MOCK PHYSICS 2
780

MINISTRY OF SECONDARY EDUCATION

GOVERNMENT BILINGUAL HIGH SCHOOL YAOUNDE

MOCK GENERAL CERTIFICATE OF EDUCATION EXAMINATION

APRIL 2021 **ADVANCED LEVEL**

Subject Title	Physics
Paper Number	2
Subject Code	780

Time allowed: Two and a half hour

INSTRUCTIONS TO CANDIDATES

- Answer all questions.

Section 1 and Section 2 is designed to be answered in 1 hour each and Section 3 is designed to be answered in 30 minutes

You are advised to divide your time accordingly.

For your guidance the approximate mark allocation for each part of the question is indicated in brackets.

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

In calculations, you are advised to show all the steps in your working, giving your answers at each stage.

Non – programmable calculators and formulae booklets are allowed.

SECTION 1 (one hour)
(Answer all questions in this section)

1) The total energy "E" of a relativistic particle (a particle moving at the speed of light) is related to the speed of light "c" as shown by the consistent physical equation below, where r and μ are constants.

$$\left(\frac{E}{rc}\right)^2 - \left(\frac{\mu}{r}\right)^2 = 1$$

(i) What is the meaning of the underlined word? (1 mark)
(ii) Determine the base units of r and μ. (4 marks)
(iii) In your opinion which physical quantity does r represent? (1 mark)

(Total = 6 marks)

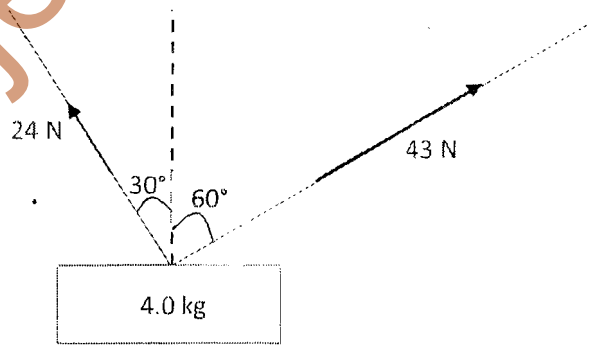
2)
(i) State Keppler's 2nd law of planetary motion. (1 marks)
(ii) With a stated assumption, show mathematically that the period of revolution of a planet around the sun is given as: $T = 2\pi\sqrt{\frac{R^3}{GM}}$ Where, T is the period, R the mean radius and M the mass of the sun. (3 marks)
(iii) Sketch a graph of force against distance to show the variation of the gravitational force on a particle taken from the centre of the earth to some point far away from the earth's surface (r_E). (3 marks)

(Total = 7 marks)

3) A rubber cord of a catapult has a cross sectional area of 2 mm^2 and initial length of 0.20 m, and is stretched to 0.24 m to fire a small object of mass 10 g.
Assume that Young's modulus for rubber is 6 x 10^8 Pa and that only elastic deformation occurs during the process;
(a) Define the term elastic deformation. (1 mark)
(b) Determine the initial velocity of the object when it just leaves the catapult. (5 marks)

(Total = 6 marks)

4. The figure below shows a mass of 4.0 kg being raised by two unequal forces of 43 N and 24 N. The 43 N force acts at an angle of 60° to the vertical and the 24 N force acts at an angle of 30°.



Calculate the acceleration of the mass. **(5 marks)**

5. A grating has lines per millimeter and is illuminated by monochromatic light of wavelength 5.9 x 10^{-7} m which is incident normal to the grating.
(i) Find the direction of the first order diffraction image? (2 marks)
(ii) Is it possible to obtain third order images with this grating for this wavelength of light? (2 marks)
(iii) What would be the effect on the number of orders if the wavelength is increased? (2 marks)

(Total = 6 marks)

ANSWER EITHER 6 a, b, c and d OR 6 e, f and g.

EITHER 6 a, b, c and d

(a) (i) Describe a method you would use to produce a uniform steady magnetic field in the lab.
(2 marks)

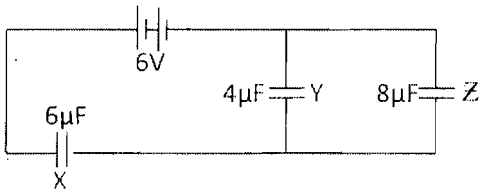
(ii) A beam of electrons are accelerated through a p.d (V), and enter a uniform magnetic field (B), with velocities at right angle to the field. Use the above information to show that the charge to mass ratio is;

$\frac{e}{m} = \frac{2V}{B^2r^2}$ Where r is the radius of the path taken by the electrons. (3 marks)

(b) Describe an experiment you would carry out in the lab using a beam of electrons to determine the specific charge on an electron? (7 marks)

(c) Neon ions each of mass 3.3×10^{-26} kg are accelerated through a p.d of 1400 V. The ions then enter a region of space where there are uniform magnetic field and electric field. Acting at right angles to each other and the original direction of motion of the ions. Calculate the speed of the accelerated ions just before they enter the B and E field.

(d)



Examine the circuit in the figure above and calculate;

(i) The potential difference across capacitor X (3 marks)

(ii) The charge on the plates of capacitor Y (2 marks)

(iii) The energy associated with the charge stored in capacitor Z. (2 marks) **(Total = 20 Marks)**

OR e, f and g

(e) (i) Define simple harmonic motion. (2 marks)

(ii) Describe an experiment to measure the acceleration of free fall(g). (Your description should include a diagram, procedure, precaution, observation and conclusion). (7 marks)

f)

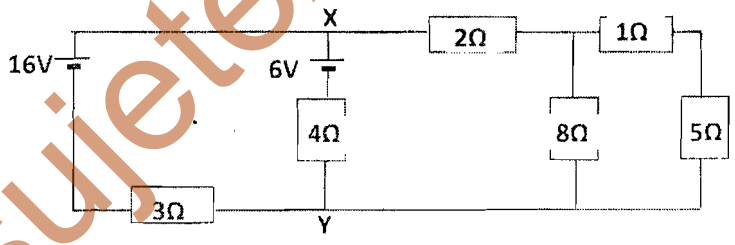


Figure 2

Calculate (i) the current through the 8Ω resistor

(ii) the p.d. across XY in figure 2. **(8 mks)**

g) Ice of mass 0.02 kg at – 15 ^{0}C and 0.085 kg of water at 40 ^{0}C are placed inside a calorimeter of mass 0.05 kg and specific heat capacity 400 J kg^{-1} K^{-1}. Calculate the final temperature of the water. (L_f of ice = 3.4×10^5 J kg^{-1}K^{-1}; s.h.c of ice = 2000 J kg^{-1}K^{-1}; C_w = 4200 Jkg^{-1} K^{-1}). (4 marks) **(Total = 20 Marks)**

SECTION II (30 minutes)
DATA ANALYSIS (COMPULSORY)

7) The current I through a silicon diode varies with the applied potential difference, V, across it as shown in the table below.

Voltage/V	0.05	0.10	0.16	0.29	0.37	0.41
Current/x 10^{-3} mA	0.5531	1.5034	4.9916	67.20	332.9	740.8

It is suspected that the current varies with p.d as follows,

$$I = I_0 e^{\left(\frac{eV}{\alpha}\right)}$$

Where I_0 = saturation current; e = electronic charge; $\alpha = 8.01 \times 10^{-21}$ J

(a) Plot a suitable graph that would enable you to obtain the value of I_0 and e. (11 marks)

(b) Hence determine the values of I_0 and e. (3, 5 marks)

(c) Compare your value of e with the standard value. Give any reason for the discrepancy. (1 mark)

(Total = 20 marks)

SECTION III (One Hour)

OPTIONS; (Answer any 2 questions out of the 4 questions in this section)

OPTION 1: ENERGY RESOURCES AND ENVIRONMENTAL PHYSICS

8) (a) (i) List two advantages of wind energy over nuclear energy.

(ii) List two disadvantages of wind energy as opposed to nuclear energy. (4 marks)

(iii) Water flows in a waterfall at a rate of 10×10^3 kg s^{-1} and takes 2 s to reach the stream vertically below. Calculate the power of the falling water just as it hits the stream. (4 marks)

(b) Seismic activities cause several devastating effects around the globe even here in Cameroon.

(i) Define the term seismic activity. (1 mark)

(ii) State any two you know (one of which has occurred in Cameroon) (2 mark)

(iii) Describe how the one which has occurred in Cameroon can be detected by any two methods of your choice and how they can be avoided. (4 marks)

(Total = 15 marks)

OPTION 2: COMMUNICATION SYSTEMS

9) (a) (i) State two disadvantages of F.M over A.M broadcasting.

(ii) List two advantages of digital transmission over analogue. (2 +2 marks)

(b) Define each of the following as used in communication.

(i) A base station

(ii) A cell

(iii) Repeater (1 x 3 marks)

(c)(i) State and explain two factors that determine or that influence the location of a base station (4 marks)

(ii) What is the full meaning of the abbreviation PSTN? Explain its function. (4 marks)

(Total = 15 marks)

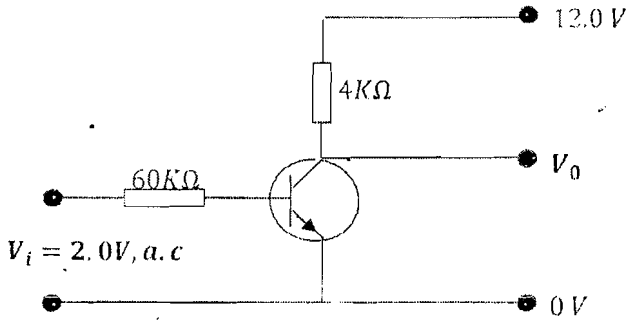
OPTION 3: ELECTRONICS

10) (a)(i) Describe the formation of the depletion layer about the p – n junction. (3 marks)

(ii) List one property of the depletion layer. (1 mark)

b) Distinguish between an ***intrinsic semi conductor*** and an ***extrinsic semi conductor***. **(3mks)**

b) The figure below shows a basic amplifier circuit for a transistor



i) State whether the transistor is a **p – n – p** or is an **n – p – n** transistor.

Given that $V_{BE} = 0.7V$, the input voltage is ***2.0 V a.c*** and the d.c gain for the transistor is **50**, calculate

ii) the base current iii) the collector current iv) the output voltage V_0

v) On the same axes sketch the graphs to show how the input voltage and the output voltage vary with time. **(8mks)**

(Total = 15 marks)

OPTION 4 MEDICAL PHYSICS

11) (a) Define each of the following terms as used in medical physics

(i) Radiation dose

(ii) Audible frequency range

(iii) Persistence of vision. (1 x 3 marks)

(b) Explain

(i) Why sound intensities are compared using the logarithmic scale.

(ii) MRI is preferred over imaging using frequency EM radiation like those produced in micro – wave ovens, even though these E.M waves give better images than MRI

(2 x 2 marks)

(c) (i) Two sounds have intensities of 2.5×10^{-8} Wm^{-2} and 0.987 Wm^{-2}. Calculate their differences in intensity levels. (3 marks)

(ii) Draw a cross – section of a patient scanned using magnetic fields. (2 marks)

(iii) Explain how a patient's image is obtained using MRI. (3 marks)

(Total = 15 marks)

END