THE UNITED REPUBLIC OF TANZANIA
NATIONAL EXAMINATIONS COUNCIL OF TANZANIA
ADVANCED CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

131/1 **PHYSICS 1**

(For Both School and Private Candidates)

Time: 3 Hours **Year : 2021**

Instructions

1. This paper consists of sections A and B with a total of **ten (10)** questions.
2. Answer **all** questions in section A and **two (2)** questions from section B.
3. Section A carries **seventy (70)** marks and Section B carries **thirty (30)** marks.
4. Mathematical tables and non-programmable calculators may be used.
5. Cellular phones and any unauthorised materials are **not** allowed in the examination room.
6. Write your **Examination Number** on every page of your answer booklet(s).
7. The following information may be useful:
   (a) Acceleration due to gravity, $g = 9.8\ m/s^2$
   (b) Gravitational constant, $G = 6.67 \times 10^{-11}\ Nm^2kg^{-2}$
   (c) Mass of the earth, $M_e = 6.0 \times 10^{24}\ kg$
   (d) Radius of the earth, $R_e = 6.4 \times 10^{6}\ m$
   (e) Ratio of specific heat capacities, $\gamma = 1.4$
   (f) Density of air $= 1.3\ kg/m^3$
   (g) Pie, $\pi = 3.14$

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SECTION A (70 Marks)

Answer **all** questions in this section.

1. In a simple pendulum experiment a period of 40 seconds was measured for 20 oscillations when the length of the pendulum was taken to be 100 cm. Calculate;

   (a) the maximum error in measuring the acceleration due to gravity, g given that the smallest readable units of stop watch and metre rule were 0.1 seconds and 0.1 cm respectively. **(05 marks)**

   (b) the percentage error of acceleration due to gravity, g if its actual value at a particular place is 9.79 m/s^2. **(05 marks)**

2. (a) (i) Distinguish between damped oscillations and un-damped oscillations. **(02 marks)**

   (ii) Elaborate three characteristics of simple harmonic motion (S.H.M). **(03 marks)**

   (b) When a body of mass m was attached to the lower end of a spiral spring and slightly released, it causes an extension of 1.5 cm. If it then set into vertical oscillations of small amplitude, calculate its periodic time. **(05 marks)**

3. (a) (i) Write the mathematical expressions of Newton's laws of universal gravitation and gravitational field strength. **(02 marks)**

   (ii) Use the answers in 3 (a) (i) to show that the magnitude of the gravitational field at the earth's surface is given by $\frac{GM_e}{R_e^2}$, where M_e is the mass of the earth, R_e is the radius of the earth and G is the gravitational constant. **(03 marks)**

   (b) Prove that the radius R_o of the orbit of the satellite is given by $R_0 = \sqrt[3]{\frac{GM_eT^2}{4\pi^2}}$, where T is the period of revolution, G and M_e have the same meaning as in 3 (a) (ii). **(05 marks)**

4. (a) (i) How does a man jumping from a certain height manage to increase the number of loops made in the air? **(02 marks)**

   (ii) Why is it advisable to use a wrench with a long arm to tighten the bolt of a truck wheel? **(03 marks)**

   (b) Calculate the moment of inertia if the energy of 484 J was spent in increasing the speed of a fly wheel from 60 rev./min to 360 rev/min. **(05 marks)**

5. (a) (i) State the law applied when a body is cooling under forced convection. **(02 marks)**

(ii) Write the mathematical expression of the law stated in 5 (a) (i) and briefly give the physical meaning of each term. **(03 marks)**

(b) If the ends of a straight uniform metal rod are maintained at temperatures of 100 °C and 20 °C while the room temperature being below 20 °C;

(i) sketch a graph of variation of temperature of the rod versus its length when its surface is unlagged. **(03 marks)**

(ii) Comment on the nature of the graph drawn in 5 (b) (i). **(02 marks)**

6. (a) (i) What are the two necessary requirements needed to establish a temperature scale? **(02 marks)**

(ii) Identify three limitations of the first law of thermodynamics. **(03 marks)**

(b) Calculate the quantity of heat transferred to nitrogen in an isobaric heating such that the gas may perform 2 joules of work. **(05 marks)**

7. (a) Briefly explain the influence of humidity on plant growth. **(04 marks)**

(b) (i) How does the thermal energy transmitted in different layers of the earth? **(03 marks)**

(ii) Give evidence to justify that primary and secondary waves were used to ascertain that the outer core of the earth is in liquid form. **(03 marks)**

SECTION B (30 Marks)

Answer **two (2)** questions from this section.

8. (a) (i) Distinguish between an e.m.f. of a cell and potential difference. **(02 marks)**

(ii) A cell of e.m.f. E and internal resistance r is supplying a current *I* across the external resistor *R*. Draw a circuit diagram to show how the e.m.f, E and potential difference, V are related. **(02 marks)**

(b) (i) How is an increase in length affects the resistivity and conductivity of a conductor? **(02 marks)**

(ii) Sketch the characteristic graph to show how the current varies with voltage in ohmic conductors. **(02 marks)**

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(c) Study the circuit diagram in Figure 1 then answer the questions that follow:

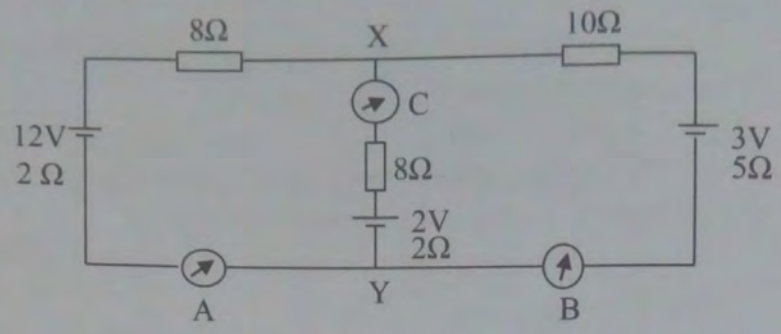


Figure 1

(i) Find the reading of the ammeters A, B and C, assuming that they have no internal resistance. **(05 marks)**

(ii) Determine the potential difference between X and Y. **(02 marks)**

9. (a) (i) How does intrinsic semiconductor differ from extrinsic semiconductor? Give two points. **(02 marks)**

(ii) Describe *p.n* junction diode characteristics and sketch a graph to show how the current through it varies with the potential difference (p.d) across it. **(04 marks)**

(b) Figure 2 is a junction-transistor voltage amplifier circuit diagram.

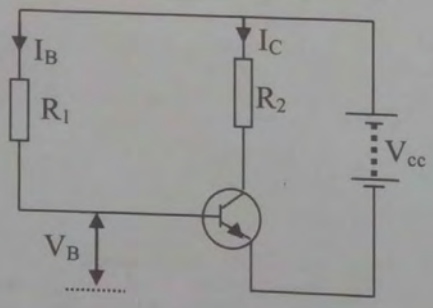


Figure 2

If $R_1 = 100\ \Omega$, $V_{CC} = 6.0$ V, $h_{FE} = 60$ and $V_{BE} = 0.6$ V, calculate;

(i) the voltage across R_1. **(02 marks)**

(ii) the magnitude of I_B and I_C. **(03 marks)**

(c) (i) Identify two distinguishable characteristics of semiconductors. **(02 marks)**

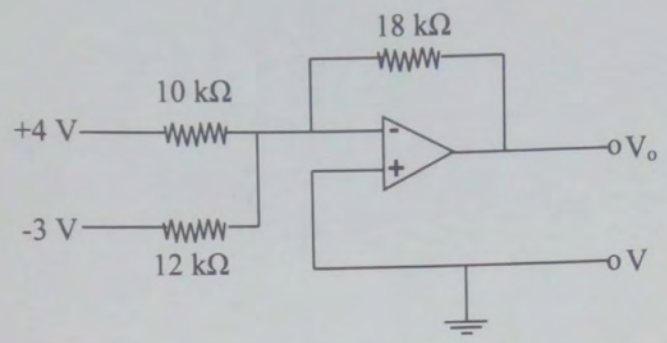
(ii) Analyze the effect of temperature in conduction of solids. **(02 marks)**

10. (a) (i) What are the three characteristics features of op-amp? **(03 marks)**

(ii) With the aid of relevant diagrams, identify two types of op-amps. **(02 marks)**

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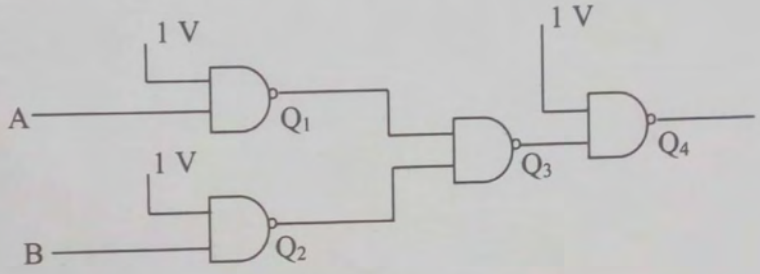
(b) (i) Determine the output voltage in the circuit diagram shown in Figure 3.



(03 marks)

Figure 3

(ii) Study the logic circuit in Figure 4 and then draw its truth table.



(4 marks)

Figure 4

(c) (i) What is meant by bandwidth of a signal? **(01 mark)**

(ii) An audio signal of 1 kHz is used to demodulate a carrier of 500 kHz. Determine the bandwidth required. **(02 marks)**

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