UNIVERSITY OF JOHANNESBURG

DFC

Supplementary Exam

2020

Degree Program : B.Eng
Course Title : Foundation Physics
Date of Test : 08-Jan-2020
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Moderators : P. Ntsoele, T. Mathe
Course Code : FPYEDO1

Semester : 2nd
Time Duration : 3 hours
Total Mark : 120

SECTION A-MULTIPLE CHOICE QUESTIONS [Marks: 40]

Answer this section on the multiple choice answer sheet provided. Follow the instructions on the sheet carefully. Do not mark more than one answer! If you make a mistake please, carefully erase/scratch out your first answer and, using your pencil/pen, fill in the answer you want. Do not fold or crease the answer sheet in any way.

1. The area of a floor tile is 900 cm^2. This is the same as
   - A. 0.09 m^2
   - B. 9 m^2
   - C. 0.9 mm^2
   - D. 90 000 m^2
2. The conversion of 750 $g.mm^{-3}$ to $kg.m^{-3}$ will be
   - A. 7,5 $\times 10^6$
   - B. 7,5 $\times 10^8$
   - C. 0,75 $\times 10^8$
   - D. 750 $\times 10^8$
3. A light ray enters one medium from another along the normal. The angle of incidence in the more dense medium
   - A. is 0^o
   - B. is 90^o
   - C. is equal to the critical angle
   - D. depends on the refractive indices of the two medium

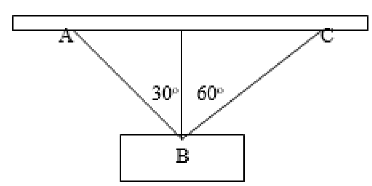
4. The mass of 1 litre of oil having a relative density of 0,8 is
   A. 0,8 g
   B. 800kg
   C. 800g
   D. 8000g

5. Light enters a glass block of refractive index 1,6 at an angle of incidence of 25 ^oC. The angle of refraction is..............
   A. 30.6^o
   B. 21^o
   C. 17^o
   D. 15.3^o

6. The length of the copper rod is 3m at 35^o . Its length at 20 ^oC would be(Linear expansivity of copper = 1.7 $\times 10^5$ $^oC^{-1}$)
   A. 2.76 m
   B. 2.95 m
   C. 2.99 m
   D. 2.89 m

7. The heat required to raise a temperature of 1 kg of a substance by 1 Kelvin or 1^oC is defined as ....
   A. specific heat capacity
   B. heat capacity
   C. latent heat
   D. expansivity

8. Object of mass 3 kg, is suspended by strings AB and CB which are attached to the plank AC. The tension in the string AB is, in N



   A. 3 sin 60^o
   B. 30 cos 30^o
   C. 3 cos 30^o
   D. 30 cos 60^o

9. Which one of the following are both vector quantities?
   A. momentum and work
   B. kinetic energy and velocity
   C. force and mass
   D. velocity and displacement

10. An object decelerates from 72 $km.h^{-1}$ to 36 $km.h^{-1}$ over a distance of 15 m .The deceleration is ....

    A. 33.3 $m.s^{-2}$

    B. 10 $m.s^{-2}$

    C. 259 $m.s^{-2}$

    D. 36 $m.s^{-2}$

11. How can Newtons first law be represented?

    A. F_r= ma

    B. F_r = 0 then v = constant

    C. $F_{AB} = -F_{BA}$

    D. F = Δmv

12. A car starts from rest and accelerates at 3 $m.s^{-2}$ for 8 seconds. The distance covered in this time is ....

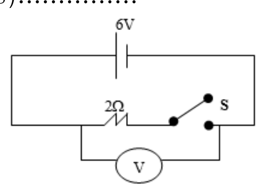
    A. 24 m

    B. 144 m

    C. 96 m

    D. 48 m

13. A new battery of EMF 6 V is connected to a 2 Ω resistor and a switch S, as shown alongside When S is OPEN, the voltmeter reads (in volts)..............

    A. 2

    B. 3

    C. 4

    D. 6

14. Which one of the following pairs are both scalar quantities

    A. energy and speed

    B. force and mass

    C. kinetic energy and acceleration

    D. velocity and displacement

15. When a force is acting on a body, work will only be done if ....

    A. the force and displacement is perpendicular to each other

    B. the force is greater than the weight of the body

    C. there is no friction or acceleration

    D. the force has a component in the direction of the displacement

16. The acceleration of the body is .... the resultant force acting on the body.
    A. numerically equal to
    B. inversely proportional to
    C. independent of
    D. directly proportional to
17. The amount of heat released by a 60W bulb burning for 6 hours would be.
    A. 120 J
    B. 720 J
    C. 180 J
    D. 360 J
18. A current of 200 mA flows in a circuit for 3 minutes. The amount of charge that will flow past a point in a circuit in this time will be..
    A. 0.6 C
    B. 600 C
    C. 36 C
    D. 360 C
19. Three identical metal spheres, X ,Y and Z are mounted on three separate insulated stands. The three spheres carry the following charges: X = - 10nC, Y = 0nC and Z = +7nC. X is first touched to Y briefly and then to Z briefly. The final charges on the three spheres, in nC will be

	X	**Y**	**Z**
A.	+1	-5	+1
B.	-1	-5	-1
C.	+2	-5	0
D.	-1	-1	-1

20. The force of attraction between two point charges can be doubled by
    A. halving the distance between them
    B. doubling the distance between them
    C. doubling the charge on both objects
    D. doubling the charge on one object, only

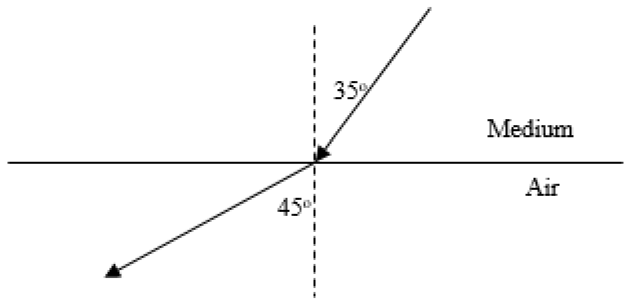
SECTION B
Problems and Computational Questions [Marks: 80]

Question 1

[OPTICS: 15]

(a) State two laws of refraction of light (4)

(b) Calculate the refractive index of the medium as indicated in the diagram below. (3)



(c) State the conditions necessary for total internal reflection to take place. (4)

(d) An object of size 15mm is placed 50 mm from the concave mirror. The focal length of the mirror is 20 mm. Find by accurate constructions, the size, position and magnification of the image. (4)

Question 2

[MECHANICS: 21]

(a) A steel ball of mass 0.2 kg is projected vertically upwards, from the top of a building 100 m high, with an initial velocity of 40 $m.s^{-1}$. Ignore air friction and calculate:

i. the total mechanical energy of the ball the time it was projected. (3)

ii. the total mechanical energy of the ball the time it reached the ground level (i.e at the bottom of the building) (1)

iii. the total mechanical energy of the ball the time it reaches its maximum height above the ground. (1)

iv. the velocity of the ball the time it reached the ground level (3)

v. time taken by the ball to reach the ground level from the time it was projected (3)

vi. the maximum height above the ground the ball reached (3)

vii. the velocity of the ball the time it was 20 m above the ground (3)

(b) Two objects of mass 12 kg and 8 kg respectively move towards each other at velocities 10 $m.s^{-1}$ and 5 $m.s^{-1}$ respectively. If the objects unite during collision, calculate the resultant velocity. (4)

Question 3

[HEAT: 9]

(a) Define specific heat capacity (3)

(b) A piece of copper of mass 100 g, is heated in water boiling at 100 ^oC, and dropped into a copper calorimeter of mass 80 g, containing 90 g of turpentine at 10 ^oC. The temperature of the mixture is 22.5 ^oC. Find the specific heat capacity of the turpentine. (Specific heat capacity of copper = 380 $J.kg^{-1}.K^{-1}$) (6)

Question 4

[HYDROSTATICS: 19]

(a) Calculate the mass of air in a room of floor dimensions 10 m $\times$ 12 m and a height of 4 m. (density of air 1.26 $kg.m^{-3}$) (4)

(b) An object of mass 500 g and a relative density of 2.4 is suspended in air by rope.

i. State Archimedes Principle (3)

ii. Calculate:

α) the tension in the rope (2)

β) the tension in the rope should the object be held suspended by the rope but totally submerged in water. (3)

γ) the density of the liquid in which the object is suspended. (3)

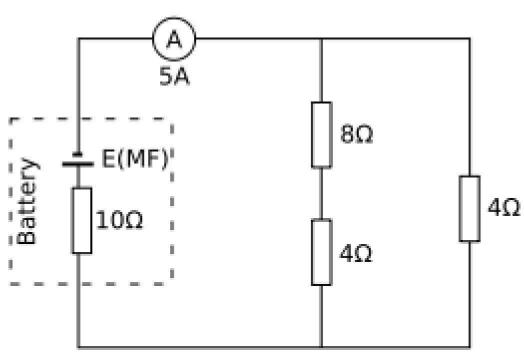
δ) density of the liquid in which the object floats with 80% of its volume submerged. (4)

Question 5

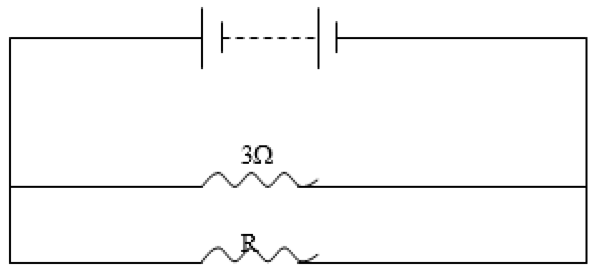
[ELECTRICITY: 16]

(a) State Coulomb's law of electrostatics. (2)

(b) What is the EMF of the battery in the following circuit? (5)



(c) The accompanying figure shows a battery, of negligible internal resistance, that converts 1440 J of chemical energy to electrical energy for a charge of 120 C that is provided to the external circuit within 20 s. The external circuit consists of a 3 Ω and a resistor R of unknown resistance.



i. Determine the potential difference across the pole of the battery. (2)

ii. Determine the total current that will flow in the external circuit. (2)

iii. Determine the power in the 3 Ω resistor. (2)

iv. Determine the resistance of R. (3)

University of Johannesburg

PHYSICS FORMULA SHEET

OPTICS	*MECHANICS*	*FLUIDS*	*HEAT*
1. $f = \frac{R}{2}$	1. $s = ut + \frac{1}{2}at^2$	1. $P = \rho gh$	1. $\Delta l = l_1 \alpha \Delta T)$
2. $m = \frac{v}{u}$	2. $s = vt - \frac{1}{2}at^2$	2. $W = \rho gV$	2. $\Delta A = \gamma\ A \Delta T$
3. $m = \frac{v}{f} - 1$	3. $s = \left(\frac{u+v}{2}\right)t$	3. $B = \rho_{liquid} gV$	3. $\Delta V = \beta V \Delta T$
4. $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$	4. $v = u + at$	4. $RD_S = \frac{w_{in\ air}}{w_{in\ air} - w_{in\ water}}$	4. $Q = mc\Delta T$
5. $n = \frac{\sin\theta_1}{\sin\theta_2}$	5. $v^2 = u^2 + 2as$	5. $RD = \frac{W\ in\ air - W\ in\ liquid}{W\ in\ air - W\ in\ water}$	5. $T(^oC) = (T + 273)K$
6. ${}_1n_2 = \frac{n_1}{n_2}$	6. $\Sigma F = ma$		*ELECTRICITY*
7. $n = \frac{c}{v}$	7. $w = mg$		1. $V = IR$
8. $n = \frac{real\ depth}{apparent\ depth}$	8. $W = F.s$		2. $emf = I(R + r)$
9. $n_1 \sin i_1 = n_2 \sin i_2$	9. $E_p = mgh$		3. $W = VIt$
	10. $E_k = \frac{1}{2}mv^2$		4. $P = VI$
			5. $F = kQ_1Q_2/r^2$
			6. $E = F/Q$

CONSTANTS

$g = 9.81 m/s^2$

$k = 9.0 \times 10^9\ N\ m^2/C^2$

CONVERSIONS

1 litre = 1 000 cm^3

1 atm = 760 torr = 1.013 x 10^5 Pa = 760 mmHg