

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,  $g = 9.8 \text{ m/s}^2$
  - (b) Gravitational constant,  $G = 6.67 \times 10^{-11} \text{ Nm}^2\text{kg}^{-2}$
  - (c) Mass of the earth,  $M_e = 6.0 \times 10^{24} \text{ kg}$
  - (d) Radius of the earth,  $R_e = 6.4 \times 10^6 \text{ m}$
  - (e) Ratio of specific heat capacities,  $\gamma = 1.4$
  - (f) Density of air  $= 1.3 \text{ kg/m}^3$
  - (g) Pie,  $\pi = 3.14$



### 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  $9.79 \text{ m/s}^2$ . **(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  $R_o = \sqrt[3]{\frac{GM_e T^2}{4\pi^2}}$ , 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  $100^{\circ}\text{C}$  and  $20^{\circ}\text{C}$  while the room temperature being below  $20^{\circ}\text{C}$ ;
- (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)**

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

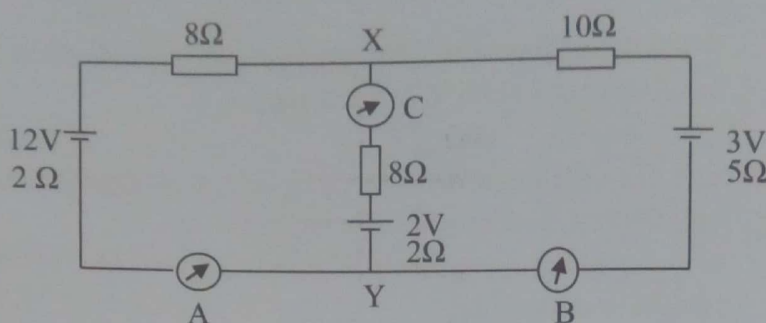


Figure 1

- (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.

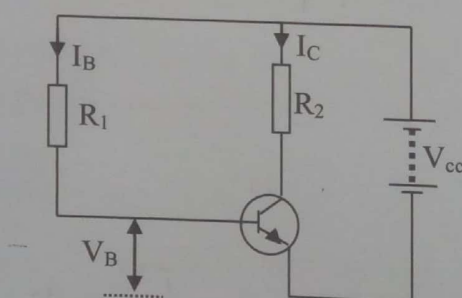
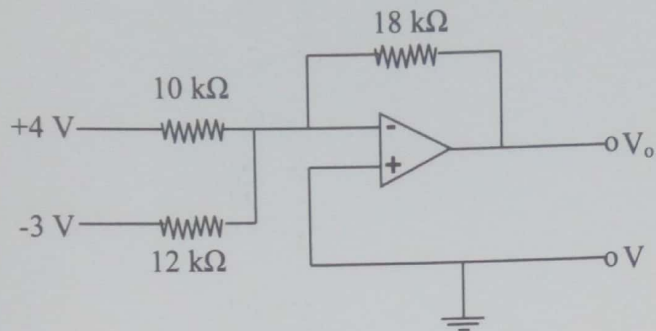


Figure 2

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

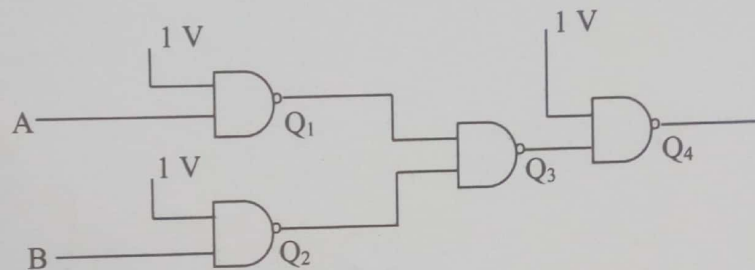
- (b) (i) Determine the output voltage in the circuit diagram shown in Figure 3.



(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)