



## First year entrance exam GCE Specialization

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

1) In deriving the expression for the power ( $P$ ) available from a wind turbine, a student established the following equation.  $P - \frac{1}{3} L^2 \rho v^2 = 0$ . Where  $L$  = length of the blades,  $\rho$  = Air density and  $v$  = wind speed

a) Determine whether the equation is homogenous or not.

b) Comment on the correctness of the above equation. (4 marks)

2. a) What do you understand by the *specific heat capacity of a substance*?

b) A lump of pure ice of mass **20g** and at a temperature of **0.0 °C** is dropped into a well-insulated calorimeter (of negligible specified heat capacity) containing **210g** of alcohol at a temperature of **23.0 °C**. After stirring properly, the mixture attains an equilibrium temperature of **8.4 °C**.

(i) State one similarity between the molecular properties of ice and alcohol (liquid).

(ii) Determine the specific heat capacity of the alcohol **5 marks**

**Latent heat of fusion of ice 330000 J/Kg; massic heat of water 4190 J/Kg/K**

3.a) State Coulomb's Law.

b) In *figure 2*, two positively charged identical spheres are suspended from the same point on a support.

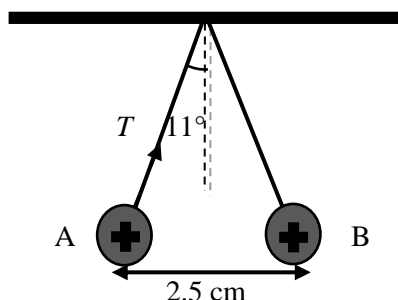


Figure 2

If each sphere carries a charge of **+1.5 nC**, determine

i) the magnitude of the electric force between the two spheres.

ii) the tension,  $T$ , in each string.

iii) the weight of each sphere. **6 marks**

4.a) (i) Distinguish between *amplitude modulation (AM)* and *frequency modulation (FM)*.

(ii) State

- One advantage that AM has over FM
- One advantage that FM has over AM

(iii) State two reasons why modulation is extremely necessary in radio communication. **5 marks**

b) Copy and complete the following table which describes functions of some parts of the transmitting unit of a radio system **5 marks**

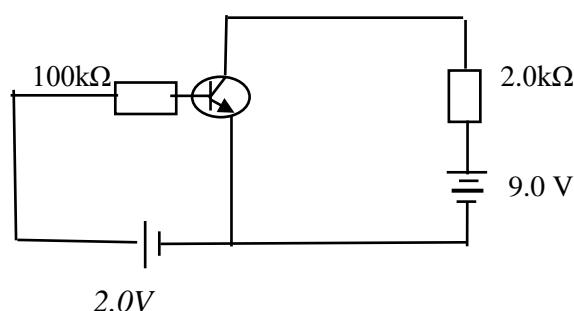
NAME OF PART	FUNCTION
Microphone	
	Raises the strength of the audio signal
Oscillator or radio frequency generator	
Modulator	
	Radiates the radio waves into space

5. What do you understand by

(i) Thermal runaway

(ii) The operating point of a transistor

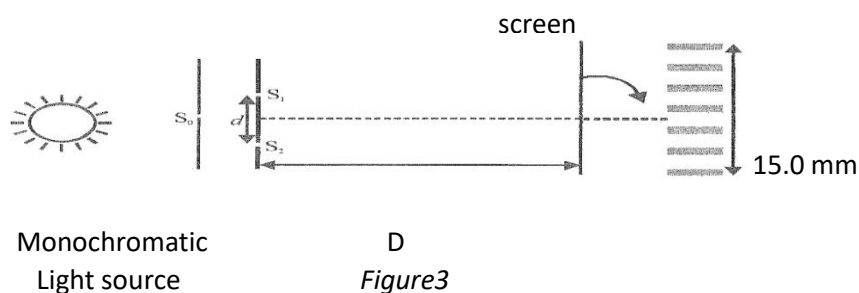
**Figures 10** shows a transistor circuit that uses a base resistor to stabilise the operating point. The transistor has a negligible base emitter voltage and a d.c gain of **50**



(iii) Explain how the base resistor provides stabilisation of the operating point.

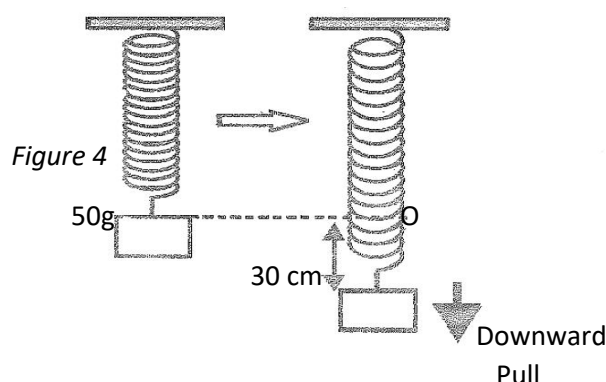
(iv) Determine the base current, the collector current and the collector emitter-voltage **6 marks**

**6.**Figure 3: shows and experimental set-used to determine wavelength of a monochromatic light source.



On the screen, alternate bright and dark fringes are observed as shows on the diagram.**a)** What is a monochromatic light source?**b)**Determine the fringe separation for the above experiment.**c)**The slits-to-fringe distance,  $D=2.0$  m while the distance between the double slits, $d=0.40$ mm.Determine the wavelength of the light from the source **4 marks**

**7.a)** A **50 g** standard mass is attached on a hookian spring hanging vertically. The mass is then pulled downwards through a distance **3.0 cm** and released, figure 4



When the mass is pulled downwards and released, it undergoes simple harmonic motion about **O** making 69 oscillations in 1 minute.

- Explain the meaning of the underlined phrase.
- Determine the kinetic energy with which the mass passes the point **O**.
- Sketch a graph to show how the acceleration of the object varies with its displacement from **O**. Indicate values on both axes. **(6 marks)**

**8.** In charging a capacitor through a resistor, a student uses the circuit in *figure 8*. The following table shows how the reading of the voltmeter (**V**) varies with time (**t**) when the switch is closed

Time, <i>t</i> /s	30	60	90	120	150	180	210	240	270	300	330
<i>V</i> /mV	2340	1960	1610	1330	1090	900	750	620	530	440	380



*Figure 8*

The potential difference across the resistor, **V**, varies with time according to the equation  $V = Ae^{\frac{-t}{B}}$

**a)** Plot a suitable graph that can be used to determine the value of **A** and **B**. **8 marks**

**b)** Use your graph to determine the value of **A** and **B**. **4 marks**

**c)** What is the physical signification of?

(i) **A?**

(ii) **B?**

**d)** If **R = 51 kΩ**, determine **2 marks**

i) The initial current flowing through the circuit

ii) The capacitance of the capacitor

iii) The charge stored in the capacitor when it is fully charged **3 marks**

**e)** Sketch a graph to show how the potential difference across the capacitor varies with time. **1 mark**