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, $\pi=3.14$.

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)**

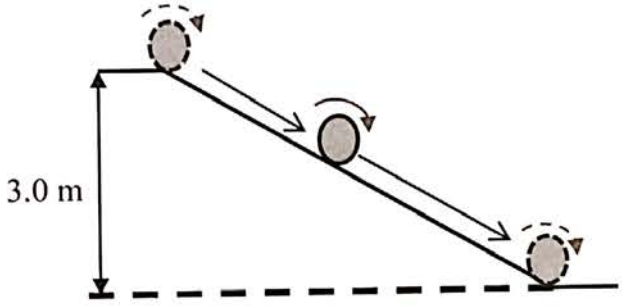


Figure 1

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)**

(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)**

(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)**

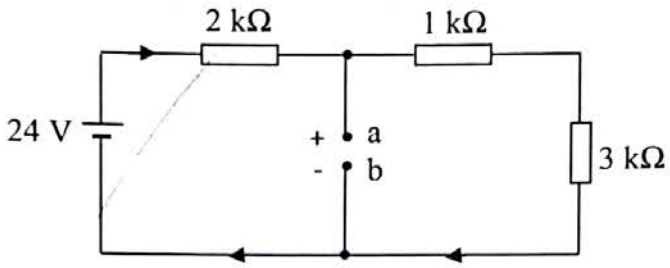


Figure 2

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

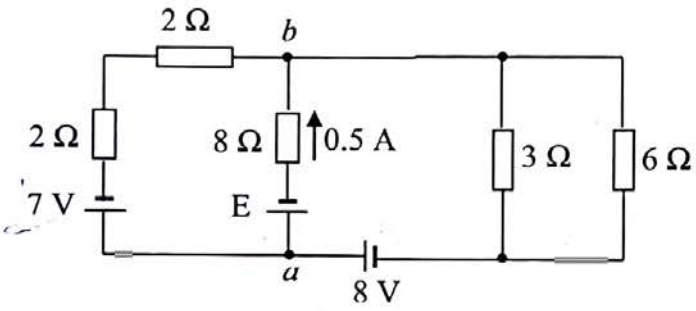


Figure 3

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)**

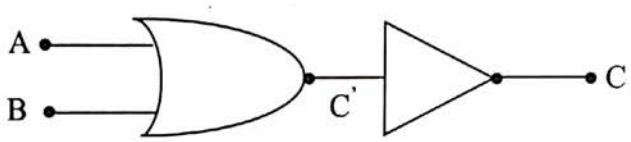
(ii) In a common base connection the emitter current I_E = 1mA and collector current I_C = 0.95 mA. If this transistor is connected in common emitter with base current of 0.05 mA; calculate the collector current. **(03 marks)**

(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)**

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

131/2 **PHYSICS 2**

(For Both School and Private Candidates)

Time: 3 Hours **Year: 2022**

Instructions

1. This paper consists of a total of **six (6)** questions.
2. Answer **five (5)** questions.
3. Each question carries **twenty (20)** 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) Density of air $\rho_a = 1.29\ kg/m^3$

(c) Density of water $\rho_w = 10^3\ kg/m^3$

(d) Speed of sound in air = 340 m/s

(e) Surface tension of water, $\gamma = 0.072\ N/m$

(f) Permiability of free space, $\mu_0 = 4\pi \times 10^{-7}\ H/m$

(g) Plank's constant, $h = 6.63 \times 10^{-34}\ Js$

(h) Reydberg's constant, $R_H = 1.1 \times 10^7\ m^{-1}$

(i) Electronic charge, $e = 1.6 \times 10^{-19} C$

(j) Speed of light, $c = 3 \times 10^8\ m/s$

(k) Mass of an electron, $m_e = 9.11 \times 10^{-31} kg$

(l) Pie $\pi = 3.14$

(a) (i) Give three importance of coefficient of viscosities of liquids in daily life activities. **(03 marks)**

(ii) Identify two assumptions made in deriving the Poiseuille's equation for the flow of a liquid through a narrow tube. **(02 marks)**

(b) (i) If the radius of a pipe carrying liquid gets decreased by 8%, how much would the pressure difference between the ends of the constricted pipe will increase to maintain a constant flow rate? **(03 marks)**

(ii) Describe the mode of action of a Pitot-static tube and apply Bernoulli's equation to obtain the formulae used to measure the velocity of a flowing liquid. **(06 marks)**

(c) (i) Under what circumstance does Torricelli's theorem apply? **(02 marks)**

(ii) Water is maintained at a height of 10 m in a tank. Calculate the diameter of the circular hole needed at the base of the tank to discharge water at the rate of 26.4 m^3/minute. **(04 marks)**

2. (a) (i) Give a concrete reason behind a straight line propagation of light irrespective of its wave nature. **(03 marks)**

(ii) In a Young's double slit experiment, the green light of mercury of wavelength 0.54 μm was used with a pair of parallel slits of separation 0.6 mm. If the fringes were observed at a distance of 40 cm from the slit; calculate the distance of separation between the fringes. **(04 marks)**

(b) (i) Identify two cases in which there is no Doppler effect in sound. **(02 marks)**

(ii) A car is sounding a horn which produces a note of frequency 500 Hz. If it approaches and then passes a stationary observer Q at a steady speed of 20 m/s; calculate the change in pitch of the note as heard by Q. **(05 marks)**

(c) (i) What properties of a medium are responsible for propagation of a wave through it? Give two points. **(02 marks)**

(ii) A horizontal stretched elastic string of length and mass of 3.0 m and 12 kg respectively is subjected to a tension of 1.6 N. If a transverse wave of frequency 40 Hz is propagated down the string; determine the distance between successive crests of this wave motion. **(04 marks)**

3. (a) (i) What is meant by the angle of contact between the liquid and a solid as used in properties of matter? **(01 mark)**

(ii) Outline four factors on which the value of angle of contact depends. **(04 marks)**

(b) (i) Give a qualitative distinction between surface tension and surface energy of a liquid. **(03 marks)**

(ii) A small air bubble of radius 0.1 mm is situated just below the water surface. If the atmospheric pressure is 1.013×10^{5} N/m^{2}; determine the pressure inside the air bubble. **(04 marks)**

(c) (i) Stipulate four practical applications of capillarity in daily life activities. **(04 marks)**

(ii) Water rises in a capillary tube to a height of 2.0 cm. Compute the height at which water will rise in another capillary tube whose radius is $\frac{1}{3}$ of the first tube. **(04 marks)**

4. (a) (i) State Coulomb's law. **(01 mark)**

(ii) A proton of mass 1.673×10^{-27} kg falls through a distance of 1.5 cm in a uniform electric field of magnitude 2.0×10^{4} NC^{-1}. If air resistance and acceleration due to gravity are neglected, calculate its time of fall. **(06 marks)**

(b) A 100 V battery terminals are connected to two large and parallel plates which are 2 cm apart. If the field in the region between the plates is nearly uniform, determine the force on an electron in this field. **(05 marks)**

(c) If an electron is released from rest from the upper plate inside the field in 4 (b), determine;

(i) the velocity with which it will hit the lower plate. **(03 marks)**

(ii) its kinetic energy and the time it will take for the whole journey. **(05 marks)**

5. (a) (i) Why do magnetic lines of force always form a closed loop? **(02 marks)**

(ii) A force of 0.025 N was experienced by a test wire of length 0.05 m placed in a magnetic field of strength 0.2 T carrying a current of 2.5 A. Calculate the angle between the wire and the field lines. **(04 marks)**

(b) (i) Identify two classes of magnetic materials which are weakly affected by magnetic field. **(02 marks)**

(ii) A toroid with an air core, carrying a current of 0.15 A has a mean circumference of 50 cm and 500 number of turns. Determine its magnetizing force and magnetic flux density. **(05 marks)**

(c) (i) Briefly explain the cause of earth's magnetic field. **(03 marks)**

(ii) An aircraft is flying horizontally at 860 km/hr in a region where the vertical component of the earth's magnetic field is 6.0×10^{-5} T. If its wing span is of 54 m; determine the potential difference induced between one wing tip and the other. **(04 marks)**

6. (a) (i) What is meant by energy level? **(01 mark)**

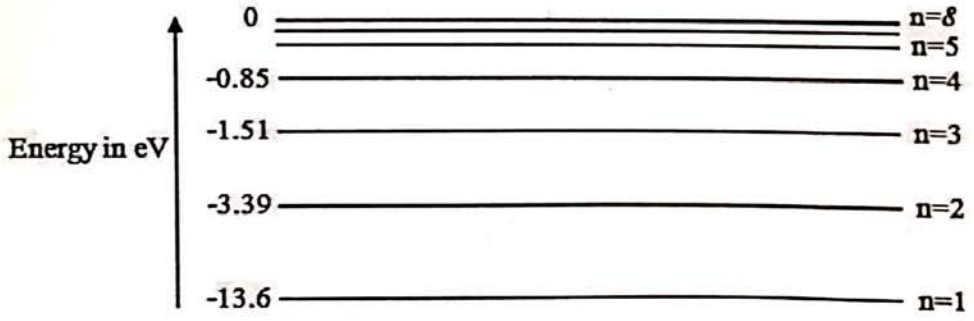
(ii) How does ionization energy differ from excitation energy? **(03 marks)**

(b) (i) Why did the Thompsons's model fail? **(02 marks)**

(ii) Identify four applications of Cathode ray oscilloscope. **(04 marks)**

(iii) Calculate the wavelength of the most energetic x-rays produced by a tube operating at 1.5×10^5 V. **(04 marks)**

(c) Study the following Figure of the energy level diagram for hydrogen atom and then answer the questions that follow.



(i) Calculate the frequency and the wavelength of the radiation emitted as a result of an electron transition from $n=3$ to $n=2$. **(04 marks)**

(ii) What is the energy at the level where $n=5$? **(02 marks)**

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

131/3A

PHYSICS 3A
(PRACTICAL A)

(For Both School and Private Candidates)

Time: 3:20 Hours **Year: 2022**

Instructions

1. This paper consists of **three (3)** questions.
2. Answer **all** questions.
3. Question **Number 1** carries 20 marks and the other **two (2)** carry 15 marks each.
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).

The following information may be useful:

Specific heat capacity of water $C_w = 4.2$ J/gK

Pie, $\pi = 3.14$.

1. You are provided with a wire W, metre rule, two cork pads, test tube, micrometer screw gauge, slotted mass of 20 g, retort stand with its accessories, masking tape and optical pin.

Proceed as follows:

(a) Measure and record the length, *l* and diameter, d of a wire **W**.

(b) Wind the whole length of the wire, **W** tightly on the test tube making sure the turns are as close as possible but not overlapping.

(c) Measure the length x of the coil made as shown in Figure 1 and count the number of turns.

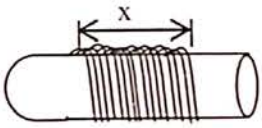


Figure 1

(d) Remove the coil from the test tube; straighten the first and last coil. Clamp one end on the retort stand while bending the other end to make a hook. Count the number of complete turns, n, remaining and measure the distance h_1 between the ends of coil as shown in Figure 2.

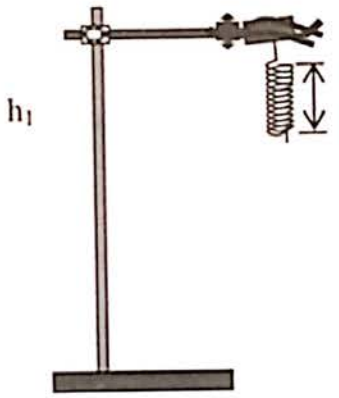


Figure 2

(e) Load a 20 g mass on the other end of the coil and arrange as shown in Figure 3. Measure and record the distance, h_2 between the ends of the turns.

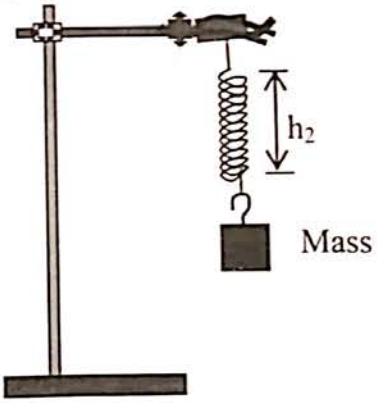


Figure 3

(f) Remove the mass, reduce the number of turns by straightening three turns of the coil from the upper end and adjust the point of suspension of the coil. Record the number of turns, n remaining and measure the distance, h_1. Load 20 g mass on the coil and then measure and record the distance, h_2.

(g) Repeat procedures in 1 (f) so as to obtain other three readings to make a total of five readings for n, h_1 and h_2.

Questions

(i) Record the values of n, h_1 and h_2 and find extension e as shown in the following table:

Number of turns n remaining						
Distance, h_1 (cm)						
Distance, h_2 (cm)						
Extension, $e = (h_2 - h_1)$ (cm)						

(ii) Plot a graph of extension, e against the number of turns, n.

(iii) Determine the slope S of the graph.

(iv) Compute the value of constant G from the equation; $\frac{1}{n} = \frac{Gx}{de}$.

2. Form Five Physics students were debating on whether hot objects made with the same materials but having different masses have the same rate of cooling or not. Conclude their debate by performing the experiment using the following procedures:

(a) Measure the mass of an empty calorimeter provided.

(b) Fill the calorimeter with hot water of 90 °C to three quarters, then cover the calorimeter with a lid.

(c) While fanning with hard board, record the time (t) in seconds for every 5 °C drop of temperature of water starting from the temperature of 80 °C to 55 °C.

(d) Record the mass of the calorimeter with water.

(e) Repeat procedures 2 (c) to (d) when the calorimeter is half filled with hot water.

Questions

(i) Tabulate the results obtained in 2 (c) and (e).

(ii) Determine the mass of water m_1 and m_2 as obtained from procedures in 2 (a) and (e) respectively.

(iii) Plot the graph of time obtained in 2 (c) against that in 2 (e).

(iv) Determine the slope of the graph plotted in 2 (iii).

(v) Determine the ratio of the masses m_1 and m_2.

(vi) Use the slopes and the ratio of masses obtained from this experiment to conclude the debate of the students.

3. Laboratory equipment dealer wants to know from you the specifications of the wire which was not indicated. You are required to perform an experiment to obtain the required specifications of the wire using the metre bridge, standard resistor of 2 Ω, a dry cell, 100 cm wire of unknown resistivity, zero centred galvanometer, switch, micrometer screw gauge, metre rule and several pieces of connecting wires.

Proceed as follows:

(a) Measure and record the diameter of the wire.

(b) Connect a 2 Ω resistor in the right hand gap and in the left hand gap connect the wire at length, x = 15 cm. Close the switch and quickly determine the balancing point. Record the balance length L on the metre bridge being on the left hand side of the jockey of the galvanometer, then open the switch.

(c) Repeat procedures in 3 (b) by connecting the wire at lengths, x = 25 cm, 40 cm, 50 cm and 65 cm. In each experiment, record the corresponding values of L.

Questions

(i) Draw a clearly labelled circuit diagram of this experiment.

(ii) Tabulate your results including the values of x (m), $\frac{1}{x}$ (m^{-1}), L (m) and $\frac{1}{L}$ (m^{-1}).

(iii) Plot a graph of $\frac{1}{x}$(m^{-1}) against $\frac{1}{L}$ (m^{-1}).

(iv) Determine the slope and the intercept of the graph in 3 (iii).

(v) Determine the average value of unknown resistivity of the wire from the results in 3 (iv).

(vi) If a customer wants to buy a piece of this wire, what will be the length of the wire required to make a resistance equivalent to 10 Ω?

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

131/3B

PHYSICS 3B
(PRACTICAL B)

(For Both School and Private Candidates)

Time: 3:20 Hours **Year: 2022**

Instructions

1. This paper consists of **three (3)** questions.
2. Answer **all** questions.
3. Question **Number 1** carries 20 marks and the other **two (2)** carry 15 marks each.
5. Mathematical tables and non-programmable calculators may be used.
6. Cellular phones and any unauthorized materials are **not** allowed in the examination room.
7. Write your **Examination Number** on every page of your answer booklet(s).

The following information may be useful:
Pie, $\pi = 3.14$
Acceleration due to gravity, $g = 981\ cms^{-2}$

1. Suppose the weighing balance at your school is not working properly and you are required to determine the mass of an empty glass beaker.

Proceed as follows:

(a) Use the masking tape to firmly wrap the thread on the beaker and suspend it to the lower end of the spring as shown in Figure 1 where an optical pin is bent into 'S' shape.

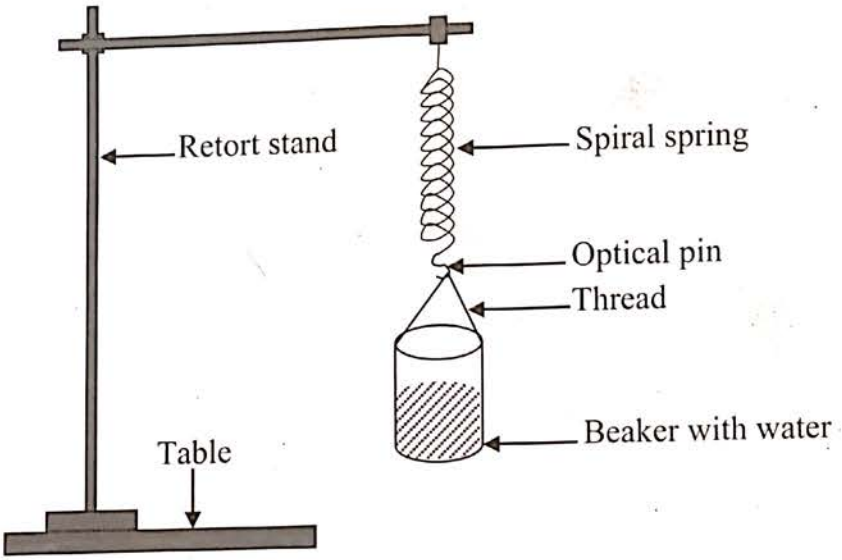


Figure 1

(b) Measure volume, V = 25 cm^3 of water and pour it into the suspended beaker. Gently pull the beaker a small distance downward and release it so that it performs vertical oscillations. Measure and record time t (s) for 30 oscillations and determine its periodic time, T.

(c) Repeat procedures in 1 (b) for V = 60 cm^3, 100 cm^3, 150 cm^3 and 200 cm^3.

Questions

(i) Tabulate your results including values of T^2 (s^2).

(ii) Plot a graph of V (cm^3) against T^2 (s^2).

(iii) Establish the equation governing this experiment.

(iv) Use the graph and the equation obtained in 1 (iii) to determine the mass of an empty glass beaker.

(v) What will happen to the floating object if it is put in oscillating beaker being at the bottom position of its oscillation? Briefly explain.

2. Hotel owner heats water for his customers every morning using electric heaters and noticed that, heat is lost because sometimes customers do not take bath. Therefore, he is aiming to use heat obtained from the heated water for other purposes. Perform an experiment to prove to him that the heated water can also be used to heat other liquids.

Proceed as follows;

(a) Fill the beaker with 100 ml of hot water of about 90 °C.

(b) Pour 50 ml of normal water (at the room temperature) into a calorimeter.

(c) Insert the calorimeter containing normal water into a beaker with hot water of 85 °C placed on a wooden block. Quickly close the beaker with a lid as shown in Figure 2.

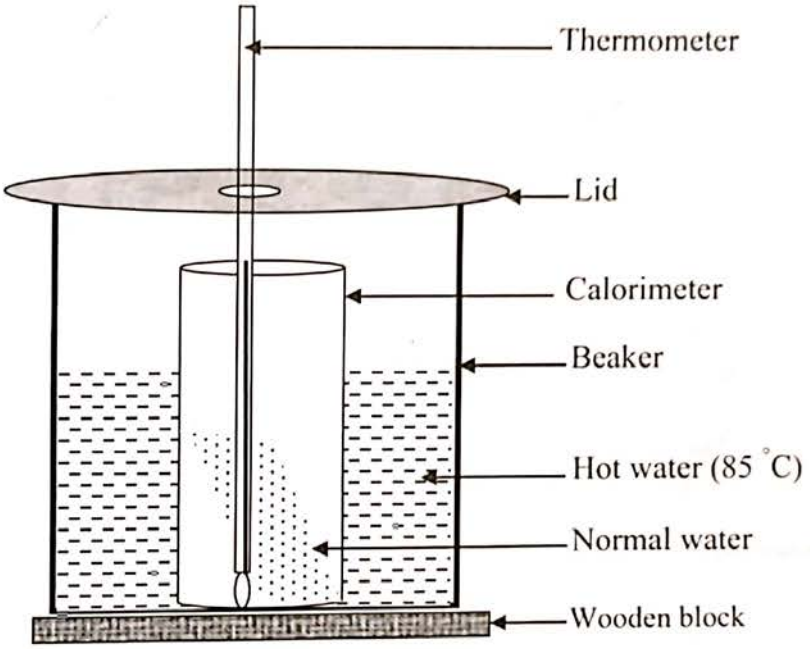


Figure 2

(d) Read and record the temperature of water in the calorimeter for every half minute until the thermometer records about 55 °C.

(e) Empty the calorimeter and the beaker.

(f) Repeat procedures 2 (a) to (d) by filling the calorimeter with 50 ml of **liquid L**.

Questions

(i) Tabulate your results.

(ii) Plot the graphs of temperature against time for water and **liquid L** on the same axes.

(iii) Determine the rate of temperature rise (°C/minute) for water and **liquid L** at 42 °C.

(iv) Suggest any two improvements that will result into increase in the temperature gained by **liquid L**.

3. You are required to investigate the value of the unknown resistance, **R** which was coupled parallel to a wire labelled **W** by means of Wheatstone metre bridge. In order to achieve the task, the following instructions were given:

(a) Connect the standard resistor of 2 Ω in the left hand gap of the Wheatstone metre bridge. The unknown resistance **R** is connected parallel to the wire labelled **W** and placed in the right hand gap, as shown in Figure 3.

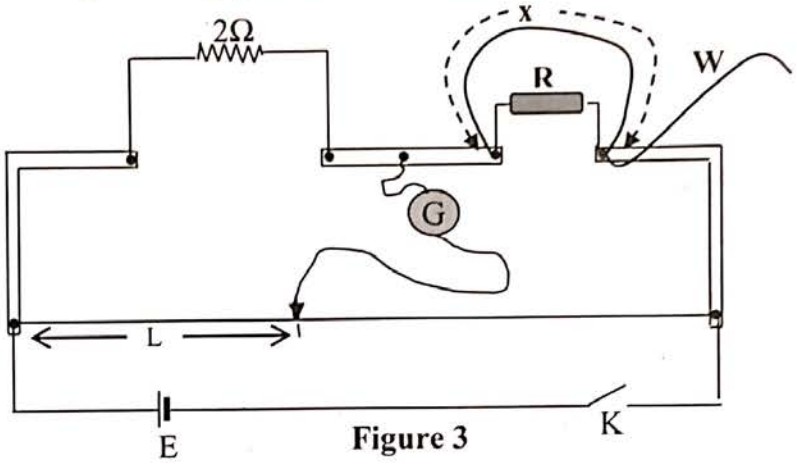


Figure 3

(b) With x = 1.0 m close the switch, K and find the balance point L, then determine the equivalence resistance, R_e.

(c) Repeat the procedure in 3 (b) with x = 0.8 m, 0.6 m, 0.4 m and 0.2 m, determine the corresponding equivalent resistance, R_e in each case.

Questions

(i) Tabulate your results in 3 (b) and (c) including the values of $\frac{1}{x}(m^{-1})$ and $\frac{1}{R_e}(\Omega^{-1})$.

(ii) Plot a graph of $\frac{1}{x}(m^{-1})$ against $\frac{1}{R_e}(\Omega^{-1})$.

(iii) Determine the slope S.

(iv) Deduce an equation that governs this experiment.

(v) Compute the value of the unknown resistance, **R**.

(vi) Determine the specific resistance of the given wire, **W**.

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ADVANCED CERTIFICATE OF SECONDARY EDUCATION

EXAMINATION

131/3C **PHYSICS 3C**

(ACTUAL PRACTICAL C)

(For Both School and Private candidates)

Time: 3:20 Hours **Year: 2022**

Instructions

1. This paper consists of **three (3)** questions**.**
2. Answer **all** questions.
3. Question **one (1)** carries **20** marks, and the other **two (2)** carry **15** marks each.
4. Mathematical tables and non-programmable calculators may be used.
5. All writing must be in **blue** or **black** ink **except** drawing which must be in pencil
6. Cellular phones and any unauthorized materials are **not** allowed in the examination room.
7. Write your **Examination Number** on every page of your answer booklet (s).

The folowing information may be useful:

Specific heat capacity of Water $C_w = 4.2J/gK$

Pie, $\pi = 3.14$.

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1. You are provided with a wire **W**, a meter rule, cork pads, a test tube, a micrometre screw gauge, five masses each having 10 g a retort stand with its accessories, an optical pin (pointer), a string of 20 cm, masking tape and a light plastic scale pan.

Proceed as follows:

(a) Measure and record the length, L (m) and diameter d (m) of the wire, W provided.

(b) Wind tightly the whole length of the wire on the test tube provided, making sure that turns are as close as possible but do not overlap.

(c) Remove the coil from the test tube, straighten the first and last turns of the coil made, then bend one end of the coil to make a hook.

(d) Arrange the apparatus as shown in Figure 1.

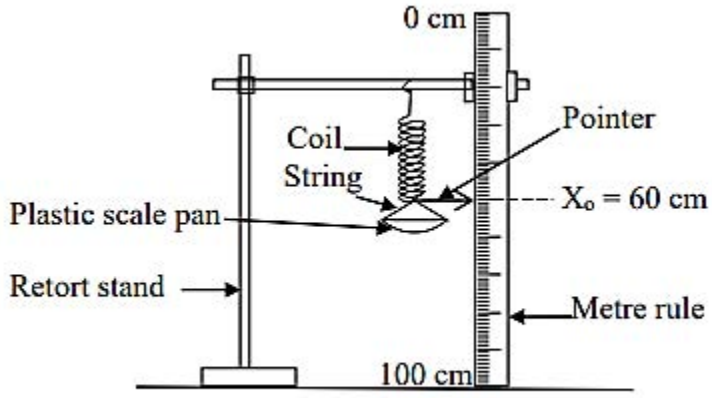

Figure 1

(e) With the help of a masking tape, insert a pointer at X_o when there is no mass placed on a plastic scale pan.

(f) Place 10 g mass on a plastic scale pan, measure the new length, X when the

spring is extended and calculate the extension.

(g) Without removing the first mass, add another mass weighing 10 g on the scale pan to make a total of 20 g and measure the new length and calculate its extension.

(h) Repeat the procedure in 1 (g) by adding 10 g mass until you get a total mass of 50 g while measuring new length and extension in each case.

Questions

(i) Tabulate your results including the values of load as F (N) and extension, e (m), where; 100 g = 1 N.

(ii) Plot a graph of extension (m) against load (N).

(iii) Give comment on the relationship between the load and extension in 1 (ii).

(iv) Determine the slope, K of the graph.

(v) Use the value obtained in 1 (iv) to calculate the value of ρ from the equation, $K = \frac{4L}{\pi d^2 \rho}$

(vi) What is the physical meaning of the value obtained in 1 (v)?

2. You provided with the following information: A hotel with ten floors and 100 rooms has installed a solar heater at the top of the building. Copper pipes were used for distributing heated water from the heater to bathrooms. However, it has been noticed that there was a temperature drop as water flows from the heater to the outlets in the bathrooms.

Proceed as follows:

(a) Pour hot water into the calorimeter so that it is $\frac{3}{4}$ full and set the apparati as shown in Figure 2.

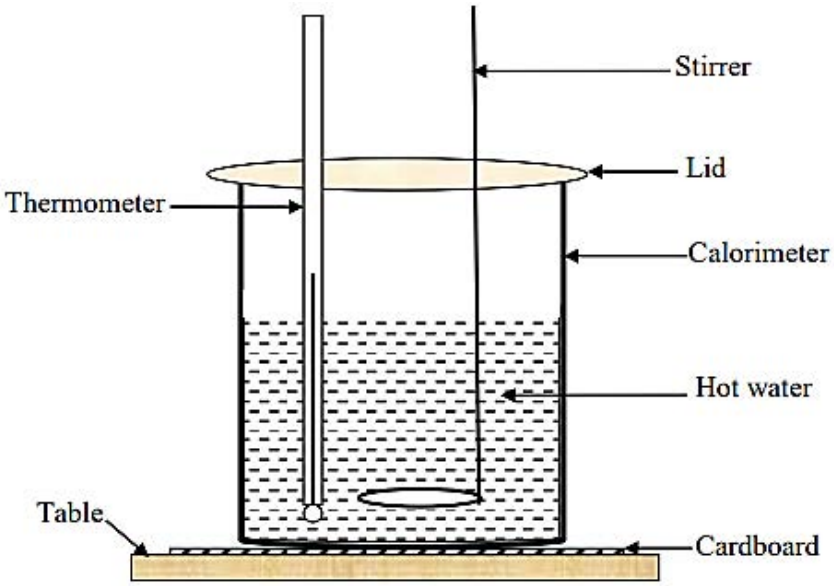

Figure 2

(b) Record the room temperature, θ_R.

(c) While stirring start with the temperature 65°C in the calorimeter, record the temperature θ of water in the calorimeter as it cools at an interval of 2 minutes for 16 minutes.

Questions

(i) Record your results in a tabular form including the values of $(\theta - \theta_R)$ and $\log(\theta - \theta_R)$.

(ii) Plot the graph of $\log(\theta - \theta_R)$ against time, (t) in minutes.

(iii) Relate the slope of a graph plotted in (ii) to the water flowing from the heater to the outlet in the bath rooms.

(iv) Deduce the temperature of the surroundings, θ_S from the equation, $\theta_S = 65 - \log^{-1} C$ where, C is the vertical intercept of the graph.

(v) What can you conclude on the values of room temperature, θ_R and surrounding temperature, θ_S obtained in this experiment?

3. You are given a series that a car manufacturing industry used electroplating technique to paint car parts whereby a selected part of the body of a car becomes one electrode and the second electrode was a selected metal. In order to paint these parts, the resistance of the electrodes must be known before introducing a current through them. You are provided with an aluminium foil (30 cm × 2 cm), 1 Ω standard resistor, resistance box, dry cell, switch and two crocodile clips.

Proceed as follows:

(a) Connect the meter bridge circuit in a usual manner with the aluminium foil in parallel with the given 1 Ω standard resistor. Use crocodile clips to fix the foil

in its position. The resistance box should be connected in a right hand gap of the meter bridge.

(b) With the resistance box set at R = 5 Ω, close the switch, K and find the balancing length, L on the bridge wire on the side where aluminium foil is fixed.

(c) Repeat the procedure in 3(b) for the values of R = 4 Ω, 3 Ω, 2 Ω and 1 Ω.

Questions

(i) Draw a circuit diagram of your experimental set up.

(ii) Tabulate your results including the values of $\frac{1}{L}$

(iii) Derive the equation governing this experiment.

(iv) Plot a graph of $\frac{1}{L}\left(m^{-1}\right)$ against R (Ω).

(v) Determine the gradient of the graph in (iv).

(vi) Estimate the resistance of aluminium sheet of the surface area of $30m^2$ to be used as an electrode.