**P510/1**

**PHYSICS**

**(Theory)**

**2 hours**

**UGANDA ADVANCED CERTIFICATE OF EDUCATION**

PHYSICS

(THEORY)

**Paper 1**

**2** Hours **30** minutes

**INSTRUCTIONS TO CANDIDATES:**

*Answer* ***five*** *questions taking* ***at least one,*** *but* ***not more than two*** *from* ***each*** *of the section* ***A, B and C.***

*Any* ***extra*** *number(s)**attempted* ***shall not be*** *marked****.***

*Start every new number on* ***a fresh*** *page****.***

*Where necessary assume;*

*Acceleration due to gravity, g = 9.81ms-2*

*Electron charge e = 1.6 x 10-19C*

*Electron mass = 9.11x10-31kg*

*Planck’s constant h = 6.6 x 10-34Js*

*Speed of light in vacuum c = 3.0 x 108 ms-1*

*Avogadro’s number NA = 6.02 x 1023 mol-1*

*One electron volt, eV = 1.6 x 10-19J*

*Avogadro’s number, NA = 6.02x1023 mol-1*

*Specific heat capacity of water = 4.2x103JKg-1K-1*

**SECTION A**

**1**. **(a)**(i) Define dimensions of physical quantities. (01 marks)

(ii) The total energy, **E** of the particle is related to its momentum, **P** and its rest mass, by the equation,  **= +**  , where, **C** is the speed of electromagnetic waves in vacuum, show that the equation is dimensionally correct. (04 marks)

**(b)**(i) Define the term resultant force. (01 mark)

(ii) A free mass of a **1.0kg** particle is acted upon by forces of **3N** at an angle **1800**, **4N** at an angle of **2700** and **7N** at an angle **370** to the vertical. Find the acceleration of the particle. (03 marks)

**(c)** (i) Define uniform deceleration. (01 mark)

(ii) Sketch a displacement against time graph for a body projected vertically upwards. (02 marks)

**(d)** A stone, **P** is dropped from the top of a tower, **44m** high. At the same time another stone, **Q** is thrown vertically up words from the foot of the tower with a velocity of **22ms-1**, find;

(i) The time the two stones take to cross each other. (05 marks)

(ii) The distance from the foot of the tower to where the two stones meet. (03 marks)

**2.** **(a**)(i) Define relative velocity . (01 mark)

(ii) A bomber, **A** is flying horizontally at a speed of **250ms-1** due east. A second bomber, **B** is also flying at a speed of **160ms-1** due **N400E**. Determine the velocity of the bomber, **B** relative to bomber, **A** assuming that they set off at the same time. (05 marks)

**(b)**(i) State the principle of conservation of linear momentum.

(01 mark)

(ii) Derive the relationship between impulse of a force and momentum. (03 marks)

**(c)** A body of mass **7500kg** moving horizontally at a speed of **5.0ms-1** collide with another body of mass **1500kg** moving in the direction **S600W** which is moving at a speed of **20ms-1**. If the two bodies stick together after collision, determine the magnitude and direction their common velocity after collision. (04 marks)

**(d)** (i) Describe a simple laboratory experiment to determine the speed of a bullet. (04 marks)

(ii) Explain how a person is able to walk continuously on the earth’s surface. (02 marks)

**3. (a)(i)** State the laws of solid friction . (01 mark)

(ii) Explain why frictional force is independent of the area of contact between two solid surfaces. (02 marks)

**(b)**(i) State and derive the work-energy theorem. (04 marks)

(ii) A wooden block of mass **990g** resting on a rough surface is attached to a spring of force constant **50Nm-1** which is fixed at one end. When a sharp nail of mass **10g** is shot at a close range into a block, the spring is compressed by **3.0cm**, if the work done against friction is **0.09J**. Find the speed of the nail just after collision with the block. (03 marks)

(iii) Sketch a graph showing variation of kinetic energy with time. (01 marks)

**(c)(**i) State the conditions for a body to be in static equilibrium. (02 marks)

(ii) A wheel of mass **15kg** and radius **100cm** is pulled by a horizontal force, **F** applied at its center against a step of height **0.4m**. Determine the size of force and the reaction force which the step offers to the wheel. (03 marks)

**(d)** Describe a simple experiment to determine the mass of a metre rule using the principle of moments and a standard mass. (04 marks)

**4. (a)** Define tensile stress and tensile strain ( 02 marks)

**(b)**(i) Derive the relationship between young’s modulus, **E,** force, **F**, cross-sectional area, **A** , length , **L** of the wire , extension, **e** and use it to obtain the dimensions of young’s modulus.

(05 marks)

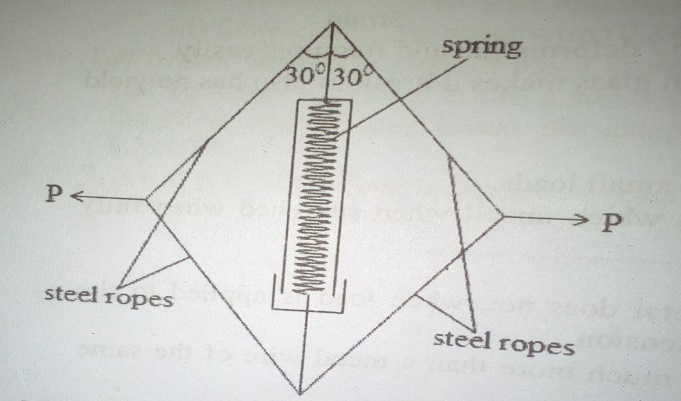
**(ii)** Describe the energy changes which take place during plastic deformation. (03 marks)

**(c)** (i) state four measurements taken when determining the young’s modulus of a material wire . (02 marks)

**Turn over**

(ii) Explain three precautions taken to ensure accurate values during the experimental determination of young’s modulus of a material wire. (03 marks)

**(d)** 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 uncompressed length of **0.80m**. When the ropes are pulled sideways in opposite directions with a force, **P** the spring compresses to a length **0.60m** and the rope makes an angle of **300** with the length of the spring as below.



Find the;

(i) Tension in each rope (03 marks)

(ii) Force, **P** (02 marks)

**SECTION B**

**5. (a)**(i) Define terms heat and thermometric property. (02 marks)

(ii) Give two desirable features of a good thermometric property. (02 mark)

**(b)**(i) State the conditions for an e.m.f to be generated between two junctions of a thermocouple. (01 mark)

(ii) A thermocouple has its cold junction at **00C**, its e.m.f is given by, **E = (20θ – 0.02θ2) µV**. find the temperature at which this thermometer can give a maximum **e.m.f** . (03 marks)

**(c)**(i) With the aid of a diagram describe briefly how the temperature of the furnace can be determined using a disappearing filament pyrometer. (06 marks)

(ii) Give two advantages of pyrometers. (02 marks)

**(d)** (i) explain three necessary corrections needed to eliminate errors when measuring temperature using a constant volume gas thermometer. (03 marks)

(ii) Give one reason why mercury is used in most of the glass thermometers. (01 mark)

**6.(a)** (i) Define specific heat capacity of a liquid. (01 mark)

(ii) Describe an experiment to determine the specific heat capacity of a liquid by electrical method. (05 mark)

(iii) Give one application of the concept of specific heat capacity. (01 mark)

**(b)**Two identical containers each of heat capacity **12JK-1** , one holds **8x10-5 m3** of water and takes **150 seconds** to cool from **325K** to **320K** and the second container holds an equal volume of unknown liquid which takes **50seconds** to cool over the same temperature range. If the density of that liquid is **800kgm-3**. What is the specific heat capacity of that liquid? (03 marks)

**(c)**(i) Define the term cooling correction. (01 mark)

(ii) When hot liquid in a container is placed in a room whose temperature is **250C,** it loses heat at a rate of **2.5**W and when the same sample of the liquid is placed in a room of temperature **400C**, the rate of heat loss doubles that at **250C**. What is the estimated temperature of the liquid? (03 marks)

**(d)** A certain solid of specific heat capacity **1800Jkg-1K-1**, was heated at a constant rate and its temperature rose from **200C** to **800C** in **200**seconds. At **800C** the solid melted for **200**seconds. Then the liquid formed was heated to a temperature of **1100C** in **100**second. Find;

(i) Specific latent heat of fusion of the solid. (03 marks)

(ii) The specific heat capacity of the liquid. (03 marks)

**7. (a)** Define the term temperature gradient and state its S.I units

(02 marks)

**(b)** (i) Describe the mechanism of heat conduction through a solid conductor . (05 marks)

(ii) Using graphs describe the rate of heat fall in both lagged and un-lagged conductor of the same length, whose ends are maintained at different temperatures. (04 marks)

**(c)** Water in an aluminum saucepan of diameter **16cm** and thickness **4cm** is kept boiling at **1000C** on a hot stove. The water boils off at a rate **2.28x10-4kgs-1**. Find the temperature of the underside of the saucepan, assuming it is uniformly heated and neglecting heat losses to the surrounding (thermal conductivity of aluminum = **2.06x102Wm-1K-1**, **Lv =** **2.26x106 Jkg-1**) (05 marks)

**(d)** (i) State three measurements taken when determining thermal conductivity of a good conductor using Searle’s method.

(03 marks)

(i) Give a reason why the above method is the accurate one. (01 mark)

**SECTION C**

**8. (a)** Define the terms nuclear binding energy and isotones. (02 marks)

**(b)** Iron, , breaks into its constituent nucleons , given that ;

Mass of  **= 1.008665U,** mass of  **= 1.007277U,** mass of,

**= 0.00054858U,** mass of  **= 55.9349U, 1U = 931MeV,** calculate;

1. Mass defect (02 marks)
2. Binding energy (02 marks)
3. Binding energy per nucleon. (02 marks)

**(c)** (i) Explain why the mass of nucleus is always less than the mass of its constituent nucleons (02 marks)

(ii)Describe briefly how energy is generated during nuclear fission in a nuclear reactor. (04 marks)

**(d)** The nucleus of **,** decays to **206** by emission of an alpha particle. Given that mass of,  **= 210.049U,** mass of alpha **= 4.0034U**, mass of, **206 = 206.034U.** Find the speed of the alpha particle emitted**,** given that **1U = 1.66x10-27Kg**. (06 marks)

**9**. (**a**)(i) Define half-life and a Becquerel (02 marks)

(ii) Using a radioactive decay equation, **N =**  derive the relationship between half-life and decay constant. (03 marks)

**(b)**(i) Describe how a **G.M** tube is used to detect the presence of ionizing radiations. (05 marks)

(ii)Briefly describe how the volume of blood in patients can be estimated using radioactivity. (03 marks)

**(c)** A G.M tube which is placed, **10cm** from a **1.0g** source of Random,  gives a count rate of **75** counts per second. If the receiving area of the mica window is **5cm2**, find;

(i) The number of random atoms from the source disintegrating per second. (02 marks)

(ii) The half-life of random. (03 marks)

**(d)** Define the term dead time. (01 marks)

**10.** (a) Differentiate between cathode rays and positive rays

(02 marks)

**(b)** (i) State and justify two properties of cathode rays . (04 marks)

(ii) Describe the motion of electrons in an electric field and magnetic field. (04 marks)

**(c)** A beam of electrons is accelerated through a potential difference of **2000V** and is directed midway between two horizontal plates of length **5.0cm** and a separation of **2.0cm**, the potential difference across the plates is **80V**.

1. Calculate the speed of the electrons as they enter the region between the plates. (03 marks)
2. Find the speed of the electrons as they emerge from the region between the plates. (05 marks)

**(d)** Briefly describe the process of thermionic emission (02 marks)

**END**