TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF APPLIED AND HEALTH SCIENCES

DEPARTMENT OF MATHEMATICS & PHYSICS

UNIVERSITY EXAMINATION FOR:

BACHELOR OF SCIENCE IN FISFERIES AND OCEANOGRAPHY.

APS 4109: FUNDAMENTALS OF PHYSICS

SPECIAL/ SUPPLIMENTARY EXAMINATIONS

SERIES: SEPTEMBER 2018

TIME: 2 HOURS

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of **FIVE** questions.

Answer question one **COMPULSORY** and any other **TWO** questions.

This paper consists of Choose No questions.

Do not write on the question paper.

Where necessary take:

- Acceleration due to gravity, g =9.8m/s^2
- Permittivity of free space, ε_0 =8.85x10-^{12} F/M
- Charge on electron, = -1.602x10^{-19}C
- Mass of an electron, Me =9.1x10^{-31}kg
- Speed of light in a vacuum, c=3.0x10^8m/s

Question One (compulsory) 30 marks

a) (i) State two limitations of dimensional analysis. (2 marks)

(ii) Experiments indicate that the speed c of an ocean wave is effectively independent of amplitude and for long wave length it is independent of surface tension. Suppose we write

$C \propto g^x \lambda^y \rho^z$ then $C = kg^x \lambda^y \rho^z$ where k is a dimensionless constant. Find the values of x, y and z. (4 marks)

b) (i) Define frequency and state its S.I unit. (2 marks)

(ii)A wave of wave length 3 mm travels with a speed of 300 m/s. Determine its frequency . (2marks)

c) State and explain two factors that affect the resistance of metallic conductors. (2marks)

(d) Figure 1 shows an electric circuit with a battery of e.m.f 3V .

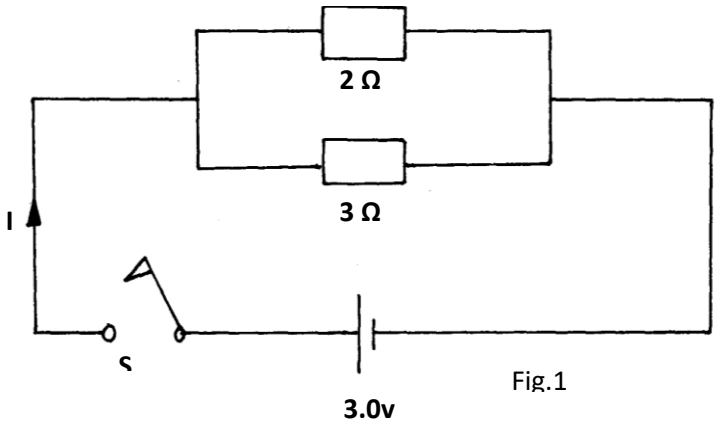

Fig.1

Calculate:-

i) Total resistance of the circuit. (2 marks)

(ii) Current through each resistor. (3 marks)

e. (i) Differentiate between kinetic energy and gravitational potential energy. (2 marks)

ii) A trolley of mass 2.0 kg is pulled from rest by a horizontal force of 5.0 kg for 1.2 seconds. Assuming that the surface is smooth, calculate

I) The distance covered by the trolley. (3 marks)

II) Kinetic energy gained by the trolley (3 marks)

f. What is the magnitude of the electric field **E** such that an electron, placed in the field, would experience an electrical force equal to its weight? (3marks)

g. State two factors that affect the magnitude of induced emf in coil. (2 marks)

Question Two (20 marks)

a) (i) State the Newton's laws of motion. (4 marks)

(ii)A block of mass m_2 is on an inclined plane is joined to a mass m_1 by a cord over a frictionless pulley as shown in the figure 2 below. The block slides on a frictionless surface and the effects of the pulley are negligible. Show that that acceleration is given by

$$a = \left(\frac{m_1 - m_2 \sin\theta}{m_1 + m_2}\right)g$$ (8 marks)

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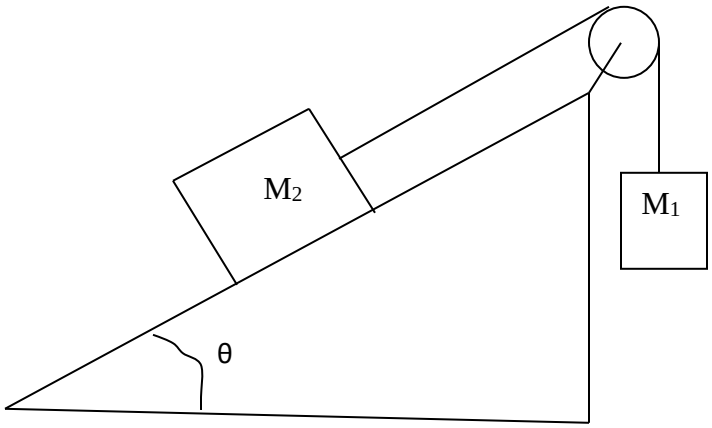


Figure2

b) (i) State the law of conservation of linear momentum. (2 marks)

(ii) A body A of mass 5kg moving with a velocity of 3 m/s collides head-on with another body B of mass 4kg moving in the opposite direction at 6 m/s. If after the collision the bodies move together, calculate the common velocity, v. (6marks)

Question three (20 marks)

a) Differentiate between longitudinal wave and transverse waves giving an example in each case. (4marks)

b) The equation represent $y = 12\sin(50t - 20x)$ a plane wave travelling in the positive x- axis. Find

(i)The frequency a plane of the wave. (3 marks)

(ii) The wave length of the wave. (3 marks)

(iii) The speed of the wave. (2 marks)

c) (i) A body moving in a circular path with a constant speed is said to be accelerating. Explain. (2 marks)

(ii) The moon revolves around the earth in a nearly circular path of radius 382,400km from the centre of the earth once in 27.3 days. Calculate the speed of the moon in m/s. (4 marks)

(iii)How faster is the moon accelerating towards the centre of the earth? (2 marks)

Question four. (20 marks)

a) (i) Differentiate between a conductor and an insulator. (2marks)

(ii) A rectangular carbon block has dimensions 1.0 cm x 1.0 cm x 50 cm. What is the resistance measured between the square ends? (3 marks)

(iii)What is resistance measured between the opposite rectangular faces? (Take the resistivity of carbon at 20^0C to be $3.5\text{x}10^{-5}\ \Omega$m) (3 marks)

(b) Two point charges q_1=+20nC and q_2=-75nC are separated by a distance of 3.0 cm. Find the magnitude and direction of electric force that q_1 exert on q_2. (5 marks)

c) (i)Define electromagnetic induction. (2 marks)

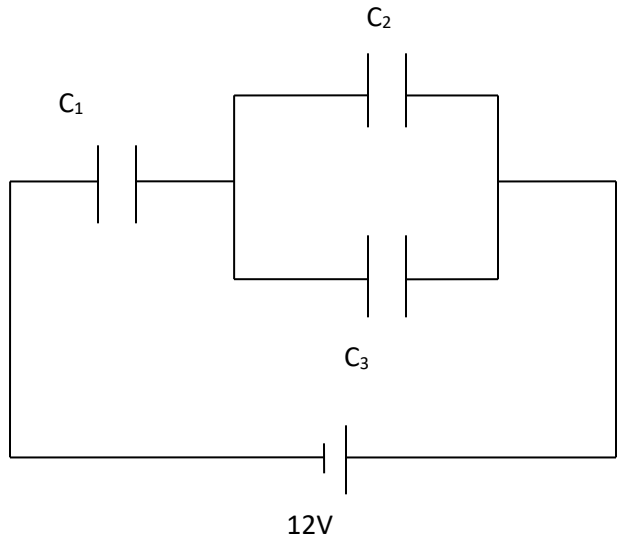
ii)A flat coil of a wire with 50 turns and a cross-sectional area of 50 cm^2 is placed in a magnetic field with its plane perpendicular to the magnetic B=0.45T. If the field is changing at the rate of 0.04T/S, find the magnitude of the induced e.m.f at the terminal of the coil. (5marks)

Question Five (20 marks)

a) Define the term capacitance of a capacitor. (1 mark)

b) State two factors affecting capacitance of parallel plate capacitor. (2 marks)

c) The circuit below, figure 3,shows three capacitors C_1=2μF, C_2=2μF and C_3= 2μF are connected to a 12V source. Calculate



i.the effective circuit capacitance. (3marks)

ii. the charge stored in each capacitor. (3 marks)

d) A 10μF capacitor is charged by 80V supply and then connected across an uncharged capacitor of 20μF. Calculate

(i) The final p.d across each capacitor. (3marks)

(ii) The final charge on each capacitor. (3marks)

(iii) The initial and final energy stored by each capacitor. (3marks)

(iv) Is the energy obtained in (iii) conserved? Explain your answer. (2 marks)