TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Applied and Health Sciences

Department of Mathematics and Physics

UNIVERSITY EXAMINATION FOR:

Bachelor of Medical Laboratory Science

APS 4111: Introduction to physics

END OF SEMESTER EXAMINATION

SERIES: May 2016

TIME: 2 Hours

DATE:

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of five questions. Attempt Question One and any other two questions.

Do not write on the question paper.

Important constants

Acceleration due to gravity g=9.81 ms^{-2}

Permittivity of free space $\varepsilon_0 = 8.85\times10^{-12} C^2 N^{-1} m^{-2}$

Acceleration due to gravity g=9.81 ms^{-2}

$\frac{1}{4\pi\varepsilon_0} = 9\times10^9 \, Fm^{-2}$

Electric charge e =1.63 x 10^{-19} C

Specific latent heat of ice=3.4 x 10^{5}Jkg^{-1}, specific latent heat of steam = 2.3 x 10^6 JK^{-1}

Speed of sound in air=340 ms^{-1}

Question One (30 Marks)

a. Distinguish between

i. fundamental and derived units (2 marks)

ii. precision and accuracy (2 marks)

iii. principle focus of a concave lens and that of a convex lens (2 marks)

iv. a real and a virtual image (2 marks)

v. longitudinal and transverse waves (2 marks)

b. Find by dimensional analysis the correctness of the equations $\frac{2s-ut}{a}=t^2$ where a is the acceleration, ***u*** *the* initial velocity, ***t*** the time and ***s*** the displacement. (4 marks).

c. Describe an experiment that you can perform to prove the existence of atmospheric pressure. (3 marks)

d. A body initially at rest accelerates uniformly and reaches 20 m/s in 2 s. find:
   i. the acceleration (2 marks)
   ii. distance covered in this time (2 marks)

e. Find the
   i. effective resistance of two resistors R_1 and R_2 when connected in parallel (3 marks)
   ii. the effective capacitance for two capacitors C_1 and C_2 connected in series (3 marks)

f. Define the following terms (3 marks)
   i. photoelectric effect
   ii. Compton scattering
   iii. pair production

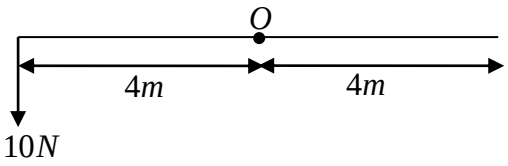
Question Two (20 marks)

a. What are SI units? List the fundamental quantities under the SI system of units together with their respective units (4 marks)

b. Derive the following equation of linear motions: (6 marks)
   i. $v^2=u^2+2as$
   ii. $S=ut+\frac{1}{2}at^2$

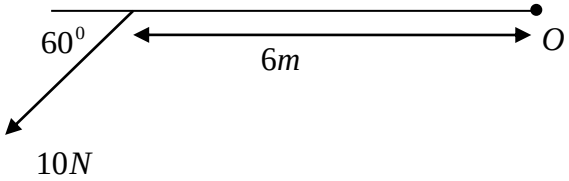
c. Name and describe the two types of errors. Cite an example in each case. (5 marks)

d. Find the torque of the 10 N force about O in Figure 1 and Figure 2.

i. 

(2 marks)

Figure 1: Torque

ii. 

(3 marks)

Figure 2: Torquw

Question Three (20 marks)

a. Briefly describe the following modes of heat transfer
   i. conduction (1 mark)
   ii. convection (1 mark)
   iii. radiation (1 mark)

b. Differentiate between heat capacity and latent heat (2 marks)

c. A calorimeter with heat capacity of 80 J/K contains 50 g of water at 40 ^{0}C. What mass of ice at 0 ^{0}C needs to be added in order to reduce the temperature to 10 ^{0}C? Assume no heat is lost to the surrounding. Specific heat capacity of water is 4.2 x 10^3 J /kg K and specific latent heat of ice is 3.4 x 10^5 J/kg. (5 marks)

d. A whistle giving out 500 Hz moves away from a stationery observer in a direction towards and perpendicular to a flat wall with a velocity of 1.5 m/s. How many beats per second will be heard by the observer? Take the speed of sound as 336 m/s and assume there is no wind. (4 marks).

e. Name at least four types of electromagnetic radiation. (2marks)

f. Describe at least one use of each of the electromagnetic radiation mention in (f) above. (4 marks)

Question Four (20 marks)

a. If a fish is 2m below the surface, how deep does the fish appear to be to n observer directly above? The refractive index of water is 1.33. (3 marks)

b. Use ray diagrams to show the formation of an image by a convex lens when an object is placed:
   i. beyond the center of curvature (3 marks)
   ii. between the center of curvature and principle focus (3 marks)
   iii. between the principle focus and the lens (3 marks)

c. An object is placed 0.2 m in front of a convex lens of focal length 0.4 m.
   i. Calculate the magnification of the image formed (4 marks)
   ii. if the convex lens is replaced with a concave lens of equal length, what will be the magnification of the new image formed? (4 marks)

Question Five (20 marks)

a. For the circuit shown in Figure 3, calculate:

   i. capacitance of the combination (4 marks)
   ii. total charge (2 marks)
   iii. energy stored (2 marks)

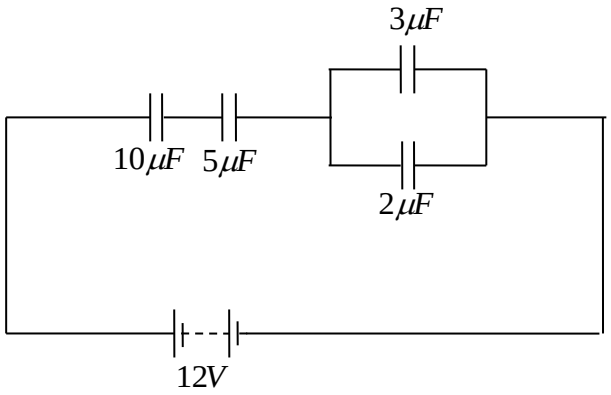


Figure 3: Capacitors

b. Show that the charge decreases exponentially with time when a capacitor is discharging. (5 marks)

c. A network is as arranged in Figure 4. Determine:

i. The equivalent resistance (3 marks)

ii. total current (2 marks)

iii. the voltage across the 2 Ω resistor (2 marks)

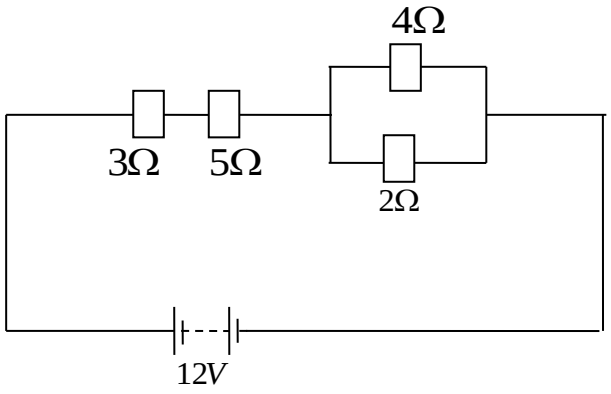


Figure 4: Resistors