

# TECHNICAL UNIVERSITY OF MOMBASA

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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.**

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### **Important constants**

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

Permittivity of free space  $\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$

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

$$\frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{ Fm}^{-2}$$

Electric charge  $e = 1.63 \times 10^{-19} \text{ C}$

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

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

### **Question One (30 marks)**

- a. Define the following terms
  - i. measurement (1 mark)
  - ii. unit of measurement (1 mark)
  - iii. error (1 mark)
- b. The density of mercury is  $13600 \text{ kg m}^{-3}$ . If the mass is measured in grams and length in centimetres, what will be the density of mercury in the new system of units? (4 marks)
- c. Differentiate between systolic and diastolic as used in blood pressure analysis. (2 marks)
- d. Briefly explain how a centrifuge works. (3 marks)

- e. Name the three modes of heat transfer. (3 marks)
- f. Citing an example in each case, distinguish between mechanical and electromagnetic waves (3 marks)
- g. State the laws of refraction (2 marks)
- h. Under what conditions does total internal reflection occur? (2 marks)
- i. Explain what is meant by:
  - i. additivity of electric charge (1 mark)
  - ii. Conservation of electric charge (1 mark)
- j. Two resistors of  $3\Omega$  and  $6\Omega$  are connected in parallel across a p.d. of 6V. Find the total current in the circuit. (3mks)
- k. A circuit comprises of a  $2\mu\text{F}$  capacitor in parallel with a  $3\mu\text{F}$ . A  $5\mu\text{F}$  capacitor is in series with this group. Calculate the effective capacitance of the circuit. (3mks)

### Question Two (20 marks)

- a. Given that  $x = 2 \pm 0.15$  and  $y = 3 \pm 0.2$ . Find:
  - i.  $x + y$  (3 marks)
  - ii.  $xy$  (3 marks)
- b. If  $a$  be the acceleration,  $u$  the initial velocity,  $v$  the final velocity,  $t$  the time and  $s$  displacement, find by dimensional analysis the consistency of the equations:
 
$$a = \frac{v^2 - u^2}{2s}$$
 (4 marks)
- c. Derive the relationship between angular and linear velocity. (3 marks)
- d. A particle of mass 2 g move in a circular path of radius 4 m with an angular velocity of 10 rev/s. Find centripetal force. (3 marks)
- e. A ball is thrown vertically upwards with a velocity of 40 m/s. Calculate:
  - i. maximum height reached (2 marks)
  - ii. time of flight (2 mark)

### Question Three (20 marks)

- a. Explain why water is usually used as a coolant. (2 marks)
- b. 0.02 kg of ice and 0.1 kg of water at  $0^\circ\text{C}$  are in a container. Steam at  $100^\circ\text{C}$  is passed in until all the ice is just melted. How much water is now in the container? (4 marks)
- c. Explain the working mechanism of the following
  - i. refrigerator (6 marks)
  - ii. infant incubator (3 marks)
- d. A car sounding a horn producing a note of 500 Hz approaches and then passes a stationery observer at a steady speed of 20 m/s. calculate the speed in pitch of the note heard by the observer.. (5 marks)

### Question Four (20 marks)

- a. State the laws of reflection. (2 marks)
- b. As shown in Figure 1, a beam of light travelling through water is incident on a flint glass surface at an angle of  $30^\circ$  and is refracted at an angle of  $24^\circ$ .

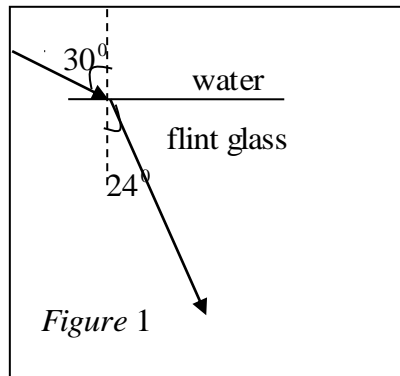


Figure 1: Refraction

Calculate the refractive index for light passing from water to flint glass. (3mks)

- c. Draw a ray diagram to show how a thin converging lens can form a magnified virtual image of an object. (3 marks)
- d. An object is placed 12 cm from a converging lens of focal length 18 cm. find:
  - i. the position of the image (3 marks)
  - ii. the magnification of the image (2 marks)
  - iii. is the image virtual or real explain your answer. (2 marks)
- e. Describe with the aid of a ray diagram the structure and action of a compound microscope. (5 marks)

**Question Five (20 marks)**

- a. Name and describe three mechanisms in which electromagnetic radiation interacts with matter. (6 marks)
- b. Two resistors of resistance  $4\Omega$  and  $8\Omega$  respectively are connected in parallel. The parallel arrangement is in series with another resistor of resistance  $2\Omega$ . Given that the current through the  $4\Omega$  resistor is  $1.2A$ , determine the potential difference across the  $2\Omega$  resistor. (4 marks)
- c. What are the factors on which parallel plate capacitor depend on? (3 marks)
- f. The area of each plate of a parallel plate capacitor is  $4 \times 10^{-2} m^2$ . If the thickness of the dielectric medium is  $10^{-3} m$  and the dielectric constant is 7, find the capacitance of the capacitor. (3 marks)
- g. Explain the following terms;
  - i. magnetic resonance imaging (2 marks)
  - ii. nuclear magnetic resonance (2 marks)