TECHNICAL UNIVERSITY OF MOMBASA

UNIVERSITY EXAMINATION FOR:

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 $\vee_0 = 8.85 \times 10^{-12} C^2 N^{-1} m^{-2}$

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

$$\frac{1}{4f\vee_0} = 9 \times 10^9 \, Fm^{-2}$$

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. 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 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. addivity of electric charge (1 mark)
   ii. Conservation of electric charge (1 mark)
j. Two resistors of 3 and 6 are connected in parallel across a p.d. of 6V. Find the total current in the circuit. (3mks)
k. A circuit comprises of a 2µF capacitor in parallel with a 3µF. A 5µF 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 0^0C are in a container. Steam at 100 ^{0}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 30^0 and is refracted at an angle of 24^0.
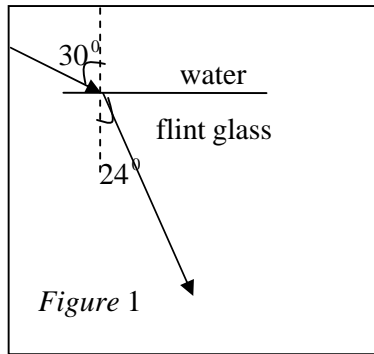
Figure 1

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   and 8   respectively are connected in parallel. The parallel arrangement is in series with another resistor of resistance 2 . Given that the current through the 4 resistor is 1.2A, determine the potential difference across the 2   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 $4\times10^{-2}m^2$. 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)