(Knowledge for Development)

KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS - 2016/2017 ACADEMIC YEAR

FIRST YEAR FIRST SEMESTER
SPECIAL/SUPPLEMENTARY EXAMINATIONS

FOR THE DEGREE OF B.ED (SCIENCE), BSC (COMP. SCIENCE), BSC (IT), BSC (PHYSICS), BSC (CHEMISTRY) & BSC (RENEWABLE ENERGY).

COURSE CODE: SPH 110

COURSE TITLE: FUNDAMENTALS OF PHYSICS I.

EXAM DURATION: 2 HOURS

DATE: 14TH SEPTEMBER 2017 TIME: 8 – 10 AM

INSTRUCTIONS TO CANDIDATES

- Answer question one and any other two questions two (2) questions. Question one is compulsory and carries 30 marks, the other questions carry 20 marks each.

KIBU observes ZERO tolerance to examination cheating.

- The following physical quantities may be useful.
  - *Acceleration due to gravity,* $g = 9.8m/s^2$
  - *Stefan- Boltzmann constant,* $\sigma = 5.67\text{x}10^{-8} W/m^2K^4$
  - *Linear expansivity of steel,* $\alpha = 1.1\text{x}10^{-5}/°C$
  - *Speed of sound in air = 340m/s*
  - *Thermal conductivity of brick = 0.13W/m°C*
  - $I_o = 1\ \text{x}10^{12} W/m^2$
  - *Specific heat capacity of water =* $4.2KJkg^{-1}K^{-1}$
  - *Universal gravitational constant,* $G = 6.67\text{x}10^{-11} Nm^2Kg^{-2}$
  - *Young's modulus of steel,* $\gamma = 2.0\ X\ 10^{11} N/m^2$

Question ONE (30 marks)

a) (i) Differentiate between scalar and vector quantities. (1 mark)

(ii) Given that $\boldsymbol{A} = 3\boldsymbol{i} + 4\boldsymbol{j} + \boldsymbol{k}$ and $\boldsymbol{B} = \boldsymbol{i} - \boldsymbol{j} + \boldsymbol{k}$, find $\boldsymbol{A}\ \boldsymbol{XB}$ and **A. B.** (3 marks)

b) A stone is whirled in a horizontal circle of radius 1.5m, 2m above the ground. The string breaks and the stone strikes the ground 10m away. Finds the centripetal acceleration of the stone. (3 marks)

c) A projectile is fired at an angle of 45^0 to the horizontal with an initial velocity of 500m/s. find:

(i) The time of flight of the projectile (2 mark)

(ii) Its range (2 marks)

e) How high above the surface of the earth does a satellite need to be so that it has an orbit period of 24hours? (3 marks)

f) A wave is described by $y = A\ Sin(kx - \omega t)$, where A = 4 cm, k =2.65 rad/m and ω=4.78 rad/s where x is in metres and t in seconds.Determine the amplitude, wavelength, frequency and speed of the wave. (4 marks)

g) A man's heart pumps blood at the rate of $1.8\ X\ 10^3\ cm^3/min$ through his aorta of cross-sectional area $0.6cm^2$. What is the average blood velocity in the aorta?(2 marks)

h) Derive the formula of area thermal expansion from linear expansion. (4 marks)

i) The temperature of a body is estimated to be 50°F. Convert this temperature to Degrees Celsius and Kelvins. (2 marks).

l) A force F, applied on a body of mass m_1 produces an acceleration of $3m/s^2$. The same force applied on another body of mass m_2 produces an acceleration of $1m/s^2$. If m_1 and m_2 are combined find their acceleration under action of F. (2 marks)

m) Differentiate between infrasonic and ultrasonic sound. (2 marks)

Question TWO (20 marks)

a) (i) Define friction. (1mark)
(ii) Distinguish between static and kinetic friction. (2 marks)

b) Find the acceleration a and tensionT for two masses hanging freely on a frictionless pulley joined by a common massless and inextensible cord in an Atwood machine.Let m_1= 10kg and m_2 = 5kg. (4 marks)

c) (i) Define the terms viscosity and suface tension(2 marks)
(ii) A ring of wire of circumference 0.32m requires an upward force of 0.035N just to break loose from a liquid surface, what is the surface tension of the liquid?(2 marks)
(iii) Consider a sphere of radius r, density ρ falling through a medium of density σ and coefficient of viscosity η. When it attains the terminal velocity v_t, its subjected to three forces. Name the three forces and show that $v_t = \frac{{}^2/_9(\rho-\sigma)r^2g}{\eta}$ (5 marks)

d) (i) Differentiate between tensile stress and tensile strain. (2 marks).
(ii) A uniform steel wire of length 400cm and cross-sectional area of $3.0\ x\ 10^{-6}m^2$is extended by$1.0x\ 10^{-3}m$. Calculate the energy stored in the wire if the elastic limit is not exceeded (2 marks).

Question THREE (20 marks)

a) Define the term *simple harmonic motion.* (1 mark).

b) Show that for an oscillating pendulum of mass m and length l the periodic time is given by $T = 2\pi\sqrt{\frac{l}{g}}$. (5 marks).

c) A plane on a runway accelerates from rest and must attain takeoff speed of 148m/s before reaching the end of the runway. The plane acceleration is uniform along the runway and of value 914cm/s. calculate:-
(i) The minimum length of the runway required by the plane to takeoff. (3 marks)
(ii) The time taken by the plane to cover the length. (3 marks)

d) A 4.00 kg gun with a 80cm long barrel fires a 50g bullet with a velocity of 400m/s. Find;-
(i) Recoil velocity of the gun (1 mark)
ii) Impulse on the bullet (1 mark)
iii) Time the bullet accelerated (1 mark)
iv) Average acceleration of the bullet (1 mark)
v) Force applied on the gun by the bullet (1 mark)

e) A helical spring gives a displacement of 10cm for a load of 500N. Find the maximum displacement when a mass of 100g is dropped from a height of 20cm on to a light pan attached to the spring. (3 marks)

Question FOUR (20 marks)

a) State *Zeroth law*of thermodynamics anddefine the terms: Specific heat capacity, specific latent heat of fusion and specific latent heat of vaporization. (4 marks)

b) State the factors which determine the rate of heat flow though a body (4 marks)

c) A bucket containing 11.5kg of cold water at 10°C is taken into a room at a warmer temperature and left until it has reached thermal equilibrium with its new surroundings. If 504KJ of energy is absorbed from its surroundings. What is the temperature of the room? (3 mks)

e) The length of the column of a mercury thermometer is 4.0 cm when the thermometer is immersed in ice water and 24.0 cm when the thermometer is immersed in boiling water. The mercury column is 25.4 cm long when the thermometer is placed in a boiling chemical. What is the boiling point of the chemical? (4 marks).

f) Calculate the quantity of heat conducted through 2 m^2 of a brick wall 12 cm thick in one hour if the temperature on one side is 8°C and on the other side is 28°C.(3 marks).

g) A man of body surface area 2.0m^2radiates 97% of heat energy when temperature changes by 12°C . At what rate is thermal energy radiated away from him? (2 marks)

Question FIVE (20 marks)

a) Define the terms Doppler Effect, beats and intensity of sound. (3 marks)

b) Give two applications of Doppler Effect. (2 marks)

c) A normal speech gives a sound intensity level of about 65 Decibels at 1 m. estimate the power in human speech assume sound travels in a hemispherical area. (4 marks).

A wave whose wavelength is 0.30m is travelling down a 300m long wire of total mass 15kg. If the tension in the wire is 1000N, what is the speed and frequency of the wave? (3 marks)

e) A Kundt's tube is filled with air and some fine powder, the air is set into vibration by a diaphragm of frequency 1100Hz at one end. The small mounds of powder are 15cm apart. What is the velocity of sound in air? (3 marks).

f) A horn of stationary car has a frequency of 400 Hz what frequency is observed by an observer moving towards the car at 30 m/s? (3 marks)

g) The lowest frequencies emitted by an organ pipe are 75.0, 225 and 375Hz. Is the pipe open or closed? (2 marks)