UNIVERSITY OF KABIANGA

UNIVERSITY EXAMINATIONS
2015/2016 ACADEMIC YEAR

FIRST **YEAR** **FIRSTSEMESTER** ***MAIN EXAMINATION***
FOR THE DEGREE OF BACHELOR OF SCIENCE AND BACHELOR OF EDUCATION SCIENCE

COURSE CODE: PHY 110

COURSE TITLE: BASIC PHYSICS I

DATE: **TIME:3HRS**

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INSTRUCTIONS TO CANDIDATES

Answer **QUESTION ONE** and **ANY OTHER THREE** questions.

Question 1 carries **24** marks and the others carry **12** marks each.

YOUMAYUSE:
You mayneed to use thefollowingconstants

- Densityofwater= 1.0 x 10^3kg/m^3
- Acceleration due to gravityg=9.8 m/s^2
- Universalgravitationalconstant G=6.67 x10^{-11}Nm^{2}kg^{-2}
- Mean radius ofthe earth Re=6400 km
- Mass of the Earth, Me, = 5.98 x 10^{24} kg

QUESTION ONE(24marks)

a) (i) Differentiate between a vector and a scalar. Give an example of each **(2mks)**

(ii)If **A** + **B** + **C** = **0** and **A** = 2**i** + 3**j** + 4**k** and B = 5i+6j+7**k** then what is **C** and |**C**|. What is the angle between **C** and the x- axis. **(3mks)**

b) What physical designs dictate the difference in speeds between a fighter-jet and a helicopter? **(2mks)**

c) Describe how adriver can steer acar traveling at constant speed so that

(i) Theacceleration is zero or
(ii)Themagnitude of the acceleration remains constant. **(2mk)**

d) A ball is thrown in such away that its initial vertical and horizontal components of velocity are

40m/sand 20m/s,respectively. Estimate the total time of flight and the distance the ball is from its starting point when it lands. **(3mk)**

e) A particle is moving with a uniform speed on a circular path, state with reason whether it has acceleration or not. **(1mk)**

f) A steel tape measure is marked such that it gives accurate length measurements at room temperature. If the tape measure is used outside on a very hot day, how will its length measurements be affected?
(1mk)

g) The equation of motion of a transverse wave in a string is given by, $y = 6.0Sin(4.0\pi t + 0.02\pi x)$, where y is in cm and t in sec. Find the amplitude, frequency, Period, Velocity of the wave. **(3mks)**

h) i) What is escape velocity?

ii) Determine the escape velocity for a body on the moon given the radius, R of the moon is $1.74 \times 10^6\, m$ and the mass of the moon is $7.36 \times 10^{22}\, kg$. **(4mks)**

i) State Hooke's law.A string is stretched by 0.2m when a mass of 0.5kg is suspended. Calculate the period of the spring when a mass of 0.25kg is suspended and put to oscillation.
(3mks)

QUESTION TWO(12marks)

(a) (i) State Newton's law of Universal Gravitation **(1mk)**

(ii)Show that at a height, h above the earth's surface, the acceleration due to gravity g_h is related to the acceleration due to gravity at the earth's surface, g by the equation,

$$g_h = \frac{g}{\left(1 + \frac{h}{R_e}\right)^2}$$

Where R_e is the radius of the earth **(3mks)**

(iii)What is the value of acceleration due to gravity at an altitude of 500km? Radius of the earth is 6400km **(1½mks)**

(b) (i) Show that the horizontal range (R) of a projectile is given by,

$$R = \frac{u_0^2 \sin 2\theta}{g},$$

where the symbol have their usual meaning. **(3½mks)**

(ii) If the angle of projection is 45° and the range is 10km, calculate the initial speed and the time of flight of the projectile. **(3mks)**

QUESTION THREE(12marks)

(a) A stone of mass 0.4kg is tied to a string of length 0.5m and whirled in a circle. If the stone revolves uniformly and makes one complete revolution per second, calculate its acceleration and the force exerted on the stone by the string. **(2mks)**

(b) Civil engineers generally bankcurves on roads in such a manner thata car going around the curve at the recommended speed does not have to relyon friction between its tyres and the road surface in order to round the curve.Suppose that the radius of curvature of a given curve is r = 60 m, and thatthe recommended speed is $v = 60$km/hr. At what angle θ should the curve bebanked? **(2mks)**

(c) (i) What is meant by ***simple harmonic motion*** **(1mk)**

(ii) Prove that the total energy of a body executing simple harmonic motion remains constant. **(2mks)**

(d) (i) Define the terms ***stress*** and ***strain***, giving their SI units **(2mks)**

(ii) A 4.0 m long copper wire of cross-sectional area 1.2cm^2 is stretched by a force of 4.8×10^3 N. If Young modulus is $Y = 1.2\times10^{11}\text{N/m}^2$, calculate the stress, strain and increase in length of the wire. **(3mks)**

QUESTION FOUR(12marks)

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

b) Derive the three equations of linear motion **(3mk)**

c) State Bernoulli's theorem and the law of continuity **(2mk)**

d) Distinguish between longitudinal and transverse waves **(2mk)**

e) State the laws of friction **(2mk)**

QUESTION FIVE(12marks)

(a) (i) Define Surface tension and give its units

(ii) The surface tension of soap solution is 2.0×10^{-2} N/m. How much work will be done in making a bubble of diameter 2.0 cm by blowing? **(3mks)**

(b) Distinguish between ***streamlined*** and ***turbulent flow*** **(2mks)**

(c) State the *equation of continuity* for fluid flow. A horizontal pipe of radius 10mm is joined to a horizontal pipe with radius 15 mm with both pipes at the same height. A fluid flows through both pipes from the narrow pipe to the wider pipe with an average velocity of 3 mm/s in the narrow pipe. Assume that the fluid has zero viscosity.

(i) What is the volume flow rate?

(ii) What is the average pressure difference between the two pipes? **(4mks)**

(d) A small steel sphere of radius, r and density, ρ is dropped on a viscous fluid of density, σ and coefficient of viscosity, η. After some time, it attains terminal velocity, v. Show that this terminal velocity of the steel sphere falling under gravity through the fluid is given by,

$$v = \frac{2r^2 g(\rho-\sigma)}{9\eta}$$ **(3mks)**

QUESTION SIX(12marks)

(a) State Zeroth law of thermodynamics **(2mks)**

(b) What is the rate of heat transfer in a circular slab of a material of radius 7cm and thickness 3mm if the temperature of the inner and outer sides is 58^0C and 36^0C respectively (coefficient of thermal conductivity of the material is 4.0×10^{-4}J/mKs) **(4mks)**

(c) A stretched string has linear density of 525g/m and is under a tension of 45 N. A sinusoidal wave with frequency 120 Hz and amplitude 8.5 mm is sent along the string from one end. Calculate the power of the wave. **(3mks)**

(d) An aluminium stick of length 1.5 m is cooled from 20^0 C to -180^0 C. Find the final length if its coefficient of linear expansion is 23×10^{-6}/K? **(3mks)**