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, $G = 6.67 \times 10^{-11}$ Nm^{2}kg^{-2}

    (c)   Mass of earth, $M_E = 6.0 \times 10^{24}$ kg

    (d)   Radius of earth, $R_E = 6.4 \times 10^6$ m

    (e)   Distance of the moon from the earth, $r = 3.8 \times 10^5$ km

    (f)   Density of water at 25 ^{O}C = 1000 kgm^{-3}

    (g)   Specific heat capacity of water is 4200 Jkg^{-1}K^{-1}

    (h)   Charge of an electron, $e = 1.6 \times 10^{-19}$ C

    (i)   Coefficient of linear expansion of steel $= 1.7 \times 10^{-5}$ K^{-1}

    (j)   Coefficient of linear expansion of copper $= 1.1 \times 10^{-5}$ K^{-1}

    (k)   Pie, $\pi = 3.14$.

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; $T = 2\pi\sqrt{\dfrac{l}{g}}$.

      (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)

3.0 m
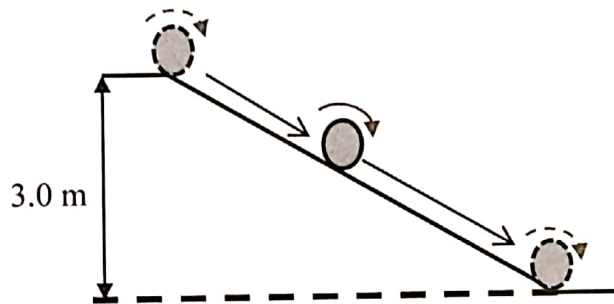
Figure 1

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)**

(b) Show that $\dfrac{H}{R} = \dfrac{1}{4}\tan\beta$, 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)**

(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)**
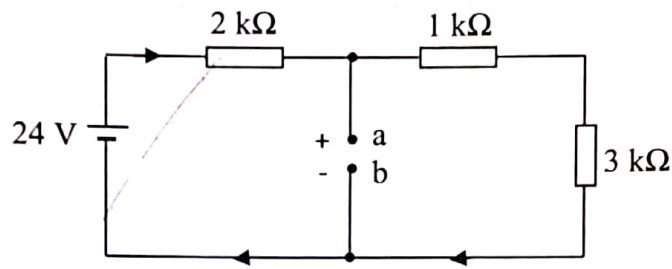

Figure 2

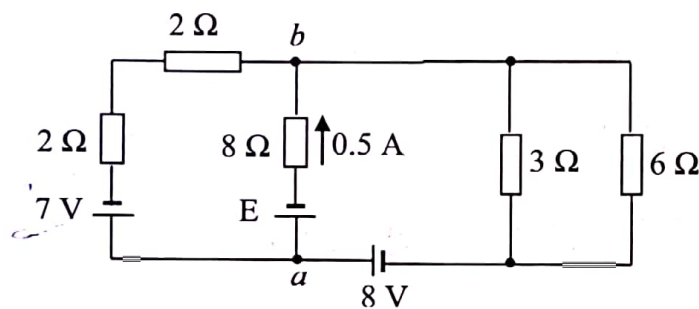(c)   Study the circuit diagram in Figure 3 and then answer the questions that follow:

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)**

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.
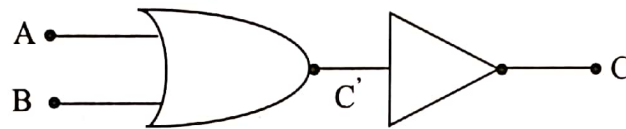

(03 marks)

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)