

P510/1
PHYSICS
PAPER 1
JULY/AUGUST 2011
2½ hours



WAKISSHA JOINT MOCK EXAMINATIONS

Uganda Advanced Certificate of Education

PHYSICS

Paper 1

2 hours 30 minutes

INSTRUCTIONS TO CANDIDATES:

Attempt five questions, including at least one, but not more than two from each of the Sections A, B and C.

Assume where necessary:

Acceleration due to gravity	g	=	9.81 ms^{-2}
Electron charge	e	=	$1.6 \times 10^{-19} \text{ C}$
Electron mass		=	$9.11 \times 10^{-31} \text{ kg}$
Radius of earth		=	$6.4 \times 10^6 \text{ m}$
Planck's constant	h	=	$6.6 \times 10^{-34} \text{ Js}$
Speed of light in vacuum, c		=	$3.0 \times 10^8 \text{ ms}^{-1}$
Stefan's - Boltzmann's constant, σ		=	$5.67 \times 10^{-8} \text{ W m}^{-2} \text{ K}^{-4}$
Wien's displacement constant		=	$2.90 \times 10^{-3} \text{ m K}$
Specific heat capacity of water		=	$4.2 \times 10^3 \text{ J kg}^{-1} \text{ K}^{-1}$
Gas constant, R		=	$8.31 \text{ J mol}^{-1} \text{ K}^{-1}$
Universal gravitational constant, G		=	$6.67 \times 10^{-11} \text{ N m}^{-2} \text{ kg}^{-2}$
Charge to mass ratio, e/m		=	$1.8 \times 10^{11} \text{ C kg}^{-1}$
Avogadro's number	N_A	=	$6.02 \times 10^{23} \text{ mol}^{-1}$
One electron volt, (eV)		=	$1.6 \times 10^{-19} \text{ J}$

SECTION A

1. (a) (i) What is meant by uniformly decelerated motion? (1 mark)
- (ii) Sketch the distance - time graph for a uniformly decelerated body. (2 marks)
- (iii) Derive the expression $V^2 = U^2 + 2aS$, where V is the final velocity attained by a body that starts moving at velocity U , covering distance S , when uniformly accelerated at $a \text{ ms}^{-2}$. (4 marks)
- (iv) Show that the expression in (a) (iii) above is dimensionally consistent. (2 marks)
- (b) A stone is projected horizontally from the top of a wall 25m high. If the stone falls at a distance 140 m from the foot of the wall, find the:
- (i) initial speed of projection of the stone. (5 marks)
- (ii) velocity of the stone just before it hits the ground. (4 marks)
- (c) Explain why a gun jerks backwards when a bullet is fired from it. (2 marks)
2. (a) (i) Distinguish between **conservative** and **non-conservative forces**? (2 marks)
- (ii) Give two examples of each. (2 marks)
- (b) State the conditions for a rigid body to be in mechanical equilibrium. (2 marks)

(c)

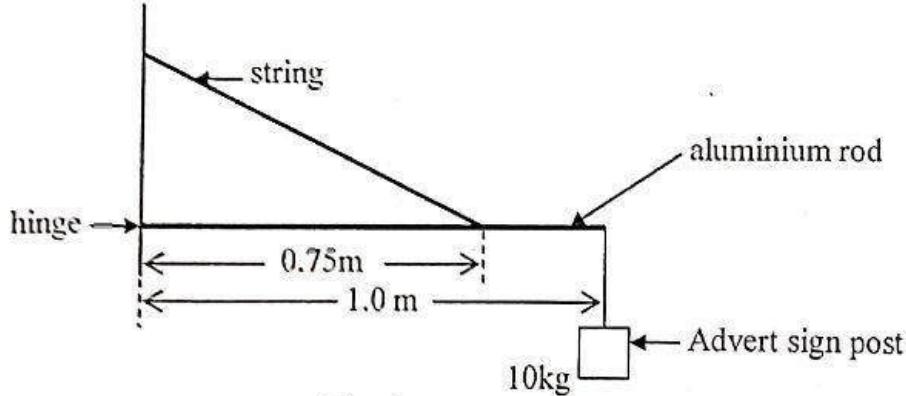


Fig. 1

Figure 1 shows an advertisement sign post of mass 10 kg supported by a hinged aluminium rod of negligible weight and a wire as shown.

- (i) Draw a sketch diagram to show the forces acting on the rod. (2 marks)

Calculate:

- (ii) the tension in the wire. (3 marks)
- (iii) the reaction at the hinge. (3 marks)

- (d) (i) A bullet moving horizontally strikes a wooden block resting on a smooth table and becomes embedded in it. State the energy changes that occur during the motion of the bullet. (2 marks)
- (ii) Find the energy lost by the bullet if they both move together after impact if mass of bullet and block are 100 g and 2 kg respectively, assuming the bullet was moving at 420 ms^{-1} . (4 marks)
3. (a) (i) State Archimedes' principle. (1 mark)
- (ii) Describe an experiment to determine the relative density of an irregular solid which sinks in water. (3 marks)
- (iii) A hydrometer floats in water with 6.0cm of its graduated stem unimmersed, and in oil of relative density 0.8 with 4.0cm of the stem unimmersed. Calculate the length of the stem unimmersed when the hydrometer is placed in a liquid of relative density 0.9. (5 marks)
- (b) (i) What is meant by **surface energy** of a liquid? (1 mark)
- (ii) Two soap bubbles of radii r_1 and r_2 respectively are formed in air. If the bubbles are merged to form a single bubble of radius r , derive an expression for r in terms of r_1 and r_2 . (4 marks)
- (c) (i) Explain the **origin of the lift force** on the wings of an aeroplane at take-off. (3 marks)
- (ii) Water flowing in a pipe on the ground with a velocity of 5 ms^{-1} and at a gauge pressure of $1.5 \times 10^5 \text{ Pa}$ is pumped into a water tank 7.5m above the ground. The water enters the tank at a pressure of $8.0 \times 10^4 \text{ Pa}$. Calculate the velocity with which the water enters the tank. (3 marks)
4. (a) What is meant by the terms:
(i) **Terminal velocity**, (1 mark)
(ii) **Coefficient of viscosity**? (1 mark)
- (b) (i) Draw a velocity-time graph for a steel-ball-bearing dropped centrally in a long column of viscous liquid. (2 marks)
- (ii) Derive an expression for the terminal velocity of a steel ball-bearing of radius, a , density, ρ , falling through a liquid of density, σ , and coefficient of viscosity η . (4 marks)
- (c) Explain how viscosity of a gas is affected by temperature. (3 marks)
- (d) (i) State the laws of solid friction. (3 marks)
(ii) Explain the origin of solid friction. (2 marks)

- (e) A car of mass 1500 kg moves along a straight surface with a speed of 20 ms^{-1} . When brakes are applied steadily, the car comes to rest after travelling 45 m. Calculate the coefficient of friction between the surface and the tyres. (4marks)

SECTION B

5. (a) (i) What is a **thermometric property**? (1mark)
(ii) Give **four examples** of thermometric properties. (2marks)
- (b) (i) Describe how the constant-volume gas thermometer can be used to measure absolute temperature. (4marks)
- (ii) Explain why the constant-volume gas thermometer is used to calibrate other thermometers. (2marks)
- (iii) State **one advantage** and **one disadvantage** of the constant-volume gas thermometer. (2marks)
- (c) (i) Define **specific heat capacity** of a substance. (1mark)
(ii) Cold water at 10°C and 85°C are run into a tank at a rate of $V \text{ m}^3$ per minute and $3.0 \times 10^{-2} \text{ m}^3$ per minute, respectively. At the point of filling the tank, the temperature of the mixture of water was 35°C . Calculate the time taken to fill the tank if its capacity is 1.5 m^3 . (5marks)
- (d) State three advantages of the continuous flow method over the method of mixtures in the determination of specific heat capacity of a liquid. (3marks)
6. (a) (i) Distinguish between a **real gas** and an **ideal gas**. (3marks)
(ii) State **two assumptions** made in the derivation of the kinetic theory expression for the pressure of an ideal gas, which have to be modified for real gases. (2marks)
- (b) Derive the expression $P = \frac{1}{3} \rho c^2$ for the pressure of an ideal gas of density, ρ and mean square speed c^2 . (6marks)
- (c) A vessel contains 5g of helium, molar mass 4g, at 27°C and pressure of $1.5 \times 10^5 \text{ Pa}$. Calculate:
(i) the kinetic energy of the gas. (4marks)
(ii) the root-mean-square speed of the molecules. (3marks)
- (d) Explain why the temperature of a gas increases when it is heated. (2marks)

7. (a) (i) Define coefficient of thermal conductivity. (1 mark)
- (ii) Explain the mechanism of thermal conduction in insulators. (3 marks)
- (b) A thermos flask has a top cover made of cylindrical cork of diameter 8.0cm and length 8.0cm. The flask contains $1.0 \times 10^{-3} \text{ m}^3$ of water at 80°C and the exposed end of the cork is at 20°C . If the cork is in contact with the water, and the water loses heat by conduction only along the cork, find:
 (i) the initial rate of heat loss. (3 marks)
 (ii) the time taken for the temperature of the water to fall to 20°C , assuming a constant rate of heat loss to be equal to the average of the initial and final rates. (4 marks)
 (Coefficient of thermal conductivity of cork = $6.0 \times 10^{-2} \text{ W m}^{-1} \text{ K}^{-1}$)
- (c) (i) State Newton's law of cooling. (1 mark)
 (ii) Describe an experiment to verify Newton's law of cooling. (5 marks)
- (d) Explain how Wien's displacement law is used to explain the colour changes in a hot metal object as its temperature rises. (3 marks)

SECTION C

8. (a) (i) What is meant by the terms half-life and decay constant? (2 marks)
 (ii) Derive the relationship between half-life and decay constant. (3 marks)
- (b) (i) What are radioisotopes? (1 mark)
 (ii) The half-life of polonium - 30 is 2.5 minutes. Determine the activity of 1g of the isotope. (5 marks)
 (iii) State one medical use and one biological use of radioisotopes. (2 marks)
- (c) (i) What is meant by dead time as applied to a Geiger - Müller tube. (2 marks)
 (ii) Sketch the count rate - voltage characteristics of the Geiger - Müller tube and explain its main features. (3 marks)
 (iii) Identify, giving reasons, the suitable range in (c) (i) of operation of the tube. (2 marks)
9. (a) (i) What is meant by a line spectrum? (2 marks)
 (ii) Explain how line spectra accounts for the existence of discrete energy levels in atoms. (4 marks)

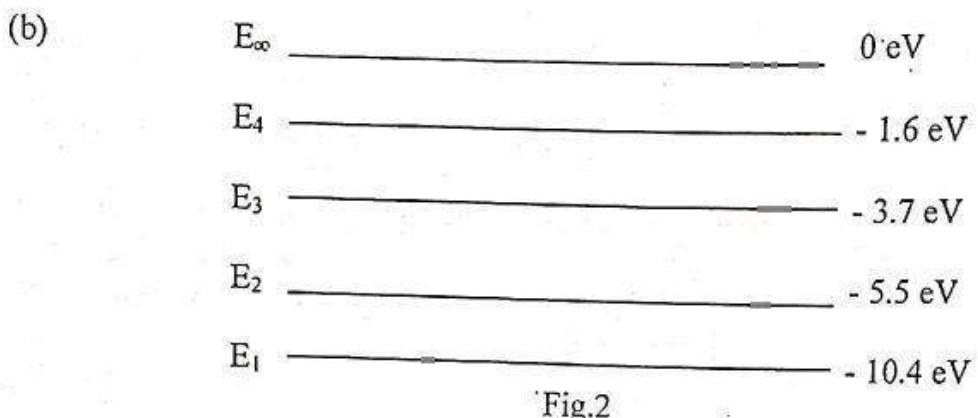


Figure 2 shows some of the energy levels of a mercury atom.
Determine:

- (i) the ionization energy of mercury in joules. (2marks)
 - (ii) the wavelength of the radiation emitted in an electron transition from E_4 to E_3 . (3marks)
 - (c) (i) Describe, with the aid of a labelled diagram, the action of an X-ray tube. (5marks)
(ii) Explain briefly how the intensity of X-rays is controlled. (2marks)
 - (iii) An X-ray tube is operated at 40 kV with an electron current of 20 mA in the tube. Determine the number of electrons striking the target per second. (2marks)
10. (a) (i) What is meant by **specific charge** of an electron? (1mark)
- (ii) A beam of electrons, having a common velocity, enters a uniform magnetic field in a direction normal to the field. Describe and explain the path of the electrons. (4marks)
- (iii) A beam of electrons directed midway between two parallel metal plates of length 4.0cm and separation 1.0cm is deflected through 10.0cm on a fluorescent screen placed 20.0cm beyond the nearest edge of the plates when a p.d. of 200V is applied across the plates. If this deflection is annulled by a magnetic field of flux density 1.14×10^{-3} T applied normal to the electric field between the plates, find the specific charge of the electrons. (5marks)
- (b) With the aid of a labelled diagram, describe and give the theory of Bainbridge mass spectrometer for measuring the specific charge of positive ions. (6marks)
- (c) State **one similarity** and **one difference** between:
 - (i) gamma rays and x-rays. (2marks)
 - (ii) nuclear fusion and nuclear fission. (2marks)

END

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Avogadro's number	N_A	=	$6.02 \times 10^{23} \text{ mol}^{-1}$
One electron volt, (eV)		=	$1.6 \times 10^{-19} \text{ J}$

SECTION A

(1 mark)

1. (a) (i) Define the term linear momentum. (1 mark)
- (ii) Distinguish between a perfectly elastic collision and perfectly inelastic collision, and give one example of each. (4 marks)
- (b) A body P of mass m_1 moving at velocity u_1 collides head-on with another body Q of mass m_2 , moving at velocity u_2 , in the same direction as P. Use Newton's laws of motion to show that the quantity $m_1 u_1 + m_2 u_2$ is conserved. (4 marks)
- (c) (i) What is meant by impulse? (1 mark)
- (ii) Explain why a high jumper has to bend his knees when landing on the ground. (2 marks)
- (d) A steady stream of balls each of mass 200 g hits a vertical wall at right angles, with equal intervals of time between the impacts of each ball on the wall. The speed of the balls is 15 ms^{-1} and 600 balls hit the wall in 12 s and rebound at the same speed.
- Find:
- (i) the average force acting on the wall. (4 marks)
- (ii) the force exerted on the wall during each collision if the duration of each collision is 0.01 s, and sketch a graph to show how the actual force on the wall varies with time over a period of 0.10 s. (4 marks)
2. (a) (i) Define surface tension and state its dimensions. (2 marks)
- (ii) Use molecular theory to explain the occurrence of surface tension. (3 marks)
- (iii) Give two observable effects of surface tension. (2 marks)
- (b) Explain why small liquid drops are spherical while large liquid drops tend to flatten at the top. (4 marks)
- (c) A clean capillary tube of internal diameter 0.04 cm is supported vertically with its lower end dipping in clean water in a beaker, and with 12 cm of the tube above the water surface.
- (i) To what height will the water rise in the tube? (3 marks)
- (ii) What will the new angle of contact be if the tube is depressed until only 4 cm of its length is above the water surface? (3 marks)
- (d) Explain why a soap film can be supported in a vertical rectangular wire frame for some time but a film of water cannot. (3 marks)

3. (a) (i) State Kepler's laws of gravitation. (3 marks)
- (ii) Show that the frequency of revolution of a planet in a circular orbit of radius R about the sun is given by
- $$f = \frac{1}{2\pi} \sqrt{\frac{GM_S}{R^3}} \text{ where } G \text{ is the universal gravitational constant and } M_S \text{ is the mass of the sun.} \quad (5 \text{ marks})$$
- (b) A satellite of mass 500 kg is in a circular orbit at a height 3.6×10^4 km above the earth's surface.
- (i) Find the kinetic energy of the satellite. (4 marks)
- (ii) Explain what happens if the mechanical energy of the satellite is increased. (3 marks)
- (c) What is meant by the terms:
- (i) weightlessness, (1 mark)
- (ii) gravitational field strength? (1 mark)
- (d) Explain why acceleration due to gravity varies with location on the earth's surface. (3 marks)
4. (a) (i) State Archimedes' principle. (1 mark)
- (ii) What is meant by apparent loss in weight of a body? (1 mark)
- (b) Describe an experiment to measure relative density of an irregular solid which floats in water. (4 marks)
- (c) A solid weighs 30 g when totally immersed in a liquid of density 800 kg m^{-3} . If it weighs 334 g in air, calculate the relative density of the liquid in which the solid would float with one quarter of its volume above the liquid surface. (6 marks)
- (d) (i) State Bernoulli's principle. (1 mark)
- (ii) Describe briefly the action of the filter pump. (3 marks)
- (e) Water flows steadily through a non-uniform pipe at a rate of $400 \text{ cm}^3 \text{ s}^{-1}$. If the cross-sectional area at one point is 4 cm^2 and at another point is 1 cm^2 , find the pressure difference between these two points in the pipe. (4 marks)

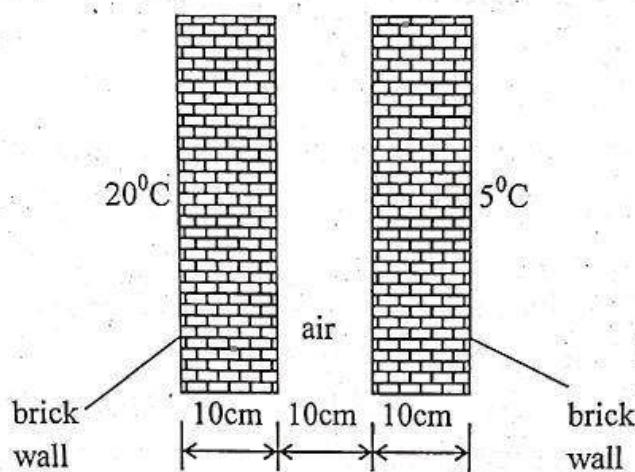
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SECTION B

5. (a) (i) Define specific heat capacity of a substance. (1 mark)
- (ii) State three advantages of the continuous flow method over the method of mixtures in the determination of specific heat capacity of a liquid. (3 marks)
- (b) In an experiment to determine the specific heat capacity of a liquid using the continuous flow method, a steady temperature difference of 2.0°C is maintained when the liquid flow rate is 3000 g min^{-1} and the rate of electrical heating is 80.0 W. On increasing the liquid flow rate to 5000 g min^{-1} , 140.0 W is required to maintain the same temperature difference.
Calculate the:
- (i) specific heat capacity of the liquid. (4 marks)
- (ii) rate of heat loss to the surroundings. (3 marks)
- (c) (i) What is meant by saturated vapour pressure? (1 mark)
- (ii) Using kinetic theory, explain boiling of a liquid. (3 marks)
- (iii) Explain why latent heat of vaporization is always greater than that of fusion. (2 marks)
- (d) An electrical heater is rated 240 V, 2000 W. If it is used to evaporate 25 g of water in 5 minutes, find the heat loss if the specific latent heat of vaporization is $2.26 \times 10^6 \text{ J kg}^{-1}$. (3 marks)
6. (a) (i) Distinguish between isothermal and adiabatic changes. (2 marks)
- (ii) State the conditions for each of the above changes to occur. (2 marks)
- (b) (i) State the first law of thermodynamics. (1 mark)
- (ii) Explain why, for a gas, the molar heat capacity at constant pressure is different from the molar heat capacity at constant volume. (3 marks)
- (iii) Derive the expression for the difference in the values of the molar heat capacities in (b)(ii) above. (4 marks)
- (c) The temperature of one mole of helium gas at a pressure of 760 mmHg increases from 28°C to 108°C when the gas is compressed adiabatically. Find the final pressure of the gas. Take $\gamma = 1.67$. (4 marks)
- (d) With the aid of a P-V diagram, explain what happens when a real gas is compressed at different temperatures. (4 marks)
7. (a) (i) Define thermal conductivity of a material. (1 mark)
- (ii) Explain why a metal is a better conductor of heat than glass. (3 marks)

- (b) (i) Describe Searle's method of determining the thermal conductivity of a good conductor of heat. (6 marks)
- (ii) State any two precautions that must be taken in the experiment in (b) (i) above. (2 marks)

(c)



The diagram above shows a section of a cavity wall of a house made up of brick, air and brick. The inside temperature is 20°C while the outside temperature is 5°C . The thermal conductivities of brick material and air are $0.6 \text{ W m}^{-1}\text{K}^{-1}$ and $0.02 \text{ W m}^{-1}\text{K}^{-1}$ respectively.

- (i) Assuming steady - state conditions, sketch a graph to show how temperature changes with distance between the brick surfaces at 20°C and that at 5°C . (2 marks)
- (ii) Calculate the thickness of brick equivalent to 10 cm of air. (2 marks)
- (d) State Stefan's law of blackbody radiation. (1 mark)
- (e) Describe briefly how the bolometer can be used to detect thermal radiation. (3 marks)

SECTION C

8. (a) (i) What is meant by specific charge of an electron? (1 mark)
- (ii) Describe an experiment to measure specific charge of an electron. (7 marks)
- (b) (i) An electron enters a uniform magnetic field in a direction normal to the field. Describe and explain briefly the subsequent path of the electron. (3 marks)
- (ii) An electron is accelerated through a p.d. of 9 kV and then passes horizontally through a small hole into a uniform horizontal magnetic field of flux density 0.01 T at right angles to the path of the electron. Calculate the radius of its path. (4 marks)

- (c) (i) Explain how constructive interference occurs when a beam of x-rays is diffracted by a crystal of atoms. (2 marks)
- (ii) For a beam of x-rays, the angle of incidence of $71^{\circ}36'$ is required for second order diffraction image to be formed by reflection at atomic planes of a crystal. Calculate the atomic spacing of the planes if the wavelength of x-rays is 4.0×10^{-11} m. (3 marks)
9. (a) What is meant by the following terms as applied to radioactivity; (1 mark)
- (i) Radioisotopes. (1 mark)
- (ii) Half-life? (1 mark)
- (b) Given that the radioactive law is, $N = N_0 e^{-\lambda t}$, obtain the relation between λ and half-life $T_{1/2}$. (3 marks)
- (c) Radium has an isotope $^{226}_{88}\text{Ra}$ of half-life 1600 years and decays by emission of α – particles and γ rays. Determine the activity of 5 g of the isotope. (5 marks)
- (d) (i) Describe, with the aid of a labelled diagram, the structure and action of the Geiger – Muller tube. (5 marks)
- (ii) Explain why the anode is made in form of a thin wire and the mica window made thin. (2 marks)
- (iii) Sketch the count rate – voltage characteristic of the Geiger – Muller tube and state with reasons, the suitable range of voltage for operation of the tube. (3 marks)
10. (a) Describe briefly the mechanism of thermionic emission. (3 marks)
- (b) Explain the following terms as applied to a vacuum diode: (1 mark)
- (i) Saturation. (2 marks)
- (ii) Rectification. (2 marks)
- (c) Sketch the current-p.d. characteristics of a thermionic diode for two different operating temperatures and explain their main features. (5 marks)
- (d) (i) With the aid of a circuit diagram, derive an expression for voltage gain of a triode when used as an amplifier. (4 marks)
- (ii) A triode valve with mutual conductance of 4.0 mA V^{-1} and anode resistance $10,000 \Omega$ is used as a single-stage amplifier. If the load resistance is $5.0 \times 10^4 \Omega$, calculate the voltage gain of the amplifier. (5 marks)

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SECTION A

1. (a) (i) Define the term **linear momentum**. *(1 mark)*
(ii) Distinguish between a **perfectly elastic collision** and **perfectly inelastic collision**, and give one example of each. *(4 marks)*
- (b) A body P of mass m_1 moving at velocity u_1 collides head-on with another body Q of mass m_2 , moving at velocity u_2 , in the same direction as P. Use Newton's laws of motion to show that the quantity $m_1u_1 + m_2u_2$ is conserved. *(4 marks)*
- (c) (i) What is meant by **impulse**? *(1 mark)*
(ii) Explain why a high jumper has to bend his knees when landing on the ground. *(2marks)*
- (d) A steady stream of balls each of mass 200 g hits a vertical wall at right angles, with equal intervals of time between the impacts of each ball on the wall. The speed of the balls is 15 ms^{-1} and 600 balls hit the wall in 12 s and rebound at the same speed.
Find:
(i) the average force acting on the wall. *(4 marks)*
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(ii) Use molecular theory to explain the occurrence of surface tension. *(3 marks)*
(iii) Give **two** observable effects of surface tension. *(2 marks)*
- (b) Explain why small liquid drops are spherical while large liquid drops tend to flatten at the top. *(4 marks)*
- (c) A clean capillary tube of internal diameter 0.04 cm is supported vertically with its lower end dipping in clean water in a beaker, and with 12 cm of the tube above the water surface.
(i) To what height will the water rise in the tube? *(3 marks)*
(ii) What will the new angle of contact be if the tube is depressed until only 4 cm of its length is above the water surface? *(3 marks)*
- (d) Explain why a soap film can be supported in a vertical rectangular wire frame for some time but a film of water cannot. *(3 marks)*

3. (a) (i) State Kepler's laws of gravitation. (3 marks)
(ii) Show that the frequency of revolution of a planet in a circular orbit of radius R about the sun is given by

$$f = \frac{1}{2\pi} \sqrt{\frac{GM_s}{R^3}} \text{ where } G \text{ is the universal}$$

gravitational constant and M_s is the mass of the sun. (5 marks)

- (b) A satellite of mass 500 kg is in a circular orbit at a height 3.6×10^4 km above the earth's surface.
(i) Find the kinetic energy of the satellite. (4 marks)
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(ii) Describe briefly the action of the filter pump. (3 marks)
- (e) Water flows steadily through a non-uniform pipe at a rate of $400 \text{ cm}^3 \text{ s}^{-1}$. If the cross-sectional area at one point is 4 cm^2 and at another point is 1 cm^2 , find the pressure difference between these two points in the pipe. (4 marks)

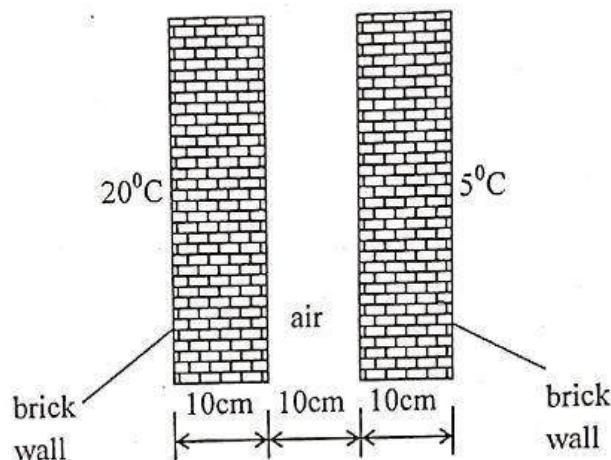
Turn Over

SECTION B

5. (a) (i) Define **specific heat capacity** of a substance. (1 mark)
- (ii) State **three** advantages of the continuous flow method over the method of mixtures in the determination of specific heat capacity of a liquid. (3 marks)
- (b) In an experiment to determine the specific heat capacity of a liquid using the continuous flow method, a steady temperature difference of 2.0°C is maintained when the liquid flow rate is 3000 g min^{-1} and the rate of electrical heating is 80.0 W. On increasing the liquid flow rate to 5000 g min^{-1} , 140.0 W is required to maintain the same temperature difference.
Calculate the:
- (i) specific heat capacity of the liquid. (4 marks)
- (ii) rate of heat loss to the surroundings. (3 marks)
- (c) (i) What is meant by **saturated vapour pressure**? (1 mark)
- (ii) Using kinetic theory, explain boiling of a liquid. (3 marks)
- (iii) Explain why latent heat of vaporization is always greater than that of fusion. (2 marks)
- (d) An electrical heater is rated 240 V, 2000 W. If it is used to evaporate 25 g of water in 5 minutes, find the heat loss if the specific latent heat of vaporization is $2.26 \times 10^6 \text{ J kg}^{-1}$. (3 marks)
6. (a) (i) Distinguish between **isothermal** and **adiabatic changes**. (2 marks)
- (ii) State the **conditions** for each of the above changes to occur. (2 marks)
- (b) (i) State the first law of thermodynamics. (1 mark)
- (ii) Explain why, for a gas, the molar heat capacity at constant pressure is different from the molar heat capacity at constant volume. (3 marks)
- (iii) Derive the expression for the difference in the values of the molar heat capacities in (b)(ii) above. (4 marks)
- (c) The temperature of one mole of helium gas at a pressure of 760 mmHg increases from 28°C to 108°C when the gas is compressed adiabatically. Find the final pressure of the gas. Take $\gamma = 1.67$. (4 marks)
- (d) With the aid of a P-V diagram, explain what happens when a real gas is compressed at different temperatures. (4 marks)
7. (a) (i) Define **thermal conductivity** of a material. (1 mark)
- (ii) Explain why a metal is a better conductor of heat than glass. (3 marks)

- (b) (i) Describe Searle's method of determining the thermal conductivity of a good conductor of heat. (6 marks)
- (ii) State any two precautions that must be taken in the experiment in (b) (i) above. (2 marks)

(c)



The diagram above shows a section of a cavity wall of a house made up of brick, air and brick. The inside temperature is 20°C while the outside temperature is 5°C . The thermal conductivities of brick material and air are $0.6 \text{ W m}^{-1}\text{K}^{-1}$ and $0.02 \text{ W m}^{-1}\text{K}^{-1}$ respectively.

- (i) Assuming steady – state conditions, sketch a graph to show how temperature changes with distance between the brick surfaces at 20°C and that at 5°C . (2 marks)
- (ii) Calculate the thickness of brick equivalent to 10 cm of air. (2 marks)
- (d) State Stefan's law of blackbody radiation. (1 mark)
- (e) Describe briefly how the bolometer can be used to detect thermal radiation. (3 marks)

SECTION C

8. (a) (i) What is meant by specific charge of an electron? (1 mark)
- (ii) Describe an experiment to measure specific charge of an electron. (7 marks)
- (b) (i) An electron enters a uniform magnetic field in a direction normal to the field. Describe and explain briefly the subsequent path of the electron. (3 marks)
- (ii) An electron is accelerated through a p.d. of 9 kV and then passes horizontally through a small hole into a uniform horizontal magnetic field of flux density 0.01 T at right angles to the path of the electron. Calculate the radius of its path. (4 marks)

Turn Over
5

- (c) (i) Explain how constructive interference occurs when a beam of x-rays is diffracted by a crystal of atoms. (2 marks)
- (ii) For a beam of x-rays, the angle of incidence of $71^{\circ}36'$ is required for second order diffraction image to be formed by reflection at atomic planes of a crystal. Calculate the atomic spacing of the planes if the wavelength of x-rays is 4.0×10^{-11} m. (3 marks)
9. (a) What is meant by the following terms as applied to radioactivity; (1 mark)
 (i) Radioisotopes. (1 mark)
 (ii) Half-life?
- (b) Given that the radioactive law is, $N = N_0 e^{-\lambda t}$, obtain the relation between λ and half-life $T_{1/2}$. (3 marks)
- (c) Radium has an isotope $^{226}_{88}\text{Ra}$ of half-life 1600 years and decays by emission of α - particles and γ rays. Determine the activity of 5 g of the isotope. (5 marks)
- (d) (i) Describe, with the aid of a labelled diagram, the structure and action of the Geiger – Muller tube. (5 marks)
 (ii) Explain why the anode is made in form of a thin wire and the mica window made thin. (2 marks)
 (iii) Sketch the count rate – voltage characteristic of the Geiger – Muller tube and state with reasons, the suitable range of voltage for operation of the tube. (3 marks)
10. (a) Describe briefly the mechanism of thermionic emission. (3 marks)
 (b) Explain the following terms as applied to a vacuum diode: (1 mark)
 (i) Saturation. (2 marks)
 (ii) Rectification.
- (c) Sketch the current-p.d. characteristics of a thermionic diode for two different operating temperatures and explain their main features. (5 marks)
- (d) (i) With the aid of a circuit diagram, derive an expression for voltage gain of a triode when used as an amplifier. (4 marks)
 (ii) A triode valve with mutual conductance of 4.0 m AV^{-1} and anode resistance $10,000 \Omega$ is used as a single-stage amplifier. If the load resistance is $5.0 \times 10^4 \Omega$, calculate the voltage gain of the amplifier. (5 marks)

END



WAKISSHA JOINT MOCK EXAMINATIONS

Uganda Advanced Certificate of Education

PHYSICS

Paper 1

2 hours 30 minutes

INSTRUCTIONS TO CANDIDATES:

Attempt five questions, including at least one, but not more than two from each of the Sections A, B and C.

Any additional question(s) answered will not be marked.

Non-programmable scientific calculators may be used.

Assume where necessary:

Acceleration due to gravity	g	=	9.81 ms^{-2}
Electron charge	e	=	$1.6 \times 10^{-19} \text{ C}$
Electron mass		=	$9.11 \times 10^{-31} \text{ kg}$
Radius of earth		=	$6.4 \times 10^6 \text{ m}$
Plank's constant	h	=	$6.6 \times 10^{-34} \text{ Js}$
Speed of light in vacuum,	c	=	$3.0 \times 10^8 \text{ ms}^{-1}$
Stefan's – Boltzmann's constant, σ		=	$5.67 \times 10^{-8} \text{ W m}^{-2} \text{ K}^{-4}$
Wien's displacement constant		=	$2.90 \times 10^{-3} \text{ m K}$
Specific heat capacity of water		=	$4.2 \times 10^3 \text{ J kg}^{-1} \text{ K}^{-1}$
Gas constant, R		=	$8.31 \text{ J mol}^{-1} \text{ K}^{-1}$
Universal gravitational constant, G		=	$6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$
Avogadro's number	N_A	=	$6.02 \times 10^{23} \text{ mol}^{-1}$
One electron volt, (eV)		=	$1.6 \times 10^{-19} \text{ J}$
Mass of the earth		=	$5.97 \times 10^{24} \text{ Kg}$
Electron charge to mass ratio, e/m		=	$1.8 \times 10^{11} \text{ C kg}^{-1}$
Specific heat capacity of copper		=	$400 \text{ J kg}^{-1} \text{ K}^{-1}$
Specific latent heat of fusion of ice		=	$3.3 \times 10^5 \text{ J kg}^{-1}$

SECTION A

1. (a) (i) What is meant by uniform motion? (01 mark)
- (ii) Sketch the displacement-time graph for a body moving with uniform motion. (01 mark)
- (b) (i) A body initially at rest is accelerated uniformly until it attains a velocity V. If the distance covered during its motion is s, derive an expression for V in terms of s and acceleration a. (03 marks)
- (ii) Show that the expression derived in (b) (i) above is dimensionally consistent. (02 marks)
- (c) (i) State the principle of conservation of energy. (01 mark)
- (ii) A tennis ball of mass 100g is dropped from rest through a height of 10m above a concrete floor. On hitting the floor, the ball rebounds to a height of 4.5m. Find the impulse of force exerted by the floor on the ball. (05 marks)
- (d) (i) Distinguish between perfectly elastic and perfectly inelastic collisions. (02 marks)
- (ii) Give one example of each of the above collisions. (01 marks)
- (iii) A body of mass m_1 moving with velocity U_1 collides with a stationary body of mass m_2 . The bodies move with velocities V_1 and V_2 respectively after collision. If the collision is perfectly elastic, show that: $U_1 = \left(\frac{m_1+m_2}{m_1-m_2}\right)V_1$ (04 marks)
2. (a) (i) Define surface tension. (01 mark)
- (ii) Deduce the dimensions of surface tension. (02 marks)
- (b) (i) Describe the capillary tube method of measuring surface tension of a liquid. (05 marks)
- (ii) Give one application of spreading. (01 mark)
- (c) (i) State the law of flotation. (01 mark)
- (ii) Show that the weight of fluid displaced by an object is equal to the upthrust on the object. (04 marks)
- d) A hydrometer of mass 48g floats with 6cm of its stem out of water.

The cross-sectional area of the stem is 0.80cm^2

Calculate the:

- (i) total volume of the hydrometer. (03 marks)
- (ii) length of the stem above the surface when it is made to float in a liquid of density 1.4gcm^{-3} . (03 marks)

3. (a) State Kepler's laws of planetary motion. (03 marks)

- (b) (i) The moon moves in a circular orbit of radius R , about the earth of mass M_e with period T . Show that $R^3 = \frac{gr_e^2 T^2}{4\pi^2}$, where r_e = radius of the earth, g is acceleration due to gravity on the earth's surface. (05 marks)
- (ii) The period of the moon around the earth is 655.2 hours. If the distance of the moon from the earth is $3.83 \times 10^8\text{m}$, calculate the acceleration due to gravity at the surface of the earth. (04 marks)
- (iii) Explain why any resistance to the forward motion of an artificial satellite results into increase in its speed. (03 marks)

- (c) (i) What is meant by weightlessness? (02 marks)
- (ii) Why does acceleration due to gravity vary with location on the surface of the earth? (03 marks)

4. (a) Define simple harmonic motion. (01 mark)

- (b) Sketch the following graphs for a body performing simple harmonic motion;
- (i) velocity against displacement graph. (02 marks)
- (ii) acceleration against displacement graph. (02 marks)

- (c) A glass u-tube contains a liquid. Air is gently blown into one of the limbs, and on releasing the pressure, the liquid oscillates in the tube.
- (i) Show that the liquid oscillates with simple harmonic motion. (04 marks)
- (ii) Explain why the oscillations eventually die out. (02 marks)

- (d) Explain why the maximum speed of a car on a banked road is higher than that on unbanked road. (04 marks)

- (e) A small bob of mass 0.20kg is suspended by an inextensible string of length 0.80m . The bob is then rotated in a horizontal circle of radius 0.40m . Find the;
- (i) linear speed of the bob, (03 marks)
- (ii) tension in the string. (02 marks)

Turn Over

SECTION B

5. (a) Define thermal conductivity of a substance and state its S.I unit. (02 marks)
- (b) (i) Explain the mechanism of heat conduction in a poor conductor. (03 marks)
- (ii) Explain briefly why a metal is a better conductor of heat than glass. (02 marks)
- (iii) Why is it necessary to make a poor conductor thin with a large cross-sectional area when determining its thermal conductivity? (03 marks)
- (c) (i) What is meant by solar constant? (01 mark)
- (ii) State Stefan-Boltzmann's law. (01 mark)
- (d) Consider the sun to be a sphere of radius $7.0 \times 10^8 \text{ m}$ whose surface temperature is 5900K.
Calculate:
(i) the solar constant at the surface of the earth if the distance of the earth from the sun is $1.5 \times 10^{11} \text{ m}$. (04 marks)
(ii) The total power received by the earth if its radius is $6.4 \times 10^6 \text{ m}$. (03 marks)
(iii) State any assumption made in your calculations. (01 mark)
6. (a) (i) Define thermometric property and give two examples. (02 marks)
- (ii) With reference to a platinum resistance thermometer, describe briefly how the thermodynamic scale of temperature can be established. (03 marks)
- (b) With the aid of a labelled diagram, describe how the total radiation pyrometer can be used to measure temperature of a hot body. (05 marks)
- (c) (i) The resistance, R_θ of a platinum wire at temperature $\theta^\circ\text{C}$, measured on the gas scale is given by $R_\theta = R_0(1 + \alpha \theta + \beta \theta^2)$, where $\alpha = 3.8 \times 10^{-3}$ and $\beta = -5.6 \times 10^{-7}$. Find the temperature indicated by the platinum resistance thermometer when the temperature on the gas scale is 200°C . (04 marks)
(ii) Briefly explain why the two temperatures in (c) (i) are different. (01 mark)
- (d) (i) State and explain the source of inaccuracies while using the mercury in-glass thermometer. (03 marks)
(ii) State two advantages of a thermocouple over an electrical resistance thermometer. (02 marks)

7. (a) (i) What is meant by critical temperature of a gas? (01 mark)
(ii) Distinguish between a gas and a vapour. (02 marks)
- (b) (i) Sketch a p-v graph for a real gas undergoing compression below its critical temperature. (02 marks)
(ii) Explain the main features of the curve in (b) (i) above. (03 marks)
- (c) Two similar cylinders X and Y contain different gases at the same pressure. When gas is released from X, the pressure remains constant for some time before it starts dropping. When gas is released from Y, the pressure continuously drops.
Explain the observations above. (03 marks)
- (d) (i) State the kinetic theory of matter. (01 mark)
(ii) Describe briefly an experiment that you can carry out in support of kinetic theory of matter. (03 marks)
- (e) A helium gas occupies a volume of 0.02m^3 at a pressure of 200kPa and temperature 27°C .
Calculate:
(i) mass of the helium gas. (03 marks)
(ii) the root-mean-square speed of the molecules of the helium gas.
Take molecular mass of helium = 4g. (02 marks)

SECTION C

8. (a) (i) Explain the observations made in the Rutherford's particle scattering experiment. (06 marks)
(ii) Why is the vacuum necessary in this experiment? (01 mark)
- (b) (i) With the aid of a labelled diagram, describe how x-rays can be produced. (05 marks)
(ii) Explain why there is a definite minimum wavelength of the x-radiation produced. (02 marks)
- (c) An x-ray tube is operated at 50KV and 20mA . If 1% of the total energy supplied is emitted as x-rays, calculate the:
(i) maximum frequency of emitted radiations. (03 marks)
(ii) rate at which heat must be removed from the target in order to keep it at a steady temperature. (03 marks)
9. (a) (i) With the aid of a labelled diagram, describe the structure and mode of action of a diffusion-type cloud chamber. (06 marks)
(ii) Explain the effect of reducing pressure in the cloud chamber on the length of tracks by alpha particles. (03 marks)

Turn Over
5

- (iii) A uniform magnetic field of flux density $2.0 \times 10^{-2} \text{ T}$ is applied on a cloud chamber. Alpha particles emitted from a radioactive source in the chamber describe a circular path of radius 50.0 cm. Calculate the energy with which the alpha particles are emitted in MeV. Take mass of an alpha particle = 4.000μ . (04 marks)

- (b) State the reason for each of the following features of a particular form of the Geiger-Muller (G-M) tube;
- a thin wire anode (01 mark)
 - a thin mica window. (01 mark)
 -

- (c) (i) For the G-M tube, Draw a labelled sketch graph showing how the number of pulses per second varies when the applied voltage is increased from zero. (02 marks)

- (ii) Explain the main features of the sketch above. (03 marks)

10. (a) Define the following terms as applied to radioactivity:

- Decay constant. (01 mark)
- Half-life. (01 mark)
- Isotopes. (01 mark)

- (b) (i) Derive the relationship between decay constant and half-life. (03 marks)

- (ii) The half-life of polonium -30 is 2.5 minutes. Calculate the mass of polonium -30 which has an activity of 1.0×10^{15} disintegrations per second. (04 marks)

- (c) (i) Explain what is meant by mass defect in nuclear physics. (02 marks)

- (ii) Calculate the binding energy per nucleon of helium ${}_{2}^{4}He$ nucleus.

Take mass of a proton = 1.0073μ

mass of a neutron = 1.0087μ

mass of a helium nucleus = 4.0015μ

$(1\mu = 931 \text{ MeV})$

(04 marks)

- (d) State **one** similarity and **one** difference between;

- Cathode rays and β - particles. (02 marks)
- Nuclear fusion and nuclear fission. (02 marks)

END

P510/1
PHYSICS
Paper 1
July/August 2014
2½ hours



WAKISSHA JOINT MOCK EXAMINATIONS

Uganda Advanced Certificate of Education

PHYSICS

Paper 1

2 hours 30 minutes

INSTRUCTIONS TO CANDIDATES:

- Answer five questions, including at least one, but not more than two from each of the Sections A, B and C.
- Any additional question(s) answered will not be marked.
- Non-programmable scientific calculators may be used.

Assume where necessary:

Acceleration due to gravity	g	=	9.81 ms^{-2}
Electron charge	e	=	$1.6 \times 10^{-19} \text{ C}$
Electron mass		=	$9.11 \times 10^{-31} \text{ kg}$
Radius of earth		=	$6.4 \times 10^6 \text{ m}$
Planck's constant	h	=	$6.6 \times 10^{-34} \text{ Js}$
Speed of light in vacuum,	c	=	$3.0 \times 10^8 \text{ ms}^{-1}$
Stefan's – Boltzmann's constant,	σ	=	$5.67 \times 10^{-8} \text{ W m}^{-2} \text{ K}^{-4}$
Wien's displacement constant		=	$2.90 \times 10^{-3} \text{ m K}$
Specific heat capacity of water		=	$4.2 \times 10^3 \text{ J kg}^{-1} \text{ K}^{-1}$
Gas constant,	R	=	$8.31 \text{ J mol}^{-1} \text{ K}^{-1}$
Universal gravitational constant,	G	=	$6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$
Charge to mass ratio,	e/m	=	$1.8 \times 10^{11} \text{ C kg}^{-1}$
Avogadro's number	N_A	=	$6.02 \times 10^{23} \text{ mol}^{-1}$
One electron volt,	(eV)	=	$1.6 \times 10^{-19} \text{ J}$

SECTION A

- (a) (i) Define linear momentum. (01 mark)
- (ii) State the law of conservation of linear momentum. (01 mark)
- (b) A hose pipe has a hole of cross sectional area 50cm^2 and ejects water horizontally at a speed of 0.3ms^{-1} . If the water is incident on a vertical wall and its horizontal velocity becomes zero, find the force the water exerts on the wall. (04marks)
- (c) For a uniformly decelerating motion, sketch
- i) a displacement-time graph. (1½marks)
 - ii) a velocity-time graph. (1½marks)
- (d) A projectile is fired in air with a speed U at an angle α to the horizontal. Show that the path of the projectile is parabolic. (03marks)
- (e) A ball is kicked from the ground at an angle of 30° to the horizontal and just clears a wall 12m high at a distance of 30m from the point where it was kicked from.
Calculate;
- i) the speed with which the ball was kicked. (04marks)
 - ii) the velocity of the ball as it is clearing the wall. (04marks)
2. (a) (i) Define stress and strain. (02 marks)
- (ii) Determine the dimensions of Young's modulus. (03 marks)
- (b) In an experiment to determine Young's modulus;
- (i) Explain why two wires of the same material are used. (02 marks)
 - (ii) Outline the measurements to be made. (02 marks)
- (c) (i) What is meant by coefficient of linear expansion of a material? (01mark)
- (ii) A metal wire of diameter 0.2mm is cooled from a temperature of 50°C to 10°C . Find the longitudinal tension set up in the wire when allowed to contract. (04marks)
- (d) (i) Distinguish between elastic deformation and plastic deformation. (02marks)
- (ii) Sketch a stress – strain graph for glass and explain its features. (04marks)

3. (a) (i) State Newton's law of gravitation. (01mark)
- (ii) Derive an expression for the period of a planet moving in a circular orbit about the sun in terms of the radius of the orbit. (04marks)
- (b) (i) What is meant by gravitational field strength? (01mark)
- (ii) Draw a sketch graph to show how the gravitational field strength varies with distance from the earth's surface for points external to it. (02marks)
- (iii) Given that the radius of the earth is 6400km and that the value of the acceleration due to gravity at its surface is 9.81ms^{-2} , calculate a value for the acceleration due to gravity at a point 400km above the earth's surface. (04marks)
- (c) Explain why an astronaut in a satellite which is in a free circular orbit around the earth experiences the sensation of weightlessness. (03marks)
- (d) (i) What is centripetal force? (01mark)
- (ii) A car travels round a bend banked at an angle of 25° . If the radius of curvature of the bend is 65m and the coefficient of friction between the tyres of the car and the road surface is 0.35, calculate the maximum speed at which the car negotiates the bend without skidding. (04marks)
4. (a) (i) Write the expression for pressure at a point at a depth h below the surface of a liquid of density p and show that it is dimensionally consistent. (03marks)
- (ii) Show that the pressure in (a) (i) above, at a given depth in a vessel is independent of the cross sectional area of the vessel. (03marks)
- (b) (i) State Archimedes' principle. (01mark)
- (ii) A balloon is inflated with air to a volume of 1.5 litres and is sealed. The density of the surrounding air is 1.3g per litre. Given the mass of air in the balloon is 2.15g and the apparent loss in weight of the inflated balloon is $42.18 \times 10^{-3}\text{N}$, calculate the mass of the balloon fabric. (05marks)
- (c) (i) State Bernoulli's principle. (01marks)
- (ii) Explain the origin of the lift force on the wings of an aeroplane at take off. (04marks)
- (d) Air flows over the upper surfaces of the wings of an aeroplane at a speed of 120ms^{-1} , and past the lower surfaces of the wings at 110ms^{-1} . Calculate the lift force on the aeroplane if it has a total wing area of 20.0m^2 . (03marks)
Take density of air = 1.29kgm^{-3}

Turn Over

SECTION B

5. (a) (i) What is meant by **triple point of water?** (01 mark)
- (ii) With reference to a constant volume gas thermometer, explain how a thermodynamic temperature scale is defined. (03marks)
- (iii) Explain why a thermocouple can be used to measure rapidly fluctuating temperatures? (02marks)
- (b) The resistance of the element in a platinum resistance thermometer is 6.750Ω at the triple point of water and 7.166Ω at room temperature. Find the temperature of the room on the scale of the resistance thermometer in $^{\circ}\text{C}$. (04 marks)
- (c) (i) Define specific latent heat of vaporisation of a liquid. (01mark)
- (ii) With the aid of a labelled diagram, describe an experiment to determine specific latent heat of vaporisation of a liquid using the method of mixtures. (06marks)
- (d) In a factory heating system water enters the radiators at 60°C and leaves at 38°C . The system is replaced by one in which steam at 100°C is condensed in the radiators, the condensed steam leaving at 82°C . Find the mass of steam that will supply the same heat as 1kg of hot water in the first instance. Take specific latent heat of vaporisation of steam to be $2.26 \times 10^6 \text{ J kg}^{-1}$. (03marks)
6. (a) Distinguish between a **real** gas and an **ideal** gas. (02marks)
- (b) (i) Use kinetic theory of matter to explain the observation that saturated vapour pressure of a liquid increases with temperature. (03marks)
- (ii) Sketch a graph to show the variation of saturated vapour pressure with temperature of a liquid. (02marks)
- (c) Describe an experiment to determine saturated vapour pressure of water at various temperatures. (06 marks)
- (d) (i) State **Dalton's law** of partial pressures. (01mark)
- (ii) A closed vessel contains air saturated with water vapour at 77°C . If the total pressure in the vessel is 1000mmHg ; calculate the new pressure in the vessel if the temperature is reduced to 27°C . Take S.V.P of water at $77^{\circ}\text{C} = 314\text{mmHg}$; S.V.P of water at $27^{\circ}\text{C} = 27\text{mmHg}$. (03 marks)
- (e) What is meant by the term **co-volume** as applied to a real gas? (01mark)

7. (a) (i) State the laws of black body radiation. (02 mark)
(ii) Why is black body radiation referred to as temperature radiation? (01 mark)

(iii) Sketch the variation of intensity of radiation emitted with wavelength for a black body at three different temperatures. (03marks)

- (b) (i) If the mean equilibrium temperature of the earth's surface is T and the total rate of energy emission by the sun is E, show that

$$T^4 = \frac{E}{16\sigma\pi R^2}$$

Where σ = Stefan's constant and R is the radius of the earth's orbit around the sun. (04 marks)

- (ii) State the assumption made in b(i) above. (01 mark)

- (c) (i) What is meant by *temperature gradient* as applied to a thermal conductor? (01mark)

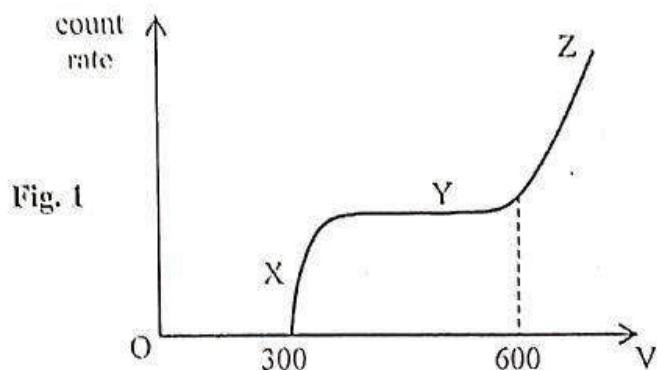
- (ii) Two perfectly lagged metal bars A and B, each of length 20cm, are arranged in parallel, with their hot ends maintained at 90°C and their cold ends at 30°C. If the cross sectional area of each bar is 2.5cm², find the net rate of heat flow through the parallel bars.

Take thermal conductivity of A = 400Wm⁻¹K⁻¹ and that of B = 200Wm⁻¹K⁻¹. (04marks)

- (d) Explain how Greenhouse effect leads to global warming. (04marks)

SECTION C

8. (a) What is meant by the following. (01 mark)
- i) Isotopes, (01 mark)
 - ii) Specific charge of an ion?
- (b) With the help of a diagram, describe how specific charge of an ion can be determined using the Bainbridge mass spectrometer. (06 marks)
- (c) In a Bainbridge mass spectrometer, the magnesium ions $^{24}\text{Mg}^+$ and $^{26}\text{Mg}^{2+}$ are deflected in circular paths by a uniform magnetic field. Calculate;
- (i) the ratio of the specific charges of the two ions. (03 marks)
 - (ii) the radius of the path of the heavier ion if that of the lighter ion is 0.36m. (03 marks)
- (d) The figure 1. below shows roughly how the count rate of a Geiger – muller tube varies with the voltage V applied to the anode of the tube.



- (i) What is the most suitable voltage, approximately for operating the GM tube? (02marks)
- (ii) Explain the existence of the plateau Y in the graph. (02marks)
- (c) State one use and one hazard of radioactivity. (02marks)
9. (a) What is meant by the following terms as applied to photoelectric effect?
- i) Work function. (01mark)
 - ii) Threshold frequency. (01mark)
- (b) Describe an experiment to determine the stopping potential of a metal surface. (05marks)

- (c) A caesium metal surface is illuminated with monochromatic light of wavelength 450nm. If its work function is 1.80eV, calculate;
- the maximum energy of the emitted photo electrons. (04marks)
 - the stopping potential which just prevents photo electric emission. (02marks)

- (d) Describe how photo electric effect can be demonstrated in the laboratory. (04marks)

(e)

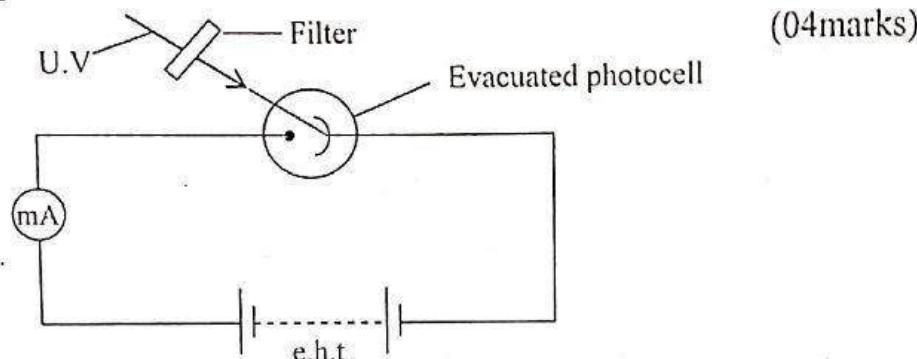


Fig. 2

The figure 2. above shows an evaluated photo cell connected in series with a milliammeter and extra- high- tension (e.h.t) and is being irradiated by an ultra violet radiation (u.v); passing through a light filter.

Explain what happens when a gas is introduced into the photo cell.

(03marks)

10. (a) What is meant by the following terms:

- Excitation energy,** (01 mark)
- Ionisation energy.** (01 mark)

- (b) In a simple model of the hydrogen atom, an electron of mass m and charge $-e$, moves in a circular orbit about the nucleus.

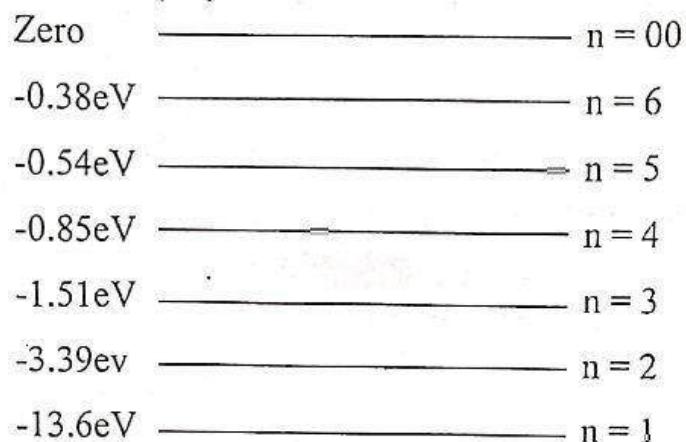
- Show that the kinetic energy of the electron is given by $e^2 / 8\pi\epsilon_0 r$. where r is the radius of the electron's orbit, ϵ_0 is the permittivity of free space. (03 marks)

- Given that the angular momentum of the electron is $nh / 2\pi$, where n is an integer and h is Planck's constant, show that the total energy of the electron is $E_n = -\frac{Me^4}{8\epsilon_0^2 h^2 n^2}$. (04marks)

- Explain the significance of the minus sign in the expression for E_n in (b) (ii) above. (02marks)

Turn Over

- (c) The diagram below shows some energy levels of the hydrogen atom in electron volts (eV).



Calculate;

- (i) the ionisation energy of the atom in joules. (03marks)
- (ii) the speed of the electron which ionises the atom. (03marks)
- (iii) the ionisation potential in volts. (03marks)

END

P510/1
PHYSICS
Paper 1
July/August 2015
2½ hours



WAKISSHA JOINT MOCK EXAMINATIONS

Uganda Advanced Certificate of Education

PHYSICS

Paper 1

2 hours 30 minutes

INSTRUCTIONS TO CANDIDATES:

- Answer five questions, including at least one, but not more than two from each of the Sections A, B and C.
- Any additional question(s) answered will not be marked.
- Non-programmable scientific calculators may be used.

Assume where necessary:

Acceleration due to gravity	g	=	9.81 ms^{-2}
Electron charge	e	=	$1.6 \times 10^{-19} \text{ C}$
Electron mass		=	$9.11 \times 10^{-31} \text{ kg}$
Radius of earth		=	$6.4 \times 10^6 \text{ m}$
Plank's constant	h	=	$6.6 \times 10^{-34} \text{ Js}$
Speed of light in vacuum,	c	=	$3.0 \times 10^8 \text{ ms}^{-1}$
Stefan's – Boltzmann's constant,	σ	=	$5.67 \times 10^{-8} \text{ W m}^{-2} \text{ K}^{-4}$
Wien's displacement constant		=	$2.90 \times 10^{-3} \text{ m K}$
Specific heat capacity of water		=	$4.2 \times 10^3 \text{ J kg}^{-1} \text{ K}^{-1}$
Specific latent heat of vaporisation of steam		=	$2.0 \times 10^6 \text{ J kg}^{-1}$
Gas constant,	R	=	$8.31 \text{ J mol}^{-1} \text{ K}^{-1}$
Universal gravitational constant,	G	=	$6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$
Charge to mass ratio,	e/m	=	$1.8 \times 10^{11} \text{ C kg}^{-1}$
Avogadro's number	N_A	=	$6.02 \times 10^{23} \text{ mol}^{-1}$
One electron volt,	(eV)	=	$1.6 \times 10^{-19} \text{ J}$

SECTION A

1. (a) (i) Distinguish between conservative and non-conservative forces. (2marks)
(ii) Give two examples of each of the above types of forces. (2marks)

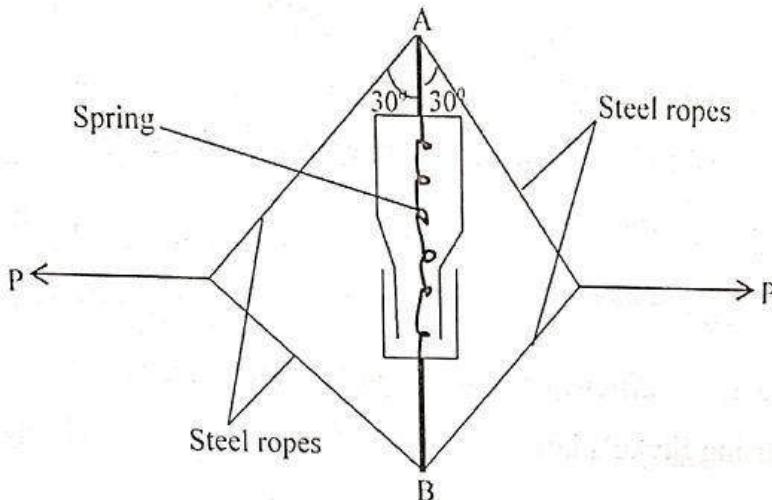
 - (b) (i) State the principle of conservation of mechanical energy. (1mark)
(ii) Explain how the principle above applies to a body falling from rest. (3marks)

 - (iii) Sketch a graph to show how kinetic energy of the falling body in (b) (ii) above varies with time. (2marks)

 - (c) A car of mass 1 tonne accelerates from 36 kmh^{-1} to 72 kmh^{-1} while moving 0.5km up a road inclined at an angle α to the horizontal, where $\sin \alpha = 1/20$. If the total resistive force to its motion is 0.3kN, find the driving force of the car engine. (4marks)

 - (d) (i) What is meant by saying that a body is moving with velocity V relative to another? (1mark)
(ii) A car which is moving due west at 4ms^{-1} changes direction and starts to move due north at 3ms^{-1} . Find the change in velocity of the car. (3mks)
-
2. (a) (i) State Hooke's law. (1 mark)
(ii) What is meant by elastic constant of a material? (1 mark)
(iii) Show that the energy stored per unit volume of a stretched wire is given by $1/2E (\text{strain})^2$ where E is young's modulus. (4 marks)

 - (b) A muscle exercising machine consists of two steel ropes attached to the ends of a strong spring of force constant 500Nm^{-1} contained in a plastic tube whose length can be adjusted. The spring has an uncompressed length of 0.80m. When the ropes are pulled sideways in opposite directions with a force P, the spring is compressed to a length of 0.60m and the ropes make an angle of 30° with the length of the spring as shown.

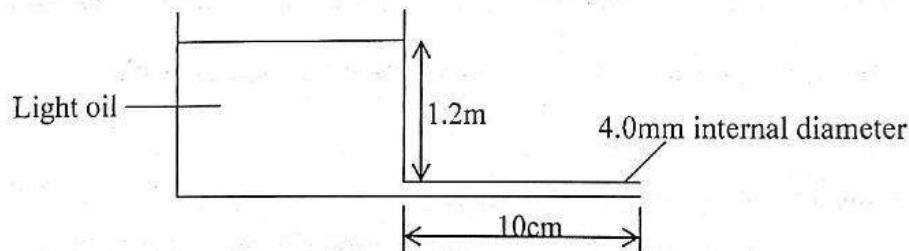


Calculate the:

- (i) tension in each rope. (4 marks)
 - (ii) force P. (3 marks)
 - (c) (i) Outline the measurements to be made during an experiment to determine Young's modulus of a material. (3 marks)
 - (ii) What precautions are necessary in the above experiment? (2 marks)
 - (d) Explain briefly why heat is evolved when a material undergoes plastic deformation. (2 marks)
3. (a) (i) Define **simple harmonic motion**. (1 mark)
- (ii) Distinguish between simple harmonic motion and any other motion of a body performing oscillations. (2 marks)
- (b) Derive an expression for velocity of a body performing simple harmonic motion in terms of amplitude and displacement from a fixed point. (4 marks)
- (c) A body of mass 50g executing, simple harmonic motion has a velocity of 3 cms^{-1} when it is 4cm from a fixed point and a velocity of 5 cms^{-1} when it is 2 cm from the fixed point.
- Find the:-
- (i) period of oscillations. (4 marks)
 - (ii) total mechanical energy of the body. (4 marks)
 - (d) (i) What is meant by **centripetal acceleration**? (1 mark)
 - (ii) Explain, with the aid of a clear diagram why a mass attached to a string rotating in a vertical plane at a constant speed flies off at a tangent if the string breaks. (3 marks)
 - (iii) State the condition when the string is likely to break. (1 mark)

Turn Over

4. (a) (i) What is meant by viscosity? (1 mark)
- (ii) Explain briefly using Kinetic theory of matter, the effect of temperature on viscosity of a gas. (3 marks)
- (b) (i) State Stoke's law. (1 mark)
- (ii) Describe how the coefficient of viscosity of a liquid can be determined using Stoke's law. (5 marks)
- (iii) State and explain the precautions that must be taken in the above experiment. (3 marks)
- (c) The figure below shows a tank containing a light lubricating oil. The oil flows out of the tank through a horizontal pipe of length 10cm and internal diameter 4.0mm.



Calculate the volume of oil which flows through the pipe in one minute when the level of oil in the tank is 1.2m above the pipe and does not alter significantly during this time. Take density of oil = 0.92 g cm^{-3} , coefficient of viscosity of oil = $8.4 \times 10^{-2} \text{ N sm}^{-2}$. (4 marks)

- (d) (i) What is meant by angle of contact as applied to a liquid? (1 mark)
- (ii) How does addition of a detergent affect angle of contract of a liquid? (2 marks)

SECTION B

5. (a) Define latent heat of vaporisation. (2 marks)
- (b) (i) With the aid of a diagram, describe how the specific latent heat of vaporisation of a liquid can be determined by the method of mixtures. (6 marks)
- (ii) State two advantages the continuous flow method has over the method of mixtures. (2 marks)
- (c) An electrical heater of 2.5kW is used to heat 2 litres of water in a kettle of heat capacity 400Jkg^{-1} . If the initial temperature of water is 24°C , and neglecting heat losses to the surroundings, find:
- (i) how long it will take to heat the water to its boiling point. (4 marks)
- (ii) the mass of water boiled off in 3 minutes, if heating started from 24°C . (3marks)
- (d) (i) State Newton's law of cooling. (1 mark)
- (ii) Explain why a small body cools faster than a large one if they are made of the same material. (2marks)
6. (a) (i) What is a super saturated vapour? (1 mark)
- (ii) Sketch a pressure - volume curve for a real gas undergoing compression below its critical temperature. (2marks)
- (iii) Explain the main features of the curve. (3marks)
- (b) (i) State Dalton's law of partial pressure. (1mark)
- (ii) A volume of $4.0 \times 10^{-3}\text{m}^3$ of air is saturated with water vapour at 100°C . The air is cooled to 30°C at constant pressure of $1.5 \times 10^5\text{Pa}$. Calculate the volume of air after cooling, if the saturated vapour pressure of water at 30°C is $2.5 \times 10^3\text{Pa}$. Take atmosphere pressure = $1.01 \times 10^5\text{ Pa}$. (4marks)
- (c) (i) State the first law of thermodynamics. (1mark)
- (ii) Use the law in (c) (i) above to derive the relation $C_p - C_v = R$ where C_p and C_v are the molar heat capacities at constant pressure and constant volume respectively and R is the universal molar gas constant. (5marks)

Turn Over

- (d) The temperature of a gas in an expandable container is raised from 0°C to 80°C at constant pressure of $4.0 \times 10^5\text{Pa}$. If the total heat added is $5.0 \times 10^4\text{J}$, find the number of moles of the gas.

Take molar heat capacity of the gas at constant pressure = $29.1\text{J mol}^{-1}\text{K}$.

(3marks)

7. (a) Define **thermal conductivity** of a material. (1mark)

- (b) (i) Explain, using molecular theory of matter, the mechanism of thermal conduction in insulators. (3marks)

- (ii) Briefly account for the fact that metals are better conductors of heat than glass. (3marks)

- (c) Ice is forming on the surface of water in a swimming pool. When it is 5.0cm thick, the temperature of the surface of the ice in contact with the air is 260K while the surface in contact with the water is at 273K.

Calculate:

- (i) the rate of heat loss per m^2 from the water. (3marks)

- (ii) the rate at which the thickness of ice is increasing. (3marks)

Take thermal conductivity of ice = $2.3\text{Wm}^{-1}\text{K}^{-1}$, density of water = 1000kgm^{-3} , specific latent heat of fusion of ice = $3.25 \times 10^5\text{Jkg}^{-1}$.

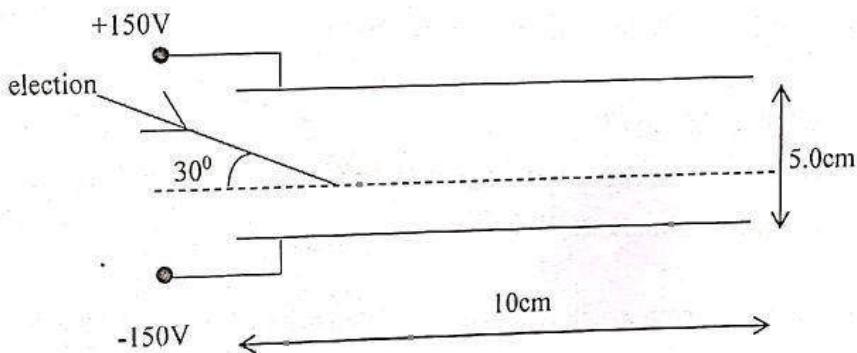
(4marks)

- (d) With the aid of a labelled diagram describe the structure and mode of operation of the ether thermoscope. (4marks)

- (e) Explain briefly the greenhouse effect. (3marks)

SECTION C

8. (a) (i) Define specific charge of an ion. (1 mark)
- (ii) Describe how the specific charge of a positive ion can be measured using the Bainbridge mass spectrometer. (6 marks)
- (iii) State **three** differences between positive rays and cathode rays. (3 marks)
- (b) An electron moving with a speed of $2.0 \times 10^6 \text{ ms}^{-1}$ enters midway between two horizontal parallel metal plates at an angle of 30° to the horizontal as shown in the diagram below.



The plates are 10cm long and 5cm apart. If the potentials of the upper and lower plates are +150V and -150V respectively,

calculate:

- (i) the time taken for the electron to traverse the region between the plates. (3 marks)
- (ii) the velocity of the electron as it emerges from the region between the plates. (4 marks)
- (c) Briefly describe the construction and action of the thermionic diode. (3 marks)

9. What is meant by the terms ; (1 mark)
- (i) Decay constant (1 mark)
- (ii) Radio isotopes? (1 mark)
- (b) Show that the half-life, $t_{\frac{1}{2}}$ of a radioactive material is given by $t_{\frac{1}{2}} = \frac{0.693}{\lambda}$, Where λ is decay constant. (3 marks)

Turn Over

7

- (c) A mass defect of 8.8×10^{-30} kg occurs in the decay of a $^{226}_{88}\text{Ra}$ nucleus.
 In a given sample, most of the nuclei decay by emission of an α -particle of energy 4.60 MeV and a γ -ray photon. Calculate the frequency of the γ ray photon emitted. Neglect recoil energy of the decayed nucleus. (5marks)
- (d) (i) With the aid of a labelled diagram, describe the structure and action of an ionisation chamber. (5marks)
 (ii) Draw a graph to illustrate the variation of ionisation current and p.d across an ionisation chamber, and explain its salient features. (3marks)
- (e) State two industrial uses of radio isotopes. (2marks)
10. (a) (i) What are X-rays? (1mark)
 (ii) Describe with the aid of a labelled diagram how X-rays are produced in an X-ray tube. (5marks)
- (b) (i) Draw a sketch graph to show how intensity of X-rays produced in the X-ray tube varies with wavelength of the X-rays. (2marks)
 (ii) Explain how the X-ray spectra are formed. (4marks)
- (c) Electrons in an X-ray tube are accelerated through p.d of 12kV. Calculate the minimum wave length of the X-rays that can be produced. (3marks)
- (d) (i) What is meant by electron energy level in an atom? (1mark)
 (ii) In a simple model of the hydrogen atom, an electron of mass m and charge $-e$, is considered to move in a nearly circular orbit about a proton. Write down the expression for the electric force on the electron, and show that the total energy of the electron is given by $-\frac{e^2}{8\pi\epsilon_0 r}$ where r is the radius of the electron orbit ϵ_0 and ϵ_0 is the permittivity of free space. (4 marks)

END



WAKISSHA JOINT MOCK EXAMINATIONS

Uganda Advanced Certificate of Education

PHYSICS

Paper 1

2 hours 30 minutes

INSTRUCTIONS TO CANDIDATES:

- Answer five questions, including at least one, but not more than two from each of the Sections A, B and C.
- Any additional question(s) answered will not be marked.
- Non programmable silent scientific calculators may be used.

Assume where necessary:

Acceleration due to gravity	g	=	9.81 ms^{-2}
Electron charge	e	=	$1.6 \times 10^{-19} \text{ C}$
Electron mass		=	$9.11 \times 10^{-31} \text{ kg}$
Mass of earth		=	$5.97 \times 10^{24} \text{ kg}$
Planck's constant,	h	=	$6.6 \times 10^{-34} \text{ Js}$
Stefan's – Boltzmann's constant,	σ	=	$5.67 \times 10^{-8} \text{ W m}^{-2} \text{ K}^{-4}$
Radius of the earth		=	$6.4 \times 10^6 \text{ m}$
Radius of the sun		=	$7.0 \times 10^8 \text{ m}$
Radius of earth's orbit about the sun		=	$1.5 \times 10^{11} \text{ m}$
Speed of light in a vacuum		=	$3.0 \times 10^8 \text{ m s}^{-1}$
Specific heat capacity of water		=	$4,200 \text{ J kg}^{-1} \text{ K}^{-1}$
Specific latent heat of fusion of ice		=	$3.34 \times 10^5 \text{ J kg}^{-1}$
Universal gravitational constant,	G	=	$6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$
Avogadro's number	N_A	=	$6.02 \times 10^{23} \text{ mol}^{-1}$
Density of mercury		=	$13.6 \times 10^3 \text{ kg m}^{-3}$
Charge to mass ratio,	e/m	=	$1.8 \times 10^{11} \text{ C kg}^{-1}$
The constant $1/4\pi\epsilon_0$		=	$9.0 \times 10^9 \text{ F}^{-1} \text{ m}$
Density of water		=	1000 kg m^{-3}
Gas constant	R	=	$8.31 \text{ J mol}^{-1} \text{ K}^{-1}$

SECTION A

1. a) i) Distinguish between speed and velocity. (2 marks)
- ii) Suppose the velocity of a body changes from U to V when accelerated uniformly at a rate, $a \text{ ms}^{-2}$. Derive an expression of the distance S covered during the acceleration. (3 marks)
- iii) Show that the expression for S derived above is dimensionally consistent. (2 marks)
- b) A small car of mass 800kg is being driven at a steady speed of 21ms^{-1} when the driver suddenly sees a stationary car 30m ahead. If it takes the driver 0.40s to react and apply brakes to produce a total resistive force of 6kN, Calculate the speed at which the small car will hit the stationary car. (4 marks)
- c) i) What is meant by **limiting friction**? (1 mark)
- ii) Explain briefly how normal reaction affects friction between solid surfaces. (3 marks)
- d) A force F acting parallel to and up a rough plane of inclination θ to the horizontal is just sufficient to prevent a body of mass m from sliding down the plane. A force of $3F$ acting parallel to and up the same plane causes the mass to be at the verge of moving up the plane. Show that $\mu = 2\tan\theta$, where μ is the coefficient of friction between the body and the plane. (4 marks)
- e) State **two** instances where friction is a nuisance. (1 mark)
2. a) Define the following terms as applied to circular motion;
- i) **Centripetal force** (1 mark)
- ii) **Angular velocity** (1 mark)
- b) A trolley of mass m is pulled over a humped track of radius r at a speed V .
- i) If the reaction from the track surface is R , write an equation that relates m , V and R . (1 mark)
- ii) Calculate the maximum speed of the trolley if its wheels are to stay in contact with the track surface.
Take radius of the hump to be 50cm. (3 marks)
- c) i) State **Kepler's laws of gravitation**. (3 marks)
- ii) Sketch a graph showing the variation of acceleration due to gravity with distance from the centre of the earth. (2 marks)
- iii) Explain the features of the sketch drawn in (c)(ii) above. (2 marks)

- d) i) What is meant by gravitational potential? (1 mark)
- ii) Derive an expression for the gravitational potential at a point on the earth's surface. (3 marks)
- iii) Assuming the earth is a uniform sphere, calculate the work done in taking a 5.0 kg mass from the earth's surface to a point 6.0×10^5 m above it. (3 marks)
3. a) i) Define the terms tensile stress and tensile strain. (2 marks)
- ii) Deduce the dimensions of Young's modulus. (3 marks)
- b) i) Outline the measurements to be made in an experiment to determine Young's modulus of steel. (3 marks)
- ii) Explain why the steel wire in the above experiment has to be long and thin. (2 marks)
- c) A rubber of length l_0 and cross-sectional area A is stretched elastically to a length l by a constant force F. Derive an expression for the energy stored per unit volume in terms of Young's modulus E, l_0 and l. (4 marks)
- d) A catapult is made of a rubber cord of total unstretched length 15cm and square cross-section of side 2.5mm. The cord is stretched to a length of 18cm and then released to propel a small piece of stone of mass 6.0g horizontally.
- Calculate the speed of the stone leaving the catapult if 5% of the energy stored in the cord becomes heat in it. (5 marks)
 - State any one assumption made in your calculation. (1 mark)
4. a) i) State the law of flotation. (1 mark)
- ii) Describe a simple experiment to verify the law of flotation. (4 marks)
- b) A metal cube of sides 12cm floats on mercury in a vessel. Water is poured carefully into the vessel until it just covers the metal block. If the densities of the metal and mercury are 7800 kgm^{-3} and 13600 kgm^{-3} respectively. Calculate the height of the water column in the vessel. (5 marks)
- c) i) What is meant by viscosity as applied to fluids? (1 mark)
- ii) Explain the variation of viscosity of a liquid with temperature. (2 marks)
- d) Derive an expression for the terminal velocity attained by a sphere of density σ and radius r falling through a liquid of density ρ and coefficient of viscosity η . (4 marks)

Turn Over

- e) A small metal ball of diameter 8.0mm falls steadily through oil and covers a distance of 20.0cm in 0.56s. If the density of the metal is 7800kgm^{-3} and that of oil is 900kgm^{-3} , calculate the coefficient of viscosity of oil. (3 marks)

SECTION B

5. a) i) Define specific heat capacity of a substance. (1 mark)
ii) Describe an experiment to determine the specific heat capacity of a liquid using the continuous flow method. (6 marks)
iii) State two advantages of this method. (2 marks)
- b) In an experiment to determine the specific heat capacity of a liquid using the continuous flow method, a p.d of 12.0V was applied to the heating coil. When the flow rate was halved, a new p.d. V was required to produce the same inlet and outlet temperatures.
Calculate V. (3 marks)
- c) i) State Newton's law of cooling. (1 mark)
ii) Use Newton's law of cooling to show that the temperature of a body of smaller mass falls at a higher rate. (2 marks)
- d) Define specific latent heat of vaporisation of a liquid. (1 mark)
- e) Explain the following observations;
i) Hot water in a cup cools faster with a wet cloth wrapped around it. (2 marks)
ii) When feeling hot, it is advisable to take warm or hot drink. (2 marks)
6. a) What is meant by the terms;
i) isothermal change.
ii) adiabatic change. (2 marks)
- b) i) Explain briefly why gas undergoing an isothermal expansion has to be in a vessel surrounded by a constant temperature bath. (2 marks)
ii) A fixed mass of a gas in the state P_1, V_1 undergoes an isothermal expansion to the state P_2, V_2 . Deduce an expression for the work done by the gas in terms of P_1, V_1 and V_2 . (4 marks)

- c) The pressure P of an ideal gas is given by $P = \frac{1}{3} nmc^2$, where n is the number of molecules per unit volume, m is the mass of each molecule and c^2 is the mean square speed of the molecules.
- Show clearly the steps taken to derive the above expression.(6 marks)
 - State the assumptions made in the derivation in (c)(i) above.(2 marks)
- d) An ideal gas of mass 5kg is confined in a vessel of volume $10m^3$ and pressure $2.0 \times 10^5 \text{ Nm}^{-2}$. Calculate the;
- mean Kinetic energy of the molecules of the gas. (2 marks)
 - r.m.s. speed of the molecules. (2 marks)

7. a) i) Define coefficient of thermal conductivity. (1 mark)
ii) Explain the mechanism of thermal conduction in non-metallic solids. (3 marks)

b)

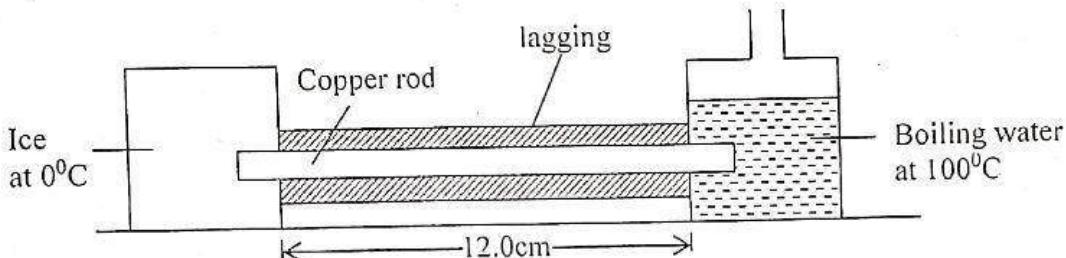


Fig 1.

Figure 1 above shows a lagged copper rod of diameter 1.0cm, whose ends are fixed into ice at 0°C and boiling water at 100°C .

- Calculate the mass of ice which will melt in 15 seconds, stating one important assumption in your calculation. (5 marks)
 - In practice the amount of ice that would melt is likely to be higher than the calculated value. Give one reason for this. (1 mark)
- c) i) What is a black body? (1 mark)
ii) With the aid of sketch graphs, explain the features of the spectral distribution of black body radiation. (4 marks)
- d) i) State Stefan's law of black body radiation. (1 mark)
ii) A cube of sides 2.0cm at a temperature of 560°C gives 60% of the emission of a black body at the same temperature. Calculate the radius of a black body sphere at a temperature of 257°C that would radiate power equivalent to 20% of that of the cube. (4 marks)

Turn Over

SECTION C

8. a) i) Distinguish between photoelectric emission and thermionic emission. (2 marks)
ii) Explain the mechanism of photo electric emission. (2 marks)
- b) i) What is stopping potential? (1 mark)
ii) Describe an experiment to determine the stopping potential of a metal surface. (5 marks)
- c) A monochromatic source emits a narrow parallel beam of light of wavelength 546nm, the power in the beam being 0.080w.
Calculate the;
i) number of photons leaving the source per minute. (4 marks)
ii) the photocurrent, if the light falls on the cathode of a photocell, assuming 1.5% of the photons incident on the cathode liberate electrons. (3 marks)
- d) Ultraviolet radiation is directed onto a freshly cleaned Zinc plate connected to the cap of a negatively charged gold leaf electroscope. Explain what is observed. (3 marks)
9. a) Define the terms **binding energy per nucleon** and **unified atomic mass unit**. (2 marks)
- b) i) Sketch a graph of binding energy per nucleon against mass number for naturally occurring nuclides. (2 marks)
ii) Use the above sketch graph to explain liberation energy by nuclear fusion and nuclear fission. (3 marks)
iii) State **one** similarity between nuclear fusion and nuclear fission and the necessary conditions for each to occur. (3 marks)
- c) Consider the nuclear reaction below, when the nucleus of uranium – 235 is bombarded by a neutron.
- $$^{235}_{92}U + {}_0^1n \rightarrow {}^{144}_{56}Ba + {}^{89}_{36}Kr + 3 {}_0^1n$$
- i) Calculate the energy released in eV by one mole of Uranium – 235 in the reaction above. (5 marks)
Mass of ${}^{235}_{92}U = 235.1175U$, ${}_0^1n = 1.0099U$,
 ${}^{144}_{56}Ba = 143.9577U$, ${}^{89}_{36}Kr = 88.9264U$,
 $1U = 931\text{MeV}$.
- ii) State **two** applications of such a reaction above. (2 marks)

- d) Explain the purpose of each of the following in a Geiger – Muller tube;
- i) Argon gas at low pressure
 - ii) Halogen gas mixed with argon gas.
 - iii) An anode in the form of a wire. (3 marks)
10. a) i) What is meant by a **line spectrum?** (1 mark)
- ii) Explain how line spectra account for the existence of discrete energy levels in atoms. (4 marks)
- b) The ionisation energy for a hydrogen atom is 13.6eV, if the atom is in its ground state and 3.4eV, if it is in its first excited state.
- i) What is meant by the terms **ionisation energy** and **excited state?** (2 marks)
 - ii) Calculate the wavelength of a photon that is emitted when a hydrogen atom returns to the ground state from the first excited state. (3 marks)
- c) Define the terms;
- i) **Radioactive decay**
 - ii) **Decay constant** (2 marks)
- d) A radioisotope $^{99}_{43}Y$ decays by emission of gamma radiation. If the half-life of the isotope is 6 hours, find the activity of 10mg of the isotope? (5 marks)
- e) State **two** industrial uses and **one** health hazard of radioactivity. (3 marks)

END