KENYA METHODIST UNIVERSITY
END OF FIRST TRIMESTER 2007 EXAMINATIONS

FACULTY : SCIENCES
DEPARTMENT : MATHEMATICS AND COMPUTER SCIENCE
COURSE CODE : PHYS 100
COURSE TITLE : PHYSICS 1
TIME : 3 HRS

Instructions:

- Answer any three questions
- You may use the following information where applicable.

i) Acceleration due to gravity g = $9.80_20\text{Ms}^{-2}_{-2}$
ii) Gravitational constant G = 6.67 x 10^{-11}NM Kg
iii) Speed of light in vacuum C = 3.0 x 10^8 MS^{-1}
iv) Avogardo's Number NA = 6.022 x 10^{23} molecules Mol^{-1}
v) Universal gas constant R = 8.314 J $Mol^{-1}K$
vi) 1 calorie = 4.186 Joules
vii) Beflzmann's constant K = R/NA = 1.38 X 10 -^{23} JK^{-1}
viii) Water density δ = 1 x 10^3 Kg M^{-3}

Question 1

a) i) Differentiate between a vector quantity and a scalar quantity giving two examples of each. (2 mks)

ii) By adding two vectors $\vec{a}$ and $\vec{b}$ and using diagrams show that the two vectors commutise

$$\vec{a} + \vec{b} = \vec{b} + \vec{a}$$ (3 mks)

b) i) What is projectile motion? (1 mk)

ii) Derive the equations of motion for maximum height and time of flight for a projectile motion.
Maximum height…….

Time of flight ……..

iii) The equation of path of a projectile (trajectory is given as

$$Y = x \tan\theta - \frac{gx^2}{2V_0^2 \cos\theta}$$

A plane is flying at a constant elevation of 1200 m with a speed of 430 Kmh^{-1} towards a point directly over a person struggling in water. AT what angle of flight Q should the pilot release a rescue capsule if it is to strike (very close) to the persons in the water? (A diagram will be important) (4 mks)

c) i) Give a condition whereby work is done. (1 mk)

ii) How much work is done by lifting a weight of 2500J through a distance of 2.0M (Assume weight is lifted at constant sped). (2 mks)

iii) Show that the work done by a spring is given as (5 mks)

$$W = \tfrac{1}{2}K X_i^2 - \tfrac{1}{2}KX_f^2$$

Question 2

a) i) State the three laws of linear momentum. (6 mks)

ii) Show that F = KMa (5 mks)

b) i) Show that the period of a simple pendulum which exhibits simple harmonic motion is given as: $T = 2\Pi\sqrt{\frac{l}{q}}$ (7 mks)

ii) Calculate the period of oscillation of a simple pendulum with a length of 50 cm. (5 mks)

Question 3

a) i) Differentiate between hydrostatics and hydrodynamics. (2 mks)

ii) Give the two assumptions made in fluids in motion (hydrodynamics) (2 mks)

iii) Differentiate between streamline flow and turbulent flow. (3 mks)

iv) Derive the equation of continuity V = Av (4 mks)
where V = Volume of fluid
A = crossectional area of pipe
v = Velocity of fluid

v) A water hose 2cm in diameter is used to fill a 20 litre bucket. If it takes 1 min to fill the bucket, what is the speed u at which the water leaves the hose? (Note that 1 litre = 10^3 cm^3) (3 mks)

vi) Derive the Bernoulli's equation. (7 mks)

vii) State any two applications of Bernoulli's equation. (2 mks)

Question 4

a) Outline the four assumptions of the molecular model of an ideal gas. (4 mks)

b) A cylinder contains 3 moles of Helium gas at Q temperature of 300K.

i) How much heat must be transferred to the gas to increase its temperature to 500 K if the gas is heated at constant volume? (3 mks)

ii) Show that the work done in an isothermal expansion of an ideal gas is given by

$W = nRT \quad \text{in}\left(\frac{v_f}{r_i}\right)$ (2 mks)

iii) Calculate the work done by 1 mole of an ideal gas that is kept at 0^0C in an expansion from 3 litres to 10 litres. (3 mks)

Question 5

a) i) State and explain the three Keplers empirical laws applied to the solar systems. (6 mks)

ii) Calculate the mass of the sun using the fact that that the period of the earth is 3.156×10^7 S and the distance from the sun is 1.496×10^1M. (5 mks)

b) i) Differentiate between heat capacity and specific heat capacity and give the SI units of each one of them. (6 mks)

ii) A 5Og chunk of metal is heated to 200^0C and then dropped into a beaker containing 400g of water initially at 20^oC. If final equilibrium temperature of the mixed system is 22.4^oC, find the specific heat capacity of the metal. (6 mks)