# PAST GCE QUESTIONS MEETLEARN.COM

# JUNE 2016

## SECTION I  (One hour)

1.  (a)  Explain why the homogeneity of a physical equation is not a sufficient condition for the correctness of the physical equation?

    (b)  Faraday's law may be stated in the form $E = -L\frac{dI}{dt}$ where, E, is the induced emf, L is the inductance of a coil and $\frac{dI}{dt}$ is the rate of change of current. Determine the base units of L if the equation is homogenous.

    **(6 marks)**

2.  A simple pendulum of length $\ell$, has a period, T, on the surface of the earth. The simple pendulum is carried in a space craft to a height of 2R, above the earth's surface where R is the radius of the earth.

    Explain whether the period of the pendulum at this height would increase or decrease.

    **(6 marks)**

3.  (a)  Distinguish between thermionic emission and the photo–electric effect.

    (b)  An electromagnetic radiation of wavelength $6.3 \times 10^{-14}$ m falls on a clean metal surface which has a work function of $2.25 \times 10^{-14}$ J. Explain whether photo-electrons would be emitted or not.

    **(6 marks)**

4.  (a)  A transformer cannot be used to run a 230 V,100 W mains lamp directly from a 12 V d.c. car battery.
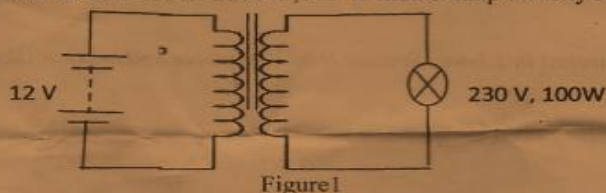


12 V               230 V, 100W

Figure 1

    Suggest in terms of fields and energy why the system cannot work.

    (b)  (i)  Discuss how the system can be adapted to function.
         (ii) What type of transformer does figure 1 represent?

    **(5 marks)**

5.  Figure 2 shows how resistors and cells may be connected in an electric circuit.
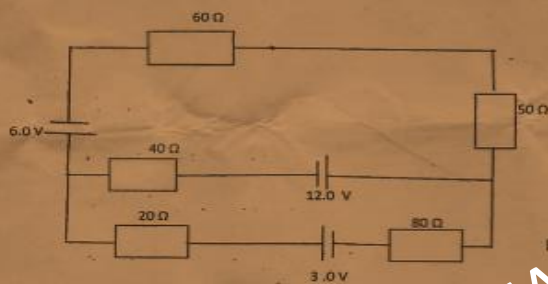


60 Ω

50 Ω

6.0 V

40 Ω

12.0 V

20 Ω

80 Ω

Figure

3.0 V

    Calculate the:
    (i)   Current flowing through the 40 Ω resistor.
    (ii)  Voltage drop across the 80 Ω resistor.

    **(7 marks)**

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**ANSWER QUESTION 6 (a), (b)    OR (d), (e)  .(f), (g)**

Either 6 (a), (b)

6    (a)    (i)    Distinguish between transverse and longitudinal waves.    (4 marks)

(ii)    Describe an experiment to determine the speed of sound in air. Your account should include a diagram, procedure, precautions, observation and conclusion.    (8 marks)

(b)    A source of sound whose frequency is 51.6 Hz is placed in front of a flat vertical smooth wall, if a microphone is moved from the source directly toward the wall a series of minimum and maximum values in its output are observed at equally spaced intervals. The speed of sound at room temperature is 330 ms⁻¹.
(i)    Explain how these minimum positions are formed.
(ii)    Calculate the separation of these minimum points.
(iii)    What can be done to increase the separation calculated in ii) above    (8 marks)

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

6    (d)    Explain why the specific heat capacities of gases are either measured at constant pressure or at constant volume while this is not required for solids and liquids.    (4 marks)

(e)    Describe an experiment to determine the specific heat capacity of a liquid. Your account should include a diagram, procedure, precautions, observation and conclusion.    (8 marks)

(f)    In terms of molecular behaviour explain ,
(i) How liquids are similar to gases but different from solids.
(ii) How solids are similar to liquids but different from gases.    (4 marks)

g)    A highly lagged compound bar 25.0 cm long is made from a copper bar 15.0 cm long joined to an aluminium bar of equal cross-sectional area. The free end of the copper is maintained at 100 $^0$C while that of aluminium is maintained at 0 $^0$C. Calculate the temperature gradient for each of the bar under steady states, given that the ratio of the thermal conductivities of copper to aluminium is 1?:7    (4 marks)

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## SECTION 11(30 minutes)

### DATA ANATYSIS

7    Table 1 shows the force, F, between two charged particles in a substance. The force is given by the

Equation $F = \frac{Q^2}{r^2 4\pi\varepsilon}$ . In order to confirm this relationship the following data was recorded for various values of F and r, the distance between the charged particles. $Q = 4.4 \times 10^{-6}$ C.

| F/N | 1.0 | 1.5 | 2.O | 2.5 | 3.0 | 4.0 | 4.5 | | 5.0 | 6.0 |
|---|---|---|---|---|---|---|---|---|---|---|
| r/nm | 355.1 | 297.5 | 258.2 | 230.6 | 210.8 | 182.6 | 172.0 | | 163.3 | 149.0 |

**Table 1**

(a)    Plot a suitable graph from which $\varepsilon$ could be determine.                                (10 marks)

(b)    (i)      Find the slope S of the graph.

(ii)     What does the S represent?

(iii)    Calculate a value for $\varepsilon$                                                        (8 marks)

(c)    What would be the nature of the force if the experiment was conducted in a medium of higher dielectric constant?                                                                (2 marks)

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### OPTIONS (1 hour)
### Answer any    two of the 4 options.

## OPTION 1: ENERGY RESOURCES AND ENVIRONMENTAL PHYSICS

8    (a)    (i)      What do you understand by finite and renewable energy resources?            (2 marks)

(ii)     Given that the mean distance of the earth from the sun is $1.5 \times 10^{11}$ m and the power output of the sun is $4 \times 10^{26}$ W, calculate a value for the solar constant . State the assumption that you have made in your calculation.            (4 marks)

(b)    Describe the processes by which electrical energy could be obtained from the following sources of energy.

-        Geothermal energy

-        Wind energy                                                                    (5 marks)

(c)    (i) Discuss the consequences on humanity of the destruction of the ionosphere layer.

(ii) Explain ways by which the ionosphere can be protected from destruction?            (4 marks)

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## OPTION 2: COMMUNICATION.

9.    (a)    (i)      Draw a basic block diagram of a mobile telephone handset                (3 marks)

(ii)     Compare the use of the optical fibre and the copper cable in the transmission of information in terms of:

-        Seçurity

-        Noise

-        Signal attenuation                                                        (6 marks)

(b)    (i)      What is the full meaning of the following abbreviations

SIM

SMS                                                                            (4 marks)

(c)    Explain how a radio receiver works.                                                    (2 marks)

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## OPTION 3: ELECTRONICS.

10. (a) Explain why a piece of pure silicon may not conduct electricity at $0^0$C but would conduct at $80^0$ C.
(4 marks)

(b) A capacitor, an ammeter and an a.c. power source are connected in series and the reading on the ammeter noted. The capacitor and the ammeter are disconnected and connected to a d.c power source. The reading is also noted. Will the ammeter readings in the two cases be same or different? Explain.
(4 marks)

Figure 3 is an amplification circuit using an NPN transistor in the common emitter mode. The base current is 25 $\mu$A when the output voltage Vo is 6.0 V for a current gain of 60.
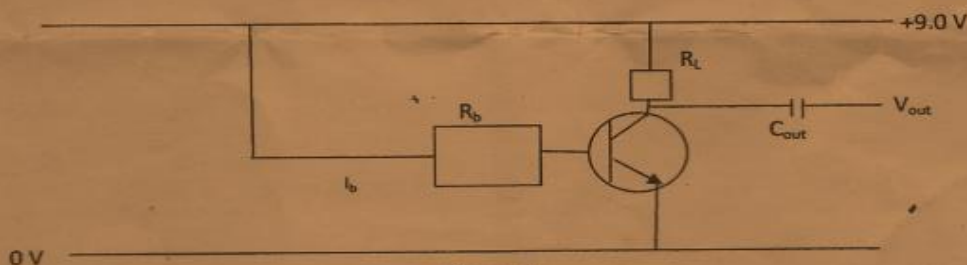


Figure 3

Calculate:
(i) The base resistance $R_b$ (2 marks)
(ii) The value of $R_L$. (3 marks)
(iii) Explain the use of the capacitor $C_{out}$. (2 marks)

## OPTION 4: MEDICAL PHYSICS

11. (a) (i) Draw a simple structure of the ear and describe how the ear functions. (4 marks)

(b) (i) Name two light - sensitive receptors in the human eye.

(ii) By reference to refraction at the cornea and the lens, draw a diagram showing how the rays from a distant object form a blurred image in the eye.

(iii) A patient suffering from long sight has a near point which is 1.5 m from his eyes. Determine the type of lens that the patient should use to correct this defect. (8 marks)

(c) Explain the principle of operation for obtaining the ECG waveform. How is it useful in diagnosing heart problems? (3 marks)

Turn Over

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