BACHELOR OF SCIENCE IN MARINE RESOURCE MANAGEMENT

APS 4109: FUNDAMENTALS OF PHYSICS

MAIN EXAMINATION

SERIES: *APRIL* 2016

TIME: 2 HOURS

When necessary take:

Acceleration due to gravity, $g=9.8ms^{-2}$

Permittivity of free space, $\varepsilon_o = 8.854\times10^{-12}$

Charge on electron, $e=-1.602\times10^{-19}$

Mass of an electron, $Me=9.1\times10^{-31}kg$

Question one (compulsory)

a) (i) what is dimensional analysis. (1mk)
(ii) Experiments indicate that the speed C of an ocean wave is effectively independent of amplitude and for long wavelengths, is dependent on surface tension. Suppose we write $C\alpha g^x\rho^y\rho^z$ then $C = g^x\rho^y\rho^z$ where k is a dimensional less constant, g is the acceleration due to gravity, λ is the wavelength and ρ is the density of the liquid. Find the values of x, y and z. (4mks)

(b) (i) state the coulomb's law. (1mk)

(ii) two point charges are located in the positive x-axis of a coordinate system. Charge q_1=1.0nC and is 2.0cm from the origin and q_2=-3.0nC is 4.0cm from the origin. What is the total force exerted by those two charges on a charge q_3=5.0nC located at the origin. (4marks)

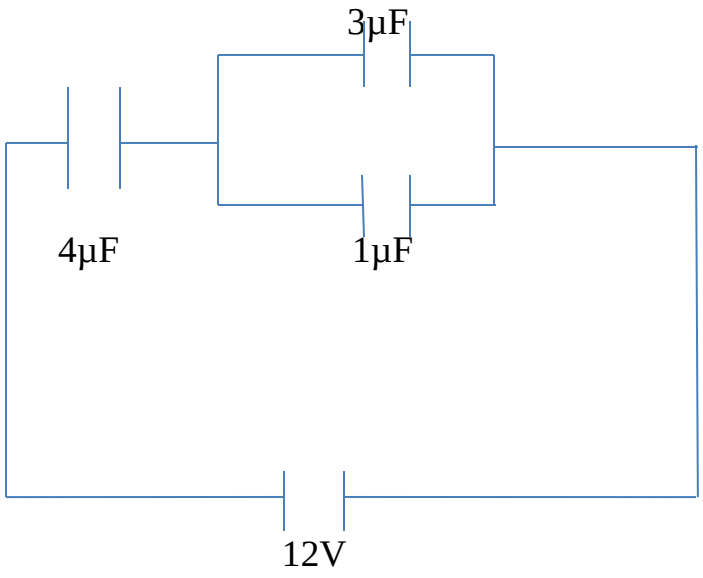
b) (i) Define centripetal force (1mark)

(ii) a body moving with a constant speed in a circular path is said to be accelerating, explain.

c) i) Define the term frequency (1mark)

ii)A wave of frequency 1K Hz travels a distance of 600m in 2 seconds. Determine its wavelength (2marks)

The figure below shows a network of capacitors



Determine

(i) The effective capacitance of the system (3marks)
(ii) the charge stored in each capacitor (3marks)
(iii) The energy stored by the 4μF capacitor (2marks)

f) i) State the work energy theorem. (1mark)

ii) A car traveling at 72 km/h is uniformly retarted by applying breaks so that it comes to rest after 8 seconds. If the car has a mass of 1250kg calculate the work done in bringing it to rest (4mks)

e) Mechanics is one of the branches of physics, state what it deals. (1mark)

Question Two

a) (i) What is an electric field?
(ii) Given that the electric force between two charges is given by:

$$F = \frac{1}{4\pi\varepsilon_0}\frac{Q_1 Q_2}{r^2}$$

Show that the electric field between
$the\ test\ charge, Q_1\ and\ the\ point\ charge\ Q_2\ \ is\ given\ by\ \ F = \frac{1}{4\pi\varepsilon_0}\frac{Q_1}{r^2}, hence$ find the

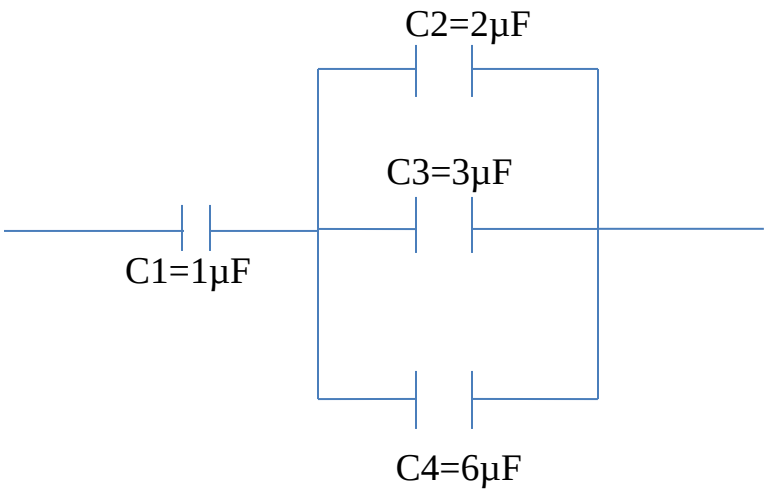
Electric field of a particle of charge $1.26\text{x}10^{-17}$C at a radius of $6.2\text{x}10^{-15}$m .

$$(F = \frac{1}{4\pi\varepsilon_0} = 9 \times 10^9 NM^2)$$

(6mks)

iii) 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?
(3mks)

b. (i) In the figure 2 below, the energy stored in C_4 is 27J. Calculate the total energy stored in the system. (7mks)



(ii) State two factors affecting the capacitance of a capacitor. (2mks)

Question Three

a) Two types of seismic waves are produced by p-waves are longitudinal and s-waves are transverse.

i) Differentiate between the longitudinal and transverse waves. (2mks)

i. State another example of:

A longitudinal wave……..

A transverse wave…….. (2mks)

b)The equation $y = 20sin(50t - 20x)$ represents a plane wave travelling in the positive x-axis direction, y being the displacement of the particle at a point x. Find

i. The frequency of the wave. (3mks)
ii. The wavelength of the wave (2mks)
iii. The speed of the wave. (2mks)

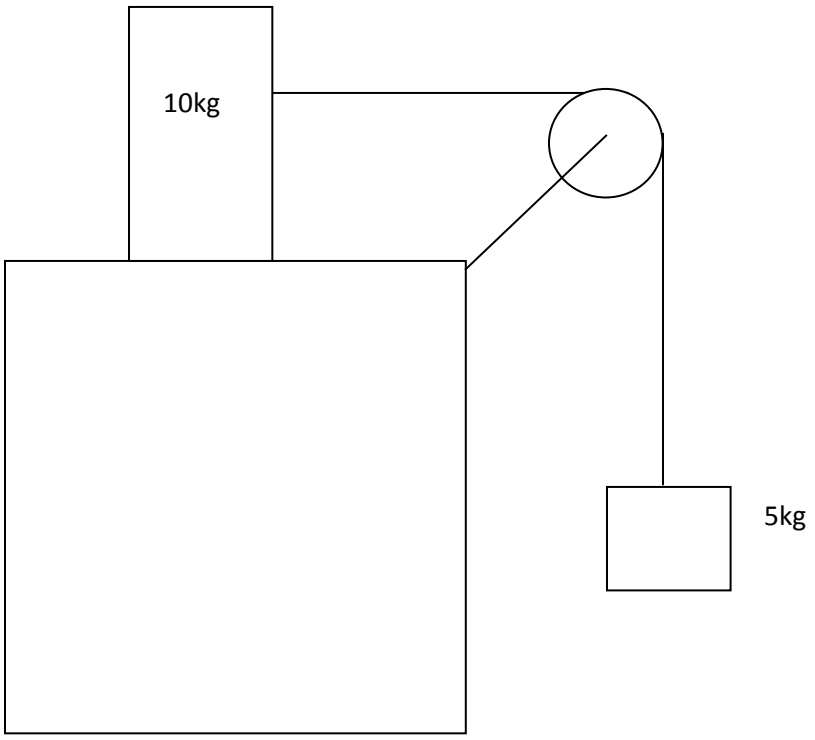
b) (i) Define the term half-life as used in radioactivity (1mk)
(ii) The half-life of a certain radioactive elements is 16years. What fraction of the element will be remaining after 48 years? (3mks)

c) A stone of mass 0.6kg attached to a string of length 0.5m is whirled in a horizontal circle at a constant speed. If the maximum tension in the string is 30N before it breaks, calculate

i. The maximum speed of the stone (2mks)
ii. The maximum number of revolution per second it can make. (3mks)

Question 4

a) (i) A block of mas 5kg is connected by a string over a friction pulley to a 10kg block that is sliding on a frictionless table as shown in figure below



Assuming the string is inextensible and mass

i) Draw a free body diagram for each mass (2mks)

ii) Determine the acceleration of the system (2mks)

iii) Determine the system tension in the string (1mks)

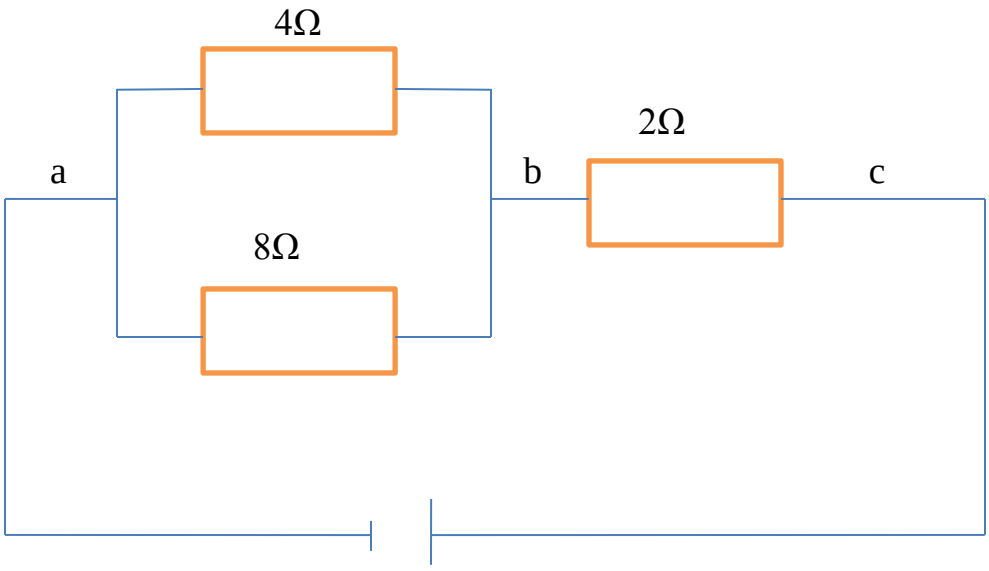
b) A 50kg passenger rides in an elevator that is accelerating upwards at 1.0ms^2 due to external forces. What is the force exerted by the floor on the passenger? (3mks)

c) A body of mass 5kg is pulled up a plane inclined at an angle of 30° to the horizontal by a force of 40N acting parallel to the plane. If the frictional force between the body and the pane is 10N, find the acceleration of the body. (5mks)

d) i) State Ohm's law. (1mks)

(ii) Calculate the electrical conductivity of the material of a length 3m, area of cross-section 0.02mm^2 and having a resistance f 2Ω. (2mks)

d) In the circuit shown in the figure, the current in the 4 Ω resistance in 1.2A. Determine the potential difference between b and c. (2mks)



Question five

a)(i) Define the term capacitance of a capacitor (1mks)

(ii) Three capacitors C_1, C_2 and C_3 are connected in series to each other.

Show that their effective capacitance is given by (5mks)

$$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$

b) A 5μF capacitor is charged to a p.d of 200v and isolated. It is then connected in parallel to 10 μ F capacitor. Find:-

i) The resultant potential difference. (4marks)

ii) The energy stored before connection. (2marks)

iii) The total energy in two capacitors after connection. (2marks)

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

c) i) Define electromagnetic induction . (1mark)

ii) State two factors that determine the magnitude of induced E.M.F in a circuit . (2marks)

iii) Define momentum and state its SI unit. (1mark)