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

131/1

PHYSICS 1

(For Both School and Private Candidates)

Time: 3 Hours **Year: 2022**

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, $G = 6.67\times10^{-11}\ Nm^2kg^{-2}$
   (c) Mass of earth, $M_E = 6.0\times10^{24}\ kg$
   (d) Radius of earth, $R_E = 6.4\times10^{6}\ m$
   (e) Distance of the moon from the earth, $r = 3.8\times10^{5}\ km$
   (f) Density of water at $25\ ^oC = 1000\ kgm^{-3}$
   (g) Specific heat capacity of water is $4200\ Jkg^{-1}K^{-1}$
   (h) Charge of an electron, $e = 1.6\times10^{-19}\ C$
   (i) Coefficient of linear expansion of steel $= 1.7\times10^{-5}\ K^{-1}$
   (j) Coefficient of linear expansion of copper $= 1.1\times10^{-5}\ K^{-1}$
   (k) Pie, $\pi=3.14$.

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SECTION A (70 Marks)

Answer **all** questions in this section.

1. (a) The period of oscillation of a simple pendulum is given by the relation; $T = 2\pi\sqrt{\frac{l}{g}}$.

(i) Deduce the formula of factional error in 'g'. **(03 marks)**

(ii) Which quantity in 1 (a) (i) should be measured most accurately? Give reason for your answer. **(02 marks)**

(b) Figure 1 shows a body of mass 20 kg and radius 0.2 m having a moment of inertia of 0.4 kgm^2 rolling down a slope of height 3.0 m. Calculate its speed at the foot of the slope. **(05 marks)**

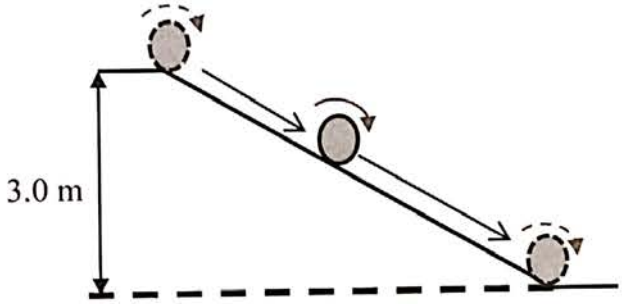


Figure 1

2. (a) (i) Why bodies on the earth's surface do not move towards each other? Explain basing on Newton's law of universal gravitation. **(03 marks)**

(ii) Use the law in (a) (i) to derive Kepler's third law. **(03 marks)**

(b) Show that the moon would depart forever if its speed were increased by approximately 41% where by M_E and M_M are the mass of the earth and moon respectively. **(04 marks)**

3. (a) (i) Briefly explain the importance of energy interchange in simple harmonic motion. **(03 marks)**

(ii) What would happen when negative sign in the equation, $a = -\omega^2 y$ as applied in simple harmonic motion (S.H.M) is omitted? **(02 marks)**

(b) An object of mass 2 kg executes S.H.M with a frequency of 2 Hz and amplitude of 2.5 cm. Calculate its maximum velocity and maximum potential energy. **(05 marks)**

4. (a) (i) Why an aircraft twist its wings as it prepared to land? **(03 marks)**

(ii) What would be the effect on the horizontal range for a given projection of angle θ if its initial velocity is doubled? **(03 marks)**

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(b) Show that $\frac{H}{R} = \frac{1}{4}\tan\beta$, given that H, R and β are the maximum height, range and an angle above the horizontal respectively for a projectile fired from the ground level. **(04 marks)**

5. (a) (i) Why lake water at very cold regions does not freeze completely into ice even if the temperature on it is far below the freezing point? Explain with the aid of a relevant diagram. **(04 marks)**

(ii) What is the biological significance of the behavior observed in 5 (a) (i)? **(02 marks)**

(b) One litre of pure water at 25 °C is poured into an electric kettle of negligible heat capacity rated 2.5 kW. If the kettle is switched on, calculate the time taken to raise the temperature of water to 100 °C. **(04 marks)**

6. (a) An ideal gas of volume 0.05 m^3 initially at 27 °C and pressure 1.0×10^5 Pa, is heated at constant pressure until its volume increases to 0.06 m^3. Calculate the external work done by the gas. **(04 marks)**

(b) If a steel rod is 5 cm longer than a copper rod and their difference in length is to be maintained constant at any temperature, find their actual lengths. **(06 marks)**

7. (a) (i) Identify two principles on which the wind turbine operates to generate electrical energy. **(02 marks)**

(ii) Why renewable energy sources are usually regarded as environmentally friendly? Explain giving two examples. **(04 marks)**

(b) (i) What is the influence of oxygen and carbon dioxide gases to plant growth? **(02 marks)**

(ii) Briefly explain the effect of rainfall on the renewal of soil air. **(02 marks)**

SECTION B (30 Marks)

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

8. (a) (i) How does a fuse protect electrical installations? **(02 marks)**

(ii) Why the bulbs in a house become dim when high power heater is connected to the main supply? **(02 marks)**

(b) (i) A current of 0.5 A passes through a light bulb rated 40 W. If the charge on electron is 1.6×10^{-19}C, calculate the number of electrons passed through the filament bulb. **(02 marks)**

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(ii) Figure 2 is a circuit diagram with resistors of 3 kΩ, 1 kΩ and 2 kΩ connected to a cell of 24 V. Use Kirchhoff's voltage law to determine the voltage between point 'a' and 'b'. **(03 marks)**

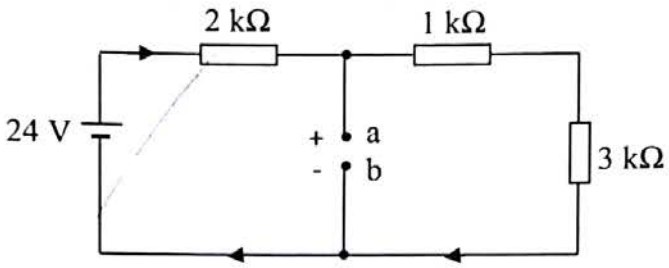


Figure 2

(c) Study the circuit diagram in Figure 3 and then answer the questions that follow:

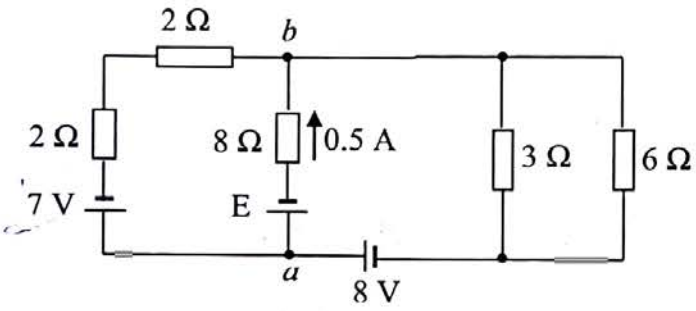


Figure 3

Determine:

(i) The value of E such that a current of 0.5 A exists in 8 Ω resistor with a sense from 'a' to 'b'. **(04 marks)**

(ii) The potential difference $V_a - V_b$. **(02 marks)**

9. (a) (i) What is meant by a semiconductor based on energy band theory of solids? **(01 mark)**

(ii) Give three distinctions between intrinsic and extrinsic semiconductor. **(03 marks)**

(b) (i) Which property of a semiconductor diode permits it to be used as a rectifier? **(03 marks)**

(ii) In a common base connection the emitter current I_E = 1mA and collector current I_C = 0.95 mA. If this transistor is connected in common emitter with base current of 0.05 mA; calculate the collector current. **(03 marks)**

(c) (i) Distinguish between breakdown voltage and knee voltage as applied to PN-junction. **(02 marks)**

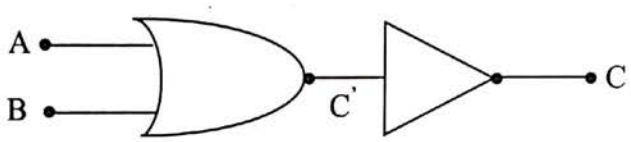
(ii) Why the conductivity of intrinsic semiconductor increases with the increase in temperature while that of metals decreases? **(03 marks)**

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10. (a) (i) Why the NAND (or NOR) gates are known as digital building blocks? **(02 marks)**

(ii) Draw the logic symbol and give the name of the gate obtained from the combination of the gates shown in Figure 4.



(03 marks)

Figure 4

(b) (i) Why the current gain in common base transistor amplifier is always less than one? **(02 marks)**

(ii) Identify three main properties of operational amplifier. **(03 marks)**

(c) (i) Give two advantages of digital circuits over analog circuits. **(02 marks)**

(ii) With the aid of illustrative diagram, state the condition necessary for a transistor to behave as an open switch. **(03 marks)**

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