P510/1

Physics

Paper 1

July/August 2022

2½ hours

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**Community**

UNNASE MOCK EXAMINATIONS 2O22

*Uganda Advanced Certificate of Education*

PAPER 1

2HOURS 30 MINUTES

***INSTRUCTIONS TO CANDIDATES***

* *Answer* ***fiv****e 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 = 9.81ms-2*
* *Electron charge, e = 1.6 x 10-19*
* *Electron mass = 9.11 x 10-31kg*
* *Mass of the earth = 5.97 x 1024kg*
* *Plank’s constant, h = 6.6 x 10-34Js*
* *Stefan’s – Boltzmann’s constant, = 5.67 x 10-8Wm-2K-4*
* *Radius of the earth = 6.4 x 106m*
* *Radius of the sun = 7 x 108m*
* *Radius of the earth’s orbit about the sun = 1.5 x 1011m*
* *Speed of light in a vacuum, c = 3.0 x 108ms-1*
* *Thermal conductivity of copper = 390Wm-1K-1*
* *Thermal conductivity of aluminium = 210Wm-1K-1*
* *Specific heat capacity of water = 4,200Jkg-1K-1*
* *Universal gravitational constant, G = 6.67 x 10-11Nm-2Kg-1*
* *Avogadro’s number, NA = 6.02 x 1023mol-1*
* *Surface tension of water = 7.0 x 10-2Nm-1*
* *Density of water = 1000kgm-3*
* *Gas constant, R = 8.31Jmol-1K-1*
* *Charge to mass ratio, elm = 1.8 x 1011Ckg-1*
* *The constant = 9.0 x 109F-1m*
* *Farady constant, F = 9.65 x 104Cmol-1*

**SECTION A**

1(a)(i) State Archimedes’ principle. (*1mark*)

(ii) Describe an experiment to determine the relative density of an irregular solid which floats in water. (*3marks*)

(b) A solid weighs 237.5g in air and 12.5g when totally immersed in a fluid of density 900kgm-3. Calculate the density of the liquid in which the solid would float with one fifth of its volume exposed above the liquid surface. (*6marks*)

(c)(i) What is meant by viscosity? (*1mark*)

(ii) Explain the effect of temperature on the viscosity of a liquid. (*3marks)*

(d)(i) State the work-energy theorem. *(1mark*)

(ii) A bullet of mass 0.1kg moving horizontally with a speed of 420ms-1 strikes a block of mass 2.0kg at rest on a smooth table and becomes embedded in it. Find the kinetic energy lost if they move together. (*5marks*)

2a(i) Define centre of gravity. (*1mark)*

(ii) Describe an experiment to find the centre of gravity of a regular piece of cardboard.

(*3marks)*

(b) Explain using the molecular theory the laws of solid friction. (*7marks)*

(c)(i)Define surface tension. (*1mark)*

(ii) Explain the origin of surface tension. (*3marks)*

(d) Explain why rain drops hit the ground with less force than they should. (*5marks*)

3(a) State Newton’s laws of motion. (*3marks*)

(b) A body X of mass m1 moves with velocity U1 and collides held on elastically with another body Y of mass m2 which is at rest. If the velocities of x and y are V1 and V2 respectively and given that; A =

Show that;

(i) = (*4marks*)

(ii) = (*3marks*)

(c) Describe an experiment to determine the acceleration due to gravity using a spiral spring of known force constant. (*5marks*)

(d) Explain the following;

(i) A mass attached to a string rotating at a constant speed in horizontal circle fill fly off at a tangent if the string breaks. (*2marks*)

(ii) A cosmonaut in a satellite which is in a free circular orbit around the earth experiences sensation weightlessness even though there is influence of gravitational field on the earth. (*3marks*)

4a(i) What is meant by simple harmonic motion? (*1mark*)

(ii) State four characteristics of simple harmonic motion. (2marks)

(b) A mass, m is suspended from a rigid support by a string of length, x. The mass is pulled aside so that the string makes an angle, θ with a vertical and then released. Show that the mass executes simple harmonic motion with a period

T = 2. (5marks)

(c) A horizontal spring of force constant 300Nm-1 fixed at one end has a mass of 3kg attached to the free end and resting on a smooth horizontal surface. The mass is pulled through a distance of 5.0cm and released.

Calculate the;

(i) angular speed (2marks)

(ii) maximum velocity attained by the vibrating body. (2marks)

(iii) acceleration when the body is halfway towards the centre from its initial position.

(2marks)

(d)(i) What is meant by a couple in mechanics? (1mark)

(ii) State the conditions for equilibrium of a system of coplanar forces. (2marks)

(e) Explain why a person standing near a railway line is sucked towards the railway line when a fast moving train passes. (3marks)

**SECTION B**

5a(i) Define thermal conductivity. (1mark)

(ii) Explain the mechanism of heat transfer in metals. (3marks)

(b) A double glazed window has two glass sheets of thickness 5.0mm, separated by a layer of air of thickness 1.2mm. If the two inner air-glass surfaces have steady temperatures of 25oC and 5oC respectively, find the;

(i) temperature of the outer-glass surfaces. (3marks)

(ii) amount of heat that flows across an area of the window of 3m2 in 3hours.(3marks)

(conductivity of glass = 072Wm-1K-1 and that of air = 0.025Wm-1K-1)

(c)(i) What is a perfectly black body? (1mark)

(ii) The energy intensity received by a spherical planet from a star is 1.5 x 103Wm-2. The star is of radius 7.0 x 105km and is 1.4 x 108km from the planet.

Calculate the surface temperature of the star. (4marks)

(d) Explain the green house effect and how it is related to global warming. (5marks)

6(a) Define specific heat capacity of a substance. (1mark)

(b)(i) Describe an electrical method for the determination of the specific heat capacity of a metal. (6marks)

(ii) State the assumptions made in the above experiment. (2marks)

(c) Steam at 100oC is passed into a copper calorimeter of mass 150g containing 340g of water at 15oC. This is done until the temperature of the calorimeter and its contents is 71oC, if the mass of the calorimeter and its contents is found to be 525g, calculate the specific latent heat of vaporisation of water. (6marks)

(d)(i) State the assumptions made in the derivation of the expression P = for pressure of an ideal gas. (2marks)

(ii) Use the expression in (i) to deduce Dalton’s law of partial pressures. (3marks)

7(a) Define a thermometric property and give two examples. (2marks)

(b) The resistance, Re of platinum varies with the temperature θoC as measured by the constant-volume gas thermometer according to the equation:

Rθ = 50.0 + 0.17θ + 3.0 x 10-4θ2

(i) Calculate the temperature on the platinum scale corresponding to 60oC on the gas scale. (6marks)

(ii) Account for the difference between the two values and the temperature at which they agreed. (2marks)

(c) Use the kinetic theory of matter to explain the following observations;

(i) Saturated vapour pressure of a liquid increases with temperature. (3marks)

(ii) Saturated vapour pressure is not affected by a decrease in volume at constant temperature. (3marks)

(d) An ideal gas of volume 100cm3 at s.tp expands adiabatically until its pressure drops to a quarter its original value. Find the new volume and temperature if the ratio of the principal specific heat capacities is 1.4. (4marks)

**SECTION C**

8a(i) What is meant by the term radioactive decay, half life and decay constant? (3marks)

(ii) Show that the half-life t½ of a radio isotope is given by t½ =

Where is the decay constant. (Assume the decay law(3marks)

(b) With the aid of a diagram describe the structure and action of diffusion cloud chamber. (5marks)

(c) The radio isotope decays by emission of β – particles. The half life of the radio isotope is 28.8 years. Determine the activity of 1g of the isotope. (5marks)

(d)(i) What are cathode rays? (1mark)

(ii) An electron accelerated by a p.d of 1000V passes through a uniform electric field intensity crossed with a uniform magnetic field of flux density 0.3T. If the electron emerges undeflected, calculate the electric field intensity. (3marks)

9a(i) Define space charge as applied to thermionic diodes. (1mark)

(ii) Draw a node current - anode voltage curves of a thermionic diode for two different filament currents and explain their main features. (*6marks*)

(b) Derive an expression for the amplification factor μ in terms of anode resistance, Ra and mutual conductance, gm for a triode value. (*3marks*)

(c) A triode with mutual conductance 3 mAV–1 and anode resistance of 10KΩ is connected to a load resistance of 20KΩ. Calculate the amplitude of the output signal, if the amplitude of the input signal is 30mV. (*4marks)*

(d)(i) What is a photon? (*1mark*)

(ii) Explain using the quantum theory, the experimental observations on the photoelectric effect. (*5marks)*

10(a) A beam of - particles is directed normally to a thin metal foil. Explain why;

(i) most of the alpha particles past straight through the foil. (*2marks)*

(ii) few alpha particles are deflected through angles more than 90o. (*2marks)*

(b) Calculate the least distance of approach of a 4.0MeV alpha particle to the nucleus of a gold atom. (Atomic number of gold = 79). *(4marks)*

(c) Explain using suitable sketch graphs, how X-ray spectra in an X-ray tube are produced. *(6marks)*

(d) A beam of X-rays of wave length 9.0 x 10-11m is incident on a sodium chloride crystal of inter-planar separation 9.0 x 10-10m. Calculate the first order diffraction angle. (*3marks)*

(e)(i) Distinguish between nuclear fusion and nuclear fission. *(2marks*)

(ii) State the conditions necessary for each of the nuclear reaction in (e)(i) to occur.

*(1mark*)

**END**