TRINITY COLLEGE NABBINGO

BEGINNING OF TERM I EXAMINATIONS

S.6 PHYSICS (P510/1)

TIME: 2 HOURS 10 MINUTES

INSTRUCTIONS

- *Attempt **any four** questions including at least one from each of the sections A, B and C.*
- *Where necessary assume*
  - *Acceleration due to gravity, g* $= 9.81ms^{-2}$
  - *Planck's constant, h* $= 6.6 \times 10^{-34} Js$
  - *Electron charge, e* $= 1.6 \times 10^{-19} C$
  - *Specific heat capacity of water* $= 4200JKg^{-1}K^{-1}$.
  - *1 Uniefied mass 1U* $= 931MeV$

SECTION A

1. (a) (i) Distinguish between *scalar* and *vector quantities*. *(2 marks)*

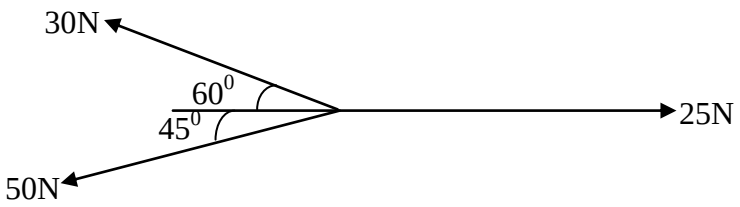
   (ii) State ***two*** examples of each. *(2 marks)*

   (b) (i)What are *dimensions of torque*? *(2 marks)*

   (ii) Using dimensional analysis, show that the formular for gravitational potential energy, $P.E = Mgh$ is correct where m is mass, g is acceleration due to gravity and h is height above the ground. *(4 marks)*

   (c) Find the indices *x, y* and *z* in the formula below using dimensional analysis and write down the formula $T = Km^x l^y g^z$ where *T* is period of oscillation, *M* is mass pendulum bob, *l* is length of string and g is the acceleration due to gravity and *K* is a dimensionless constant. *(4 marks)*

   (d) Find the resultant of the system of forces below. *(6 marks)*



2. (a) Define the following terms *(3 marks)*
   (i) Uniform acceleration
   (ii) Time of flight
   (iii) Velocity of projection

   (b) Using graphical method, derive the expression for the second equation for a body moving in a straight line. *(4 marks)*

   (c) A car moving with a velocity of 54kmhr^{-1} accelerates at a rate of 2ms^{-2}. Calculate;
   (i) the distance travelled from the place where acceleration began to that when the velocity reaches 72km/hr. *(3 marks)*
   (ii) the time taken. *(3 marks)*

   (d) A projectile is projected at an angle of 60^0 above the horizontal. It strikes a pole 3m away at a point 2m above the point of projection. Calculate;
   (i) the speed of projection. *(4 marks)*
   (ii) the velocity of the projectile when it strikes the pole. *(3 marks)*

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

   (b) Define the following;
   (i) Momentum *(1 mark)*
   (ii) The Newton *(1 mark)*
   (iii) Acceleration due to gravity. *(2 marks)*

   (c) Water leaves a horse pipe at a rate of 10kgs^{-1} with a nozzle speed of 20ms^{-1}. If it is directed horizontally to a wall which stops it, calculate the force exerted by the water on the wall. *(3 marks)*

   (d) A truck of mass 300kg is pulling a trailer of mass 900kg. the frictional force between the truck and the road is 300N and is 600N
   for the trailer. If a force of 2,400N is exerted by the truck, calculate;
   (i) the acceleration of the truck and the trailer. *(4 marks)*
   (ii) the tension in the tow-bar connecting the two. *(2 marks)*

   (e) Explain why the reading on a spring balance on the ceiling of a lift varies when the lift is ascending and when it is descending. *(4 marks)*

SECTION B

4. (a) (i) Define the term thermometric property and give four examples of a thermometric property. *(3 marks)*
   (ii) What are the qualities of a good thermometric property? *(3 marks)*

   (b) (i) Describe how the temperature of a just welded point can be measured. *(4 marks)*
   (ii) State two advantages and disadvantages of the thermometer in (b) (i) above. *(4 marks)*

(c) (i) Using the electrical thermometer, define the Celsius scale of temperature. *(3 marks)*

(ii) A Copper – constatitine thermometer couple with its cold junction at O^0C had emf of 4.28mV with its hot junction at 100^0C. The emf becomes 9.29mV when the temperature difference was 200^0C.
If the emf, E is related to the temperature difference, θ by the equation $E = A\theta + B\theta^2$, calculate the values of A and B. *(5 marks)*

5. (a) (i) Define *latent heat* and state its S.I unit. *(2 marks)*

(ii) Explain why latent heat of vaporization is greater that latent heat of fusion for the same substance. *(3 marks)*

(b) (i) Draw a circuit diagram that can be used to determine the specific latent heat of vaporization of water. *(3 marks)*

(ii) State ***three*** ways how the apparatus above minimizes lose. *(3marks)*

(c) A heating coil is placed in a filter funnel and is surrounded by lumps of ice. The p.d(V) across the heater and the mass, m of water collected in 500 seconds were measured for various values of heater current, I the readings obtained were;

V(V)	4.0	6.0	7.0	8.0
I (A)	2.0	3.0	3.5	4.0
m(g)	14.9	29.8	39.5	50.6

(i) BY plotting a suitable graph, determine the specific latent heat of fusion of ice. *(5 marks)*

(ii) How much of the power supplied is not used in melting the ice. *(1 marks)*

(d) A calorimeter with heat capacity of 80 JK^{-1} contains 50g of water at 40^0C.What mass of ice at O^0C needs to be added in order to reduce the temperature to 10^0C. (For specific latent heat of fusion, use the value obtained in (c) (i) above. *(3 marks)*

6. (a) (i) State the four assumption of kinetic theory of gases. *(4 marks)*

(ii) Derive the expression $p = \frac{1}{3}\ell\ \frac{1}{C^2}$ for the pressure of an ideal gas where ℓ is density of the gas and $\overline{C^2}$ is mean square speed. *(6 marks)*

(b) (i) Define the following terms, *mean square speed* and *root mean square speed.* *(2 marks)*

(ii) A certain gas exerts a pressure of 1.27×10^5Pa. If its density is $1.79 kgm^{-3}$. Calculate its root mean square speed. *(3 marks)*

(c) (i) State Boyle's law. (1 mark)

(ii) Using the expression for pressure of an ideal gas in (a) (i) above derive the law in (c) (i) above. *(4 marks)*

SECTION C

7. (a) Describe briefly the Bohr model for the hydrogen atom and state the assumptions that Bohr made. *(5 marks)*

(b) The total energy, E, of an electron in an atom may be expressed as;

$$E = \frac{-mq4}{8\varepsilon_0{}^2 n^2 h^2}.$$

(i) Identify the quantities m, q, n and h in the expression. *(4 marks)*

(ii) Explain the physical implication of the fact that E is always negative. *(2 marks)*

(iii) Draw energy level diagram for hydrogen to indicate emission of ultra violet, visible and infra red spectral series. *(3 marks)*

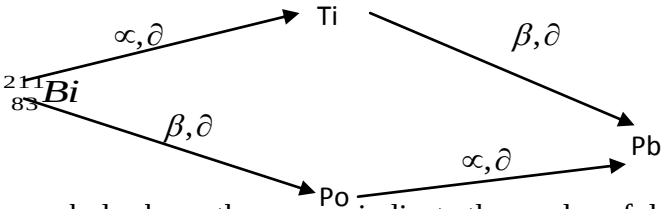
(c) What is meant by

(i) Absorption line spectrum. *(3 marks)*

(ii) Emission line spectrum. *(3 marks)*

8. (a) (i) What is radioactivity. *(1 mark)*

(ii) Part of the radioactive series can be represented as below.



The symbols above the arrows indicate the modes of decay. Write down the atomic numbers and mass numbers of Ti, Po and Pb. *(3 marks)*

(b) Describe with the aid of a labeled diagram the structure and mode of operation of Geiger Miller tube *(5 marks)*

(c) (i) Sketch the GM tube characteristic curve and explain its features. *(4 marks)*

(ii) Which is the suitable operating region? *(1 marks)*

(d) An isotope of Krypton, $^{87}_{36}Kr$ has half life of 78 minutes. Calculate;

(i) the activity of 10 μg of the isotope. *(3 marks)*

(ii) after how long the activity would be less than 1? *(3 marks)*

9. (a) (i) What is binding energy of a nucleus. *(1 mark)*

(ii) Calculate the energy in Mel released by fusing two protons and two neutrons to form a helium nucleus.

The atomic man of hydrogen	=	1.007 825U
The atomic mass of helium	=	4.002 604U
The atomic mass of neutron	=	1.008 665U

(b) Consider the following nuclear reaction

$$^{235}_{92}U + ^{1}_{0}n \rightarrow ^{92}_{x}B + ^{y}_{56}C + 3^{1}_{0}n$$

(i) Determine the values of *x* and *y*. *(2 marks)*

(ii) Name the nuclear reaction. *(1 mark)*

(iii) What is the importance of this reaction? *(1 mark)*

(iv) Calculate the energy released in the reaction.

The atomic masses are;

$^{235}U = 235.0439U$

$^{92}B = 91.8776U$

$^{y}C = 140.9136U$

$Neutron = 1.0087U$

(c) Explain briefly how the intensity and penetrating power of x-rays from an x-ray tube can be controlled. *(4 marks)*

(d) Explain how line spectrum in an x-ray tube can be produced. *(3 marks)*

END

Happy New Year 2013