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OFFICE OF THE DEPUTY PRINCIPAL
ACADEMICS, STUDENT AFFAIRS AND RESEARCH

UNIVERSITY EXAMINATIONS

2018 /2019 ACADEMIC YEAR

FIRST YEAR FIRST SEMESTER REGULAREXAMINATION

FOR THE DEGREE OF BACHELOR OF EDUCATION SCIENCE

COURSE CODE: PHY 112/ PHY 110

COURSE TITLE: MECHANICS/ BASIC PHYSICS I

DATE: 21ST DECEMBER, 2018 **TIME: 9.00 AM – 12.00 NOON**

INSTRUCTION TO CANDIDATES

- SEE INSIDE

THIS PAPER CONSISTS OF 5 PRINTED PAGES PLEASE TURN OVER

REGULAR – MAIN EXAM

INSTRUCTIONS TO CANDIDATES

i. *Answer Question **ONE** and any other **TWO** questions.*

ii. *Maps and diagrams should be used whenever they serve to illustrate the answer.*

iii. *Do not write on the question paper.*

SECTION A

Question One (12 Marks)

a) What is the difference between a vector quantity and scalar quantity and give an example of each. (2 Marks)

b) Two vectors are given by $\mathbf{A} = -3i + 7j + 4k$ and $\mathbf{B} = 6i - 10j + 9k$. Evaluate the quantities

i) $cos^{-1}\left[\frac{A.B}{AB}\right]$ (2 Marks)

(ii) $sin^{-1}\left[\frac{A.B}{AB}\right]$ (2 Marks)

c) A man stands on the roof of a 15.0-m-tall building and throws a rock with a velocity of magnitude 30 m/s at an angle of 33°above the horizontal.

Calculate:

(i) the maximum height above the roof reached by the rock; (1 Mark)

(ii) the magnitude of the velocity of the rock just before it strikes the ground (1 Mark)

(iii) the horizontal range from the base of the building to the point where the rock strikes the ground. (1 Mark)

d)i) Define surface tension. (1 Mark)

ii) Calculate the work done against surface tension forces in blowing a soap bubble 1cm diameter if the surface tension of soap solution is 2.5×10^{-2} N/m. (2 Marks)

Question Two (12 Marks)

a)Derive the three equations of motion for a body moving in a straight line under constant acceleration. (3 Marks)

b) Distinguish between longitudinal and transverse waves. (2 Marks)

c)State Bernoulli's theorem and the law of continuity. (2 Marks)

d)A particle is making two revolutions per second in a circular orbit of radius 10cm. Calculate the angular velocity, linear velocity and the centripetal acceleration of the particle in terms of π (pie). (2Marks)

e) A rod 4.2 m long and 0.50 cm2 in cross-sectional area is stretched 0.20 cm under a tension of 12.0 N. Calculate;

(i) Stress and strain (2 Marks)

(ii)Young's modulus. (1 Mark)

SECTION B

Question Three (12 Marks)

a)State Newton's laws of motion (3 Marks)

b) Deduce the expression of the impulse of a variable force. (2 Marks)

b) i) Distinguish between elastic and inelastic collisions (2Marks)

(ii) A truck of mass 5500 Kg moving with a velocity of 4.6 m/s hits from behind a car of mass 1200 Kg on a straight line path with it. If the velocity of the car after collision is 2.1 m/s, calculate the velocity of the truck after collision if the car was originally stationary. (3 Marks)

iii) A particle of mass m moves with momentum p. Show that the kinetic energy of the particle is $K.E = \frac{P^2}{2m}$. and express the magnitude of the particle's momentum in terms of its kinetic energy and mass. (2 Marks)

Question Four (12 Marks)

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

ii) Show that the acceleration due to gravity outside the earth is given by $g' = \frac{r_e^2 g}{r^2}$

while inside the earth, its $g' = \frac{rg}{r_e}$. Hence sketch on a graph variation of g' with rand show the point at which $g' = g$ at $r = r_e$. (7 Marks)

b) What is escape velocity? Determine the escape velocity for a body on the moon given the radius, R of the moon is 1.74×10^6m and the mass of the moon is 7.36×10^{22}kg. (4 Marks)

Question Five (12 Marks)

a) Define simple harmonic motion. (2 Marks)

b) In an engine, a piston oscillates with simple harmonic motion so that its position varies according to the expression $x = (5.00cm)cos\left(2t + \frac{\pi}{6}\right)$ where x is in centimeters and t is in seconds. At t= 0, find

(i) the position of the piston, (2 Marks)

(ii) its velocity (2Marks)

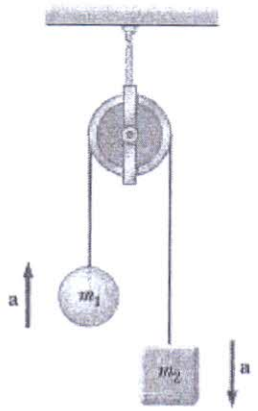
(iii) its acceleration. (2 Marks)

(iv) Find the period and amplitude of the motion. (2 Marks)

c)A block–spring system oscillates with an amplitude of 3.50 cm. If the spring constant is 250 N/m and the mass of the block is 0.500 kg, determinethe mechanical energy of the system. (2 Marks)

Question Six (12 Marks)

a)Two objects with masses of m_1 =3.00 kg and m_2 =5.00 kg are connected by a light string that passes over a light frictionless pulley to form an Atwood machineas shown in the Figure below. Determine (a) the tension in the string, (b) the acceleration of each object, and (c) the distance each object will move in the first second of motion if they start from rest. (6 Marks)



b)A 3.00-kg block starts from rest at the top of a 30.0° incline and slides a distance of 2.00 m down the incline in 1.50 s. Find

(a) the magnitude of the acceleration of the block, (2 Marks)

(b) the coefficient of kinetic friction between block and plane, (1 Mark)

(c) the friction force acting on the block, and (1 Mark)

(d) the speed of the block after it has slid 2.00 m. (2 Marks)

Question Seven (12 Marks)

a) Briefly highlight the three modes of heat transfer. (3 Marks)

b)A horizontal pipe of radius 10 mm 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 and the density of the fluid is equal to the density of water.

(i) What is the volume flow rate? (1 Mark)

(ii) What is the average speed for the wider pipe? (2 Marks)

(iii)What is the pressure difference between the two pipes? (3 Marks)

c)An aluminum stick of length 1.5 m is cooled from 200 °C to -1800 °C. Find the final length if its coefficient of linear expansion is 23×10^{-6}/K? (3 Marks)

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