(Knowledge for Development)

KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS - 2017/2018 ACADEMIC YEAR

FIRST YEAR FIRST SEMESTER
MAIN EXAMINATIONS

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

COURSE CODE: SPH 110

COURSE TITLE: FUNDAMENTALS OF PHYSICS I.

EXAM DURATION: 2 HOURS

DATE: 12th January 2018 TIME: 2- 5PM

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 $\boldsymbol{A} = 6\boldsymbol{i} + 4\boldsymbol{j} + 3\boldsymbol{k}$ and $\boldsymbol{B} = 2\boldsymbol{i} - 3\boldsymbol{j} - 3\boldsymbol{k}$, find the angle between $\boldsymbol{A}$ and $\boldsymbol{B}$ (3 marks)

b) A body of mass $2.0kg$ undergoes acceleration of $(3\boldsymbol{i}+4\boldsymbol{j})m/s^2$. Find the magnitude of its acceleration and hence determine the force acting on the body. (3 marks)

c) 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. (5 marks)

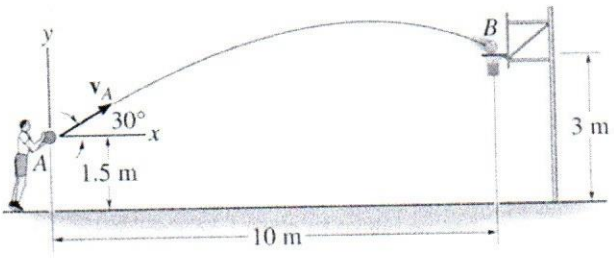
d) Derive the formula of area thermal expansion from linear expansion. (5 marks)

e) 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. (3marks)

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

g) Sketch a graph of universal gravitational constant, g, verses radius r, covering the surface, the altitude and the depth (4 marks)

h) Determine the speed at which the basketball at A must be thrown at the angle of 30^o so that it makes it to the basket at B. (4 marks)



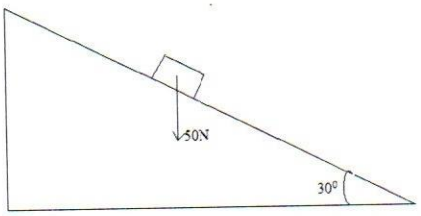
Question TWO (20 marks)

a) (i) Define friction. (1mark)

(ii) Distinguish between static and kinetic friction. (2 marks)

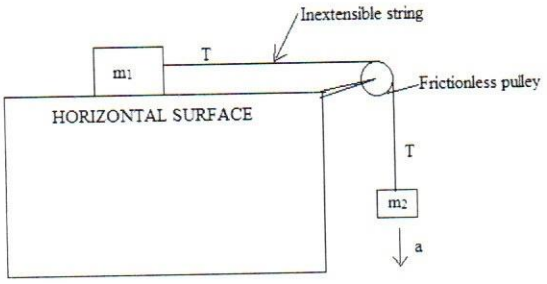
b) The figure below shows a body of weight 50N placed on a surface which is inclined at an

angle of 30^0 to the horizontal. The body experiences a maximum frictional force of 29N with the surface.



Determine the force required to move the body, up the inclined with constant velocity. (3 marks)

c) A block of mass m_1= 4kg on a rough horizontal table is driven by another block of mass m_2=1.2kg connected by a thread passing over a frictionless pulley as shown. Taking the frictional force between m_1 and the table as 1.8 N, find:



(i) Acceleration a and coefficient of friction μ.. (4 marks)

(ii) The velocity of the system when the system is released from rest and both masses move through a distance of 0.30m. (2 marks).

d) (i) Define suface tension and give its SI unit. (2 marks)

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

(iii) Consider a sphere of radius r, density ρ falling through a medium of densityσ 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)

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 158m/s before reaching the end of the runway. The plane acceleration is uniform along the runway and of value 932cm/s^2. 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 ball is thrown horizontally from the top of a vertical tower and strikes the ground at point 100m from the bottom of the tower. Given that the height of the tower is 45m, determine the:

i) Time taken by the ball to hit the ground. (2 marks)

ii) The initial horizontal velocity of the ball. (2 marks)

iii) Vertical velocity of the ball just before striking the ground. (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) Define 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 through 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 marks)

e) The length of the column of a mercury thermometer is 5.0 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 26.2 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 32°C. (3 marks).

g) A man of body surface area 2.0m^{2}radiates 96% 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).

d) A closed pipe has a length of 30cm. If the speed of sound in air is $330ms^{-1}$ and the end correction is 1cm, calculate:

(i) the fundamental frequency. (2 marks)

(ii) the wavelength of the second overtone. (2 marks)

(iii) the next two frequencies after the fundamental frequency. (3 marks)

d) The density of a gas is $6Kgm^{-3}$ at s.t.p. What is the speed of sound in the gas at 50^0C? Assume that the speed of sound in air is $331m^{-1}$ and Bulk Modulus for ideal gases is the same (density of air=$1.29Kgm^{-3}$). (4 marks)