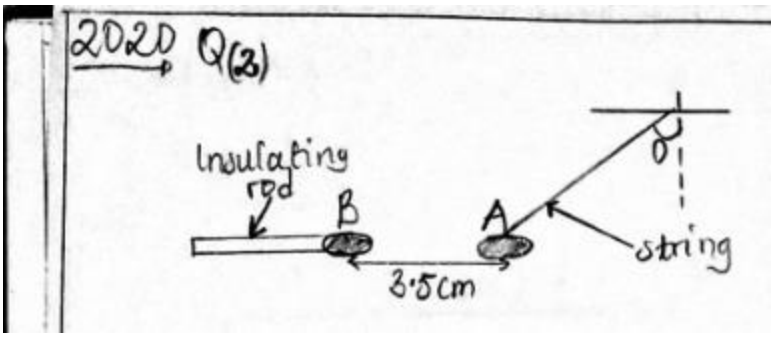
JUNE 2020
SECTION I

1. The power, P, obtainable from a wind turbine may be give by $P = KL^2 Pv^3$
Where L = length of the blades, p = Air density and v = wind speed
(a) What is a homogenous equation?
(b) Determine the base units of the constant K.
(c) State two shortcoming of using homogeneity to check the correctness of a physical equation.

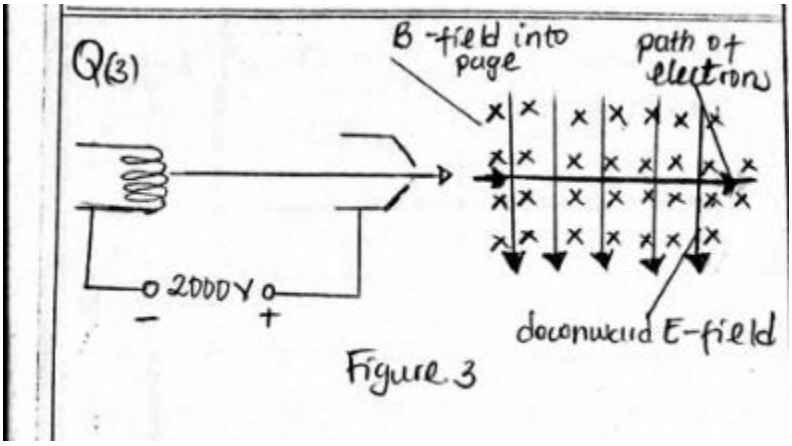
(6marks)

2. in figure 1, a charge metal sphere (A) is hung from an insulating string . Another charged sphere (B) on an insulating rod is then place close to A as shown .
The charge on A is +5.0 nC while that on B is -4.0 nC.



(a) Draw the two spheres and show the electric field pattern around them.
(b) Determine the magnitude of the electric force between them.
(c) What is the value of the angle if sphere A has a mass of 4.5×10^{-5} kg? (7 marks)

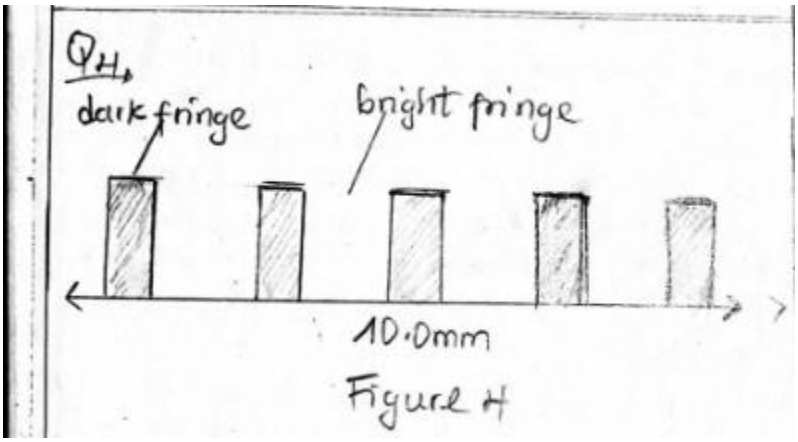
3. Figure 2 shows part of a system used to eject and accelerate electrons.



(a) State the phenomenon of emission of electrons from a sufficiently heated surface.
(b) Determine the speed with which the electrons leave the anode .

(c) Upon leaving the anode, the electrons enter into a region of cross magnetic and electric fields as shown in figure 3. If the intensity of the electric field is 7.5 x10^4 V/m, calculate the flux density of the magnetic field if the electrons passed through the cross field undeflected as shown in figure3.
(7 marks)

4. Figure 4 shows the fringe pattern obtained on a screen from Young's double-slits experiment to measure the wavelength of a monochromatic light from a source.



(a) Explain the meaning of the underlined word.
(b) Determine the fringe separation.
(c) If the distance from the double slits to the screen is 2.5 m while the separation of the double slits is 0.50 mm, determine the wavelength of the light from the source.
(5 marks)

5. strontium-89 has a half-life of 84 days.
(a) Explain the meaning of the underlined phrase.
(b) A laboratory prepares a strontium-89 source. 21 days after preparation , its activity is measured to be 7.4 x 10^6 Bq. What is the activity of the source at the time of preparation.
(5 marks)

ANSWER EITHER a, b and c OR d, e and f
6. (a) (i) State the first the first law of thermodynamics (2 marks)
2.00 kg of water has a volume 2.00 x 10^{-3} m^3 when in the liquid state at 100^0C. When the water is completely changed from liquid to vapour at 100^0C, under a constant atmospheric pressure of 1.01 x 10^5 Pa, the volume increase to 3.38 m^3.
(ii) How much work is done against the atmosphere as the water changes to vapour?
(iii) What is the change in the internal energy of the water during vaporization?
(8 marks)
(b)the graph in figure shows how tensile stress varies with tensile strength for two metallic wires, copper and steel. Study the two graphs and answer the question that follows. The stress is applied until the material breaks, in each case

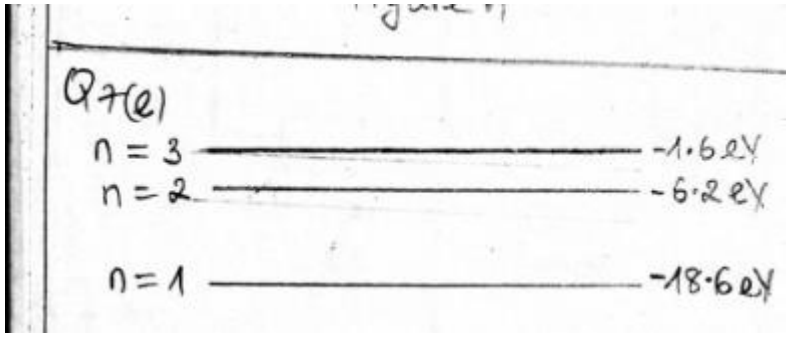
(i) Write down the breaking tensile stress of each of the material.
(ii) Which of the material is more ductile? Explain your answer
(iii) Determine the Young's modulus of each of the material.
(8 marks)

(c) (i) state any two assumptions of the kinetic theory used to derive equation . $P=1/3pc^{2.}$
(ii) What is the name given to $c^{2.}$
(4 marks)

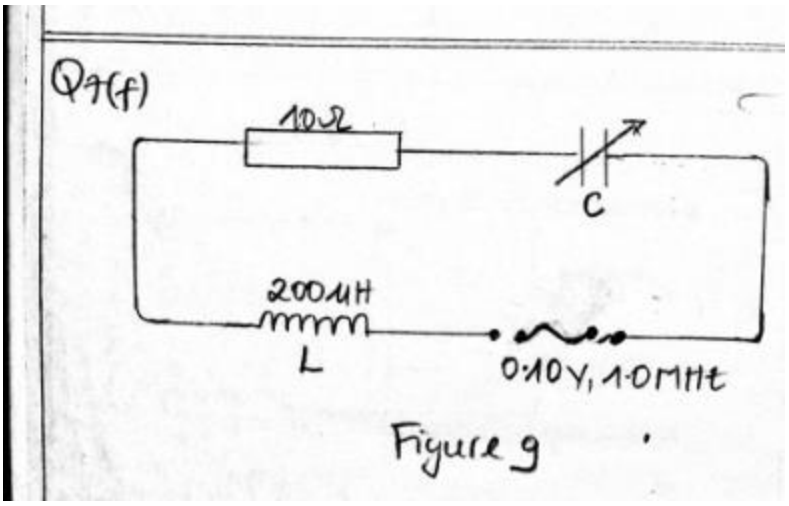
OR

(d) (i) what do you understand by the electromotive force of a cell?
In an experiment to determine the internal resistance of a battery, the current through a battery was made to vary with the voltage across a variable resistor as shown in figure 7.
Use the graph in figure 7 to determine

(ii) the internal resistance of the battery
(iii) The emf of the battery (7 marks)
(c) The three lowest energy level s of an atom are shown in figure 8 below.



(i) Determine the minimum energy in joules require to eject an electron initially in the lowest energy from the atom.
(ii) Assuming that the energy level, n, is associated with energy k/n^2, determine the energy of the level n=4 in electron/volts.
(iii) determine the wavelength of the electromagnetic radiation emitted when an electrons makes a quantum jump from the level n=3 to the level n=2. Name the region of the electromagnetic spectrum in which this radiation is found.
(7 marks).
(f) Figure 9 shows a 200 inductor, a 10Ω resistor and a variable capacitor connected in series with a 0.10 v (r.m.s value), 1.0 MHz supply. The inductor has an inductance of 200 .



At resonance, determine
(i) The capacitance of the variable capacitor
(II) the current flowing through in the circuit
(iii) The voltage across the inductor
(iv) The voltage across the capacitor.
(6 marks)

SECTION II
DATA ANALYSIS
7. In an experiment to determine how the current , I , in a circuit comprising a capacitor and a resistor in series varies with time , t, a student obtain the following results.

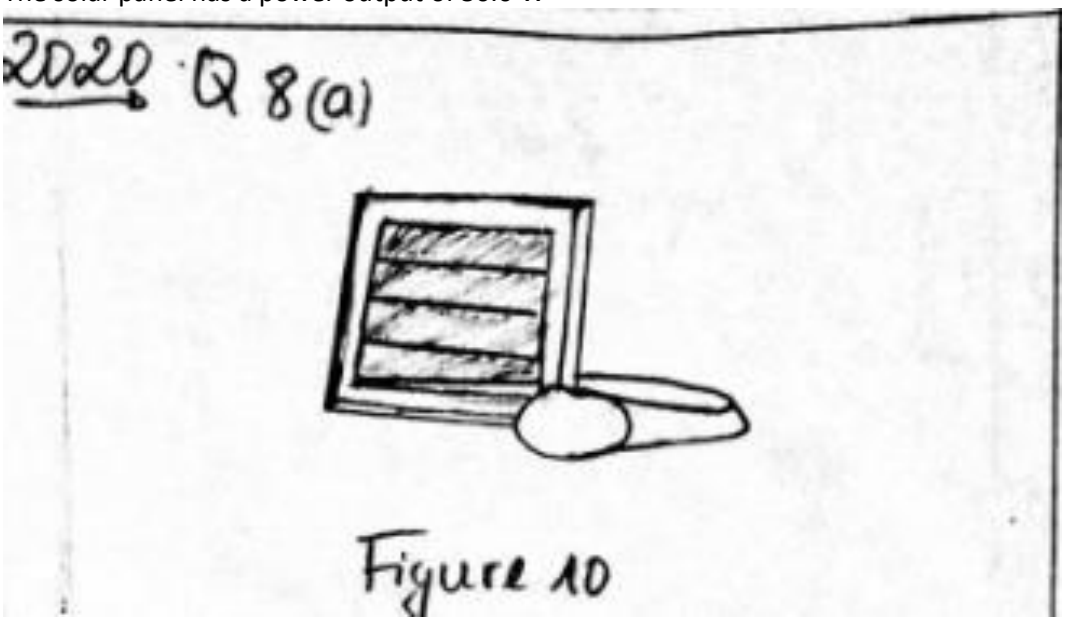
Time,t/s	I/ A
10	46.7
40	38.5
70	32.2
100	26.8
130	22.3
160	18.5
190	15.5
220	12.9
250	10.8
280	9.1
310	7.7

The current in the circuit is related to time by the equation $I = I_0 e^{-t/\beta}$ where I_0 and β are constants.
(a) Plot a suitable graph that can be used to determine the value of I_0 and β (10 marks)
(b) Use your graph to determine the value of I_0 and β (8 marks)
(c) What is the physical significant of β (2 marks)

SECTION III

ENERGY RESOURCES AND ENVIRONMENTAL PHYSICS

8. (a) Figure 10 shows a photovoltaic plate used to light a bulb in a certain house hold. The solar panel has a power output of 50.0 W



(i) If the efficiency of the panel is 30%, determine the power input into the photovoltaic plate.

(ii) Above the earth's atmosphere, the solar constant is 1.4 kWm^{-2} . However, only 40% of this power per unit area reaches the earth . Estimate the area of the solar panel in figure 10.

(iii) Explain why solar energy is referred to as renewable source of energy.

(6 marks)

(b) (i) What is the ozone layer?

(ii) Name a substance which is responsible for the depletion of the ozone layer and explain how this substance contributes to the depletion of the ozone layer.

(iii) State two effects of the depletion of the ozone layer on life on earth.

(6 marks)

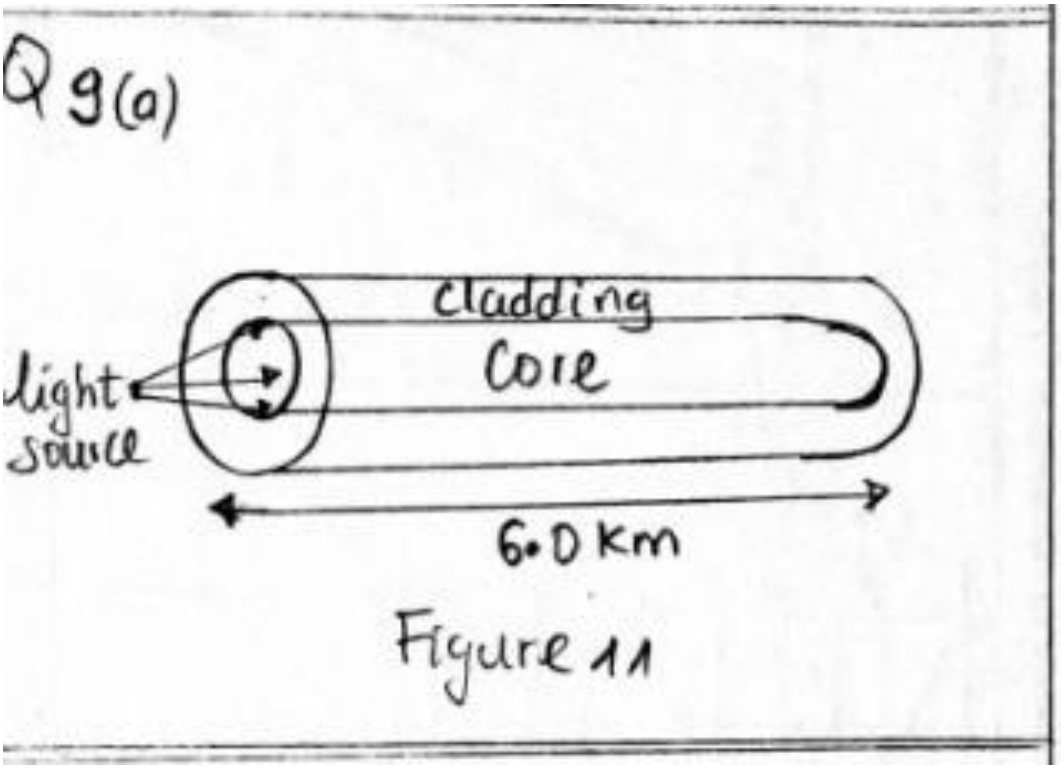
(c) (i) Give two reasons why Cameroon lies more on hydroelectricity power plates for the supply of electricity instead of fusil fuels.

(ii) Give one example of a green source of energy.

(3 marks)

COMMUNICATION

9. (a) Figure 11 shows a light signal entering into an optical fibre



A pulse of light is emitted by switching on the source for 1.0 s.
The light is emitted in many directions as shown. The critical angle at the core/cladding boundary is 59^0 and the length of the fibre is 6.0 km. The refractive index is 1.50.

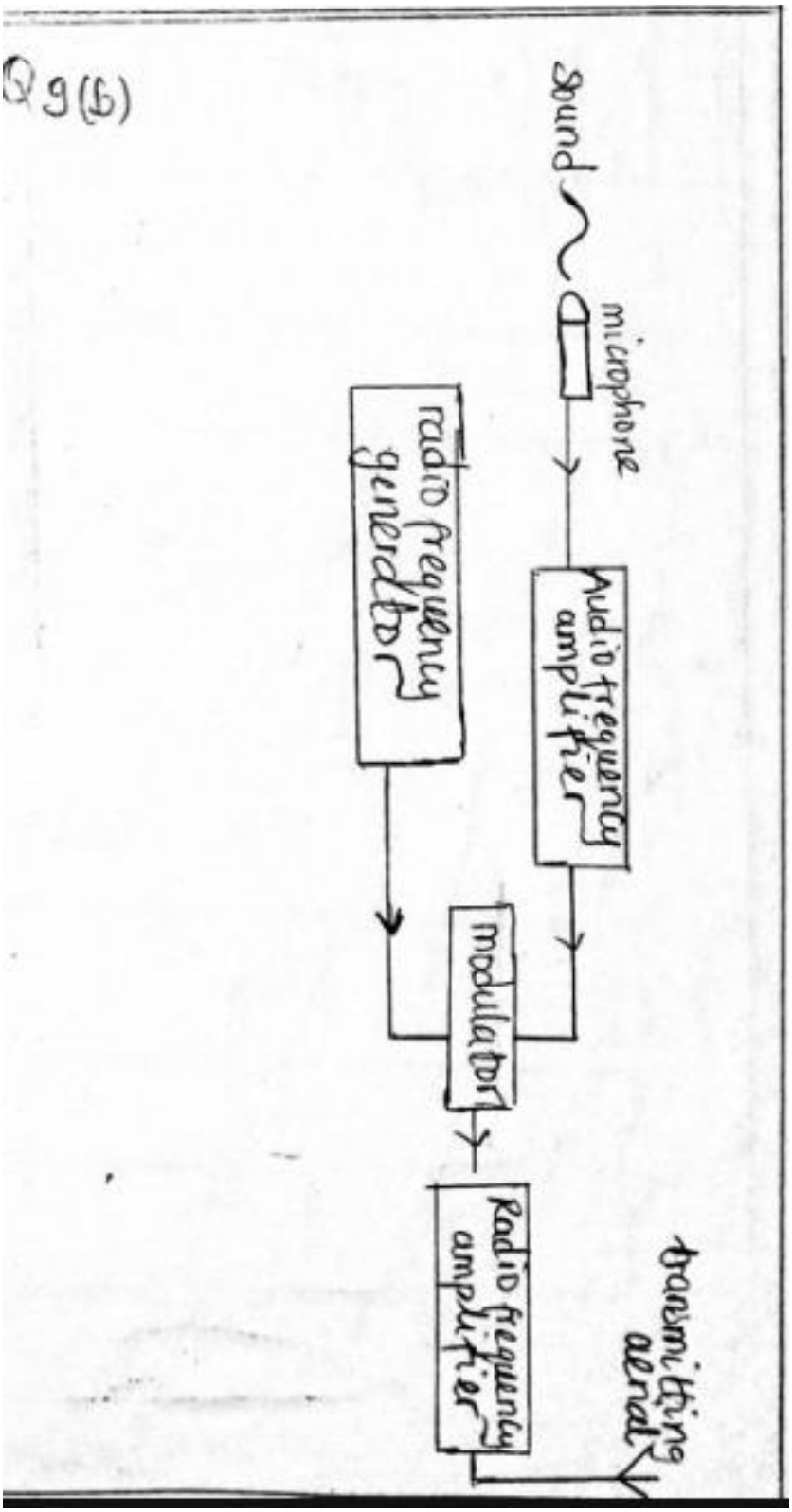
(i) State two advantages that optical fibres have over copper cables in telecommunication.

(ii) Some light from the source will travel down the fibre for its entire length.
Determine how long it takes to travel the length of the fibre.

(iii) What is the refractive index of the cladding?

(6 marks)

(b) Figure 12 shows the block diagram of a simple radio transmitter.



(i) State the function of the microphone and the modulator.
(ii) Briefly Explain the difference between amplitude modulation (A.M) and frequency modulation (F.M).
(iii) State one advantage that each of F.M and A.M has over the other. (6 marks)

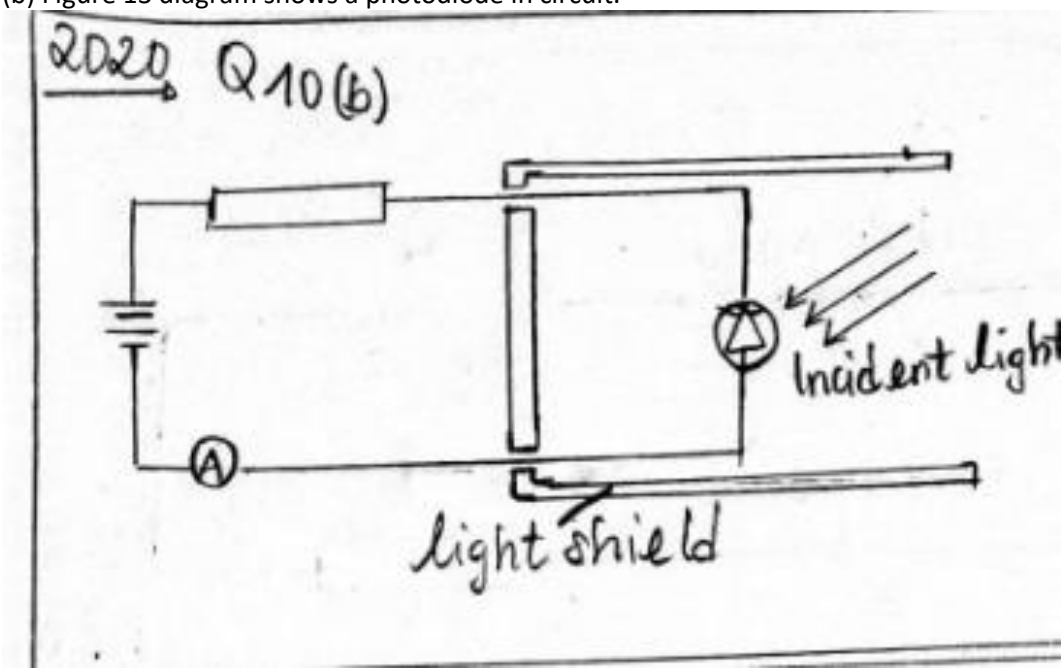
(c) State three advantages of digital transmission over analogue transmission.
(3 marks)

ELECTRONICS

10. (a) (i) Explain why the electrical conductivity of a semiconductor increases as temperature increases?

(ii) Use the band theory to distinguish between the electrical properties of wood, silicon and copper. (5 marks)

(b) Figure 13 diagram shows a photodiode in circuit.

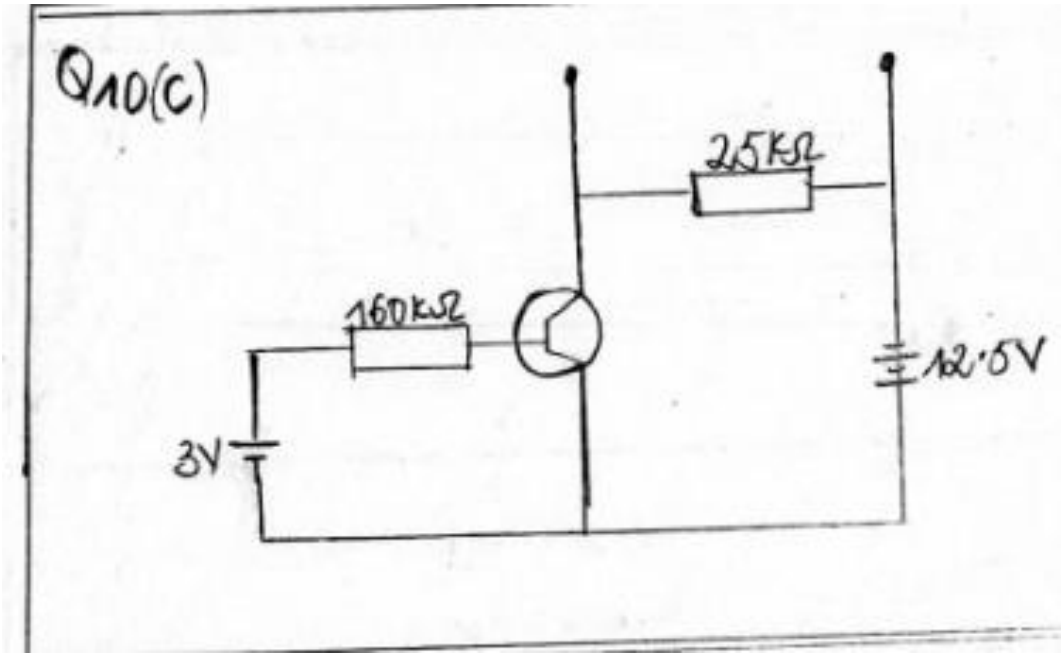


(i) Explain the meaning of dark current of a photodiode . What is the order of magnitude of this current?

(ii) What is the effect of increasing the light intensity on the diode? Explain

(4 marks)

(c) Figure 14 shows an n-p-n transistor in a circuit that can be used in voltage amplification.

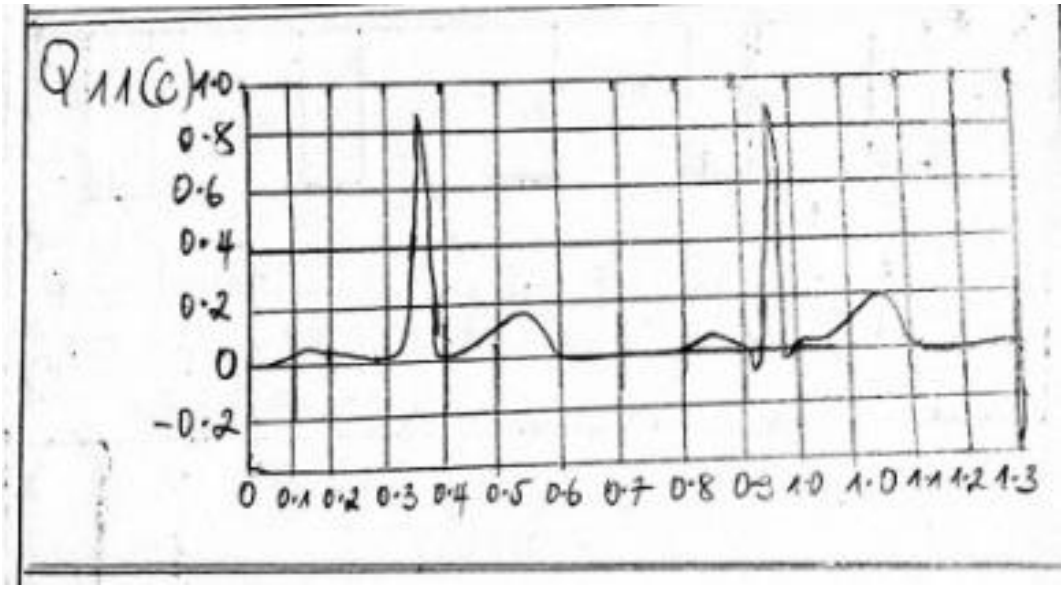


The base-emitter voltage, V_{BE} = 0.7 v and current gain (f_{FE}) = 1000.
(i) determine the base current and the collector current.
(ii) What is the operating point of the above transistor?
(6 marks)

MEDICAL PHYSICS

11. (a) (i) Why is it necessary to use a gel where the ultrasonic probe is placed?
(ii) state, with respect to the medical diagnosis, one advantage that
X-rays has over ultrasound imaging
Ultrasound imaging has over x-ray

(b) (i) Describe the changes that occur to a human eye when the eye changes from focusing a distant object to focusing a near one, both objects being viewed under bright light.
(ii) A patient's eye is said to be astigmatic. State the effect of astigmatism on the image produced by the defective eye, its cause and the shape of the lens used for correction.
A patient's near point is located 210 cm from his eyes.
(iii) What type of eye defect is the patient suffering from?
(iv) Use diagrams to explain the type of lens needed to correct this defect so that the patient should be able to read a book placed 25 cm from his eyes.
(7 marks)
(c) Figure 15 shows the electrocardiogram waveform obtained at the surface of the skin of a patient.



From the ECG waveform, determine the pulse rate per minutes.
(3 marks)