



## First year entrance exam GCE Specialization

**physical test**  
**Duration : 3 Hours**

1. 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
- b) The figure 2, shows a transistor circuit operating in the common emitter mode with a current gain 60 and  $V_{BE}$  of 0.7V.  
Calculate the output voltage  $V_o$

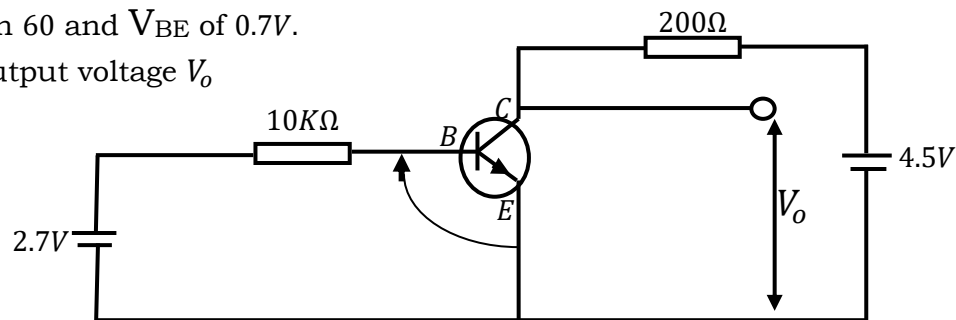


Figure 1

(10marks)

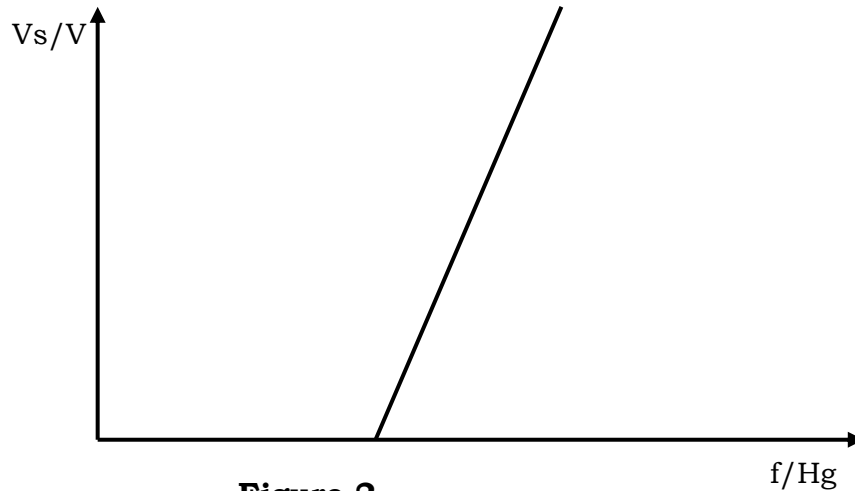
2. The ENEO, thermal plant in Limbe supplies SONARA with 1.0MW at a p.d of  $1.0 \times 10^4 V$ . The total resistance between the power station and the factory is  $0.5\Omega$ .
- (a) What is the power output of the thermal plant?
  - (b) Explain why the power station output voltage is always stepped up before transmission over a long distance.
3. An observer is standing at the bank of a stream. At what velocity will the observer see a boat sailing at  $50\text{cms}^{-1}$  relative to the stream which is flowing at  $10\text{cms}^{-1}$ .
- i) downstream.
  - ii) perpendicular to the flow of the stream

(5marks)

(5marks)

4.

Figure 1 shows a graph of stopping potential,  $V$ , plotted against frequency,  $f$ , for a certain metal,  $Z$ .



**Figure 2**

- (i) Calculate the threshold wavelength of the metal, given that the work function is 3.8 electronvolts.
- (ii) To which region of the electromagnetic spectrum does the wavelength calculated in (i) belong?
- (iii) Of what significance is the gradient of the graph in figure 1. Draw a set up from which the results above could have been obtained.

(7marks)

5.

The voltage sensitivity,  $\theta/V$ , of a moving coil meter is given by

$$\frac{\theta}{V} = \frac{BAN}{CR}$$

where  $B$  is the magnetic field strength,  $A$  the area of the coil,  $N$  the number of turns of the coil,  $C$  the torsional constant and  $R$  the resistance of the coil. What are the units of  $C$ ?

(5marks)

6.

- a) Define the term half-life as used in radioactivity.
- b) The half-life of carbon-14 is 5730 years. If the count rate of carbon -14 in 2kg of a living bone is  $3 \times 10^4$  counts per minute, determine the count rate in 0.3kg of an ancient bone that is 25 years old.

(6marks)

7.

An iron bar of length 0.80m and a copper bar of length 1.2m are joined together to form a composite bar of length 2.0m. The free ends of the copper and iron bars are maintained at  $55^\circ\text{C}$  and  $0^\circ$  respectively. Each bar has a diameter of 0.16m and is well lagged. The thermal conductivity of iron is  $75 \text{ W m}^{-1}\text{K}^{-1}$  and that of copper is  $390 \text{ W m}^{-1}\text{K}^{-1}$ .

I. Define thermal conductivity

- II. Calculate the temperature gradient along each of the bars  
III. Sketch a graph to show the variation of temperature with distance along the composite bar from the hot to the cold end of it

(7marks)

8. Copper contains about  $10^{29}$  free electrons per cubic metre. Determine the average drift velocity of the free electrons in a uniform copper wire of length  $0.5m$  when the p.d of  $1.5V$  is applied across it.

(resistivity of copper =  $1.7 \times 10^{-8}\Omega m$ )

(5marks)

9. Figure 3 below shows a set up designed by a student to determine the velocity of a pellet from a toy gun. A piece of plasticine of mass  $50g$  is balanced at the edge of the table such that it fails to fall-off. A pellet of mass  $10g$  is fired horizontally into the plasticine and remains embedded in it. As a result the plasticine reaches the floor at a horizontal distance of  $0.25m$  away from the edge of the table.

- What is the horizontal velocity of the plasticine given that the table surface is  $0.6m$  high?
- What is the velocity of the pellet just before it hit the plasticine.
- What is the velocity of the plasticine just before impact with the floor at the horizontal distance of  $0.25m$ ?

10marks

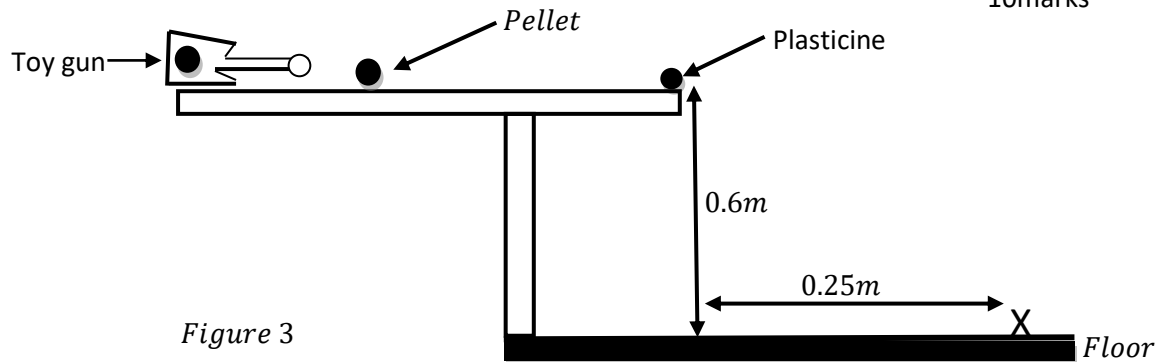


Figure 3