g is wound round a dry piece of wood to produce several turns and the ends joined together. When a powerful bar magnet is swiftly moved over the coil in an interval of 0.3 s the wire burns out.
- (i) Explain why the wire burns out. (2 marks)
- (ii) State and explain what can be done to reduce the time for the wire to burn. (3 marks)
- (iii) A wire burns out when a minimum current of 5.0 A flows in it at a pd of 150 V. If the temperature of the wire changes by 80°C, estimate the specific heat capacity of the wire. (4 marks)
- (f) A coil of inductance 50 H, a capacitor of 200 μ F and a resistor of 1 k Ω are connected in series to a signal generator.
- (i) Write down the equation for the impedance of the circuit. (1 mark)
- (ii) Determine the frequency of the a.c signal which allows for a maximum potential difference across the resistor. (3 marks)
- (iii) Explain why the potential Difference across the resistor is maximum at this frequency. (3 marks)

SECTION II (30 minutes)

DATA ANALYSIS

7. In an experiment to determine the properties of a car battery, various loads were connected to its terminals in a closed circuit. A record of the different potential difference, V , across each load and the corresponding current, through the battery was recorded as displayed in the table 1 below.

| | | | | | | | | |
|------|------|------|------|------|------|------|------|------|
| V/V | 16.6 | 15.2 | 12.0 | 8.6 | 7.8 | 6.6 | 5.2 | 3.8 |
| I/mA | 4.0 | 8.0 | 16.8 | 26.4 | 28.8 | 32.0 | 36.0 | 40.0 |

Table 1

Theory holds that the potential difference, V , and the current I , vary according to equation $\epsilon = V + Ir$. Where ϵ and r are the electromotive force and internal resistance of the battery, respectively.

- (a) Plot a suitable graph from which ϵ and r could be obtained. (7 marks)
- (b) Determine the values for ϵ and r (10 marks)
- (c) Would you expect this source to deliver power more efficiently when connected to a 200Ω or 2000Ω resistor? Explain. (3 marks)

SECTION III (1hour)

OPTIONS

Answer any two questions from the four options

OPTION 1: ENERGY RESOURCES AND ENVIRONMENTAL PHYSICS

8. (a) (i) Distinguish between renewable and non renewable energy sources giving an example of each. (4 marks)
- (ii) A solar panel delivers power of 2.0 kW when the rays of the sun fall normally on it. If the solar constant is $1.2 \times 10^3 \text{ Wm}^{-2}$ and its efficiency is only 40% , calculate the area of the solar panel. (3 marks)
- (b) (i) Explain why Cameroon cannot rely completely on the solar energy for its energy needs. (4 marks)
- (ii) Draw an energy flow diagram for an energy scheme in which wood is burnt to produce electrical energy. (4 marks)

OPTION 2: COMMUNICATION.

9. (a) (i) Draw a block diagram of a radio system. (4 marks)
- (ii) A station is broadcasting on a frequency of 92.5 MHz . Determine the capacitance of the capacitor which should be associated with an inductor of $1.25 \times 10^{-9} \text{ H}$ to receive this station. (3 marks)
- (b) (i) Compare analogue and digital systems as means of transmitting information. (3 marks)
- (ii) Discuss the problems and the advantages for Cameroon changing from analogue to digital transmission in the near future. (5 marks)

OPTION 3: ELECTRONICS

10. (a) State in words and in the form of a truth table the actions of the following logic gates.

- (i) AND
- (ii) OR
- (iii) NAND

(6 marks)

(b) Figure 2 shows a transistor circuit operating in the common emitter mode with a current gain of 60 and V_{BE} of 0.7 V.

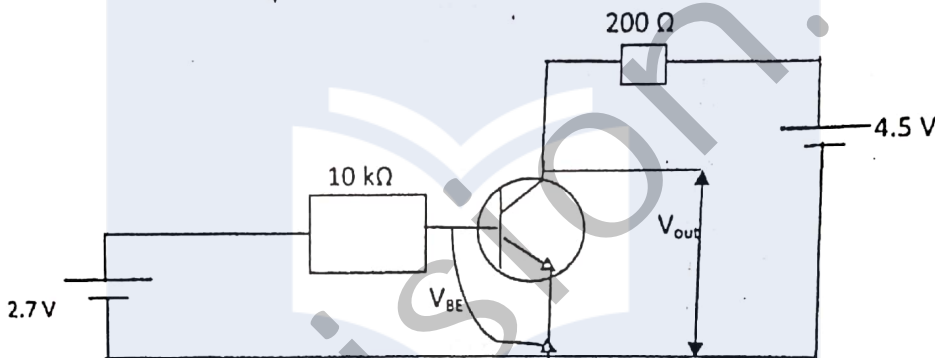


Figure 2

Calculate the output voltage V_o

(9 marks)

OPTION 4: MEDICAL PHYSICS

11. (a) Explain using ray diagram how a normal eye focuses an image of an object on the retina. (5 marks)
- (b) A doctor notices that one of her patients can see clearly some text when it is near but will see the same text appearing blurred when moved further away. Explain how such a defect can be corrected using a named lens. (4 marks)
- (c) Select a non - ionizing imaging technique and explain how it is used in medical diagnosis. (6 marks)