UNIVERSITY OF JOHANNESBURG

# FACULTY OF SCIENCE

## DEPARTMENT OF PHYSICS

NATIONAL DIPLOMA IN ANALYTICAL CHEMISTRY

**MODULE** PHYSICS PHY1TB1 /PHYXTB1 /PHY1YT1

**CAMPUS DFC**

## JANUARY SUPPLEMENTARY EXAMINATION

**DATE 07/01/2020** **SESSION: 08:00 – 11:00**

**ASSESSOR** **MR. T.E NEMAKHAVHANI**

**INTERNAL MODERATOR** **MR. M LETSWALO**

**DURATION 3 HOURS** **MARKS 120**

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**NUMBER OF PAGES: 7 PAGES, INCLUDING 2 INFORMATION SHEETS**

**INSTRUCTIONS: CALCULATORS ARE PERMITTED (ONLY ONE PER STUDENT)**

**REQUIREMENTS: ANSWER BOOK**

**ANSWER ALL QUESTIONS IN THE ANSWER BOOK PROVIDED**

## QUESTION 1

1.1. State *pascal's principle*. (4)

1.2. State two quantities that the pressure in liquids is directly proportional to. (2)

1.3. Name the instrument used to measure atmospheric pressure and the liquid used in the instrument. (3)

1.4. Convert a pressure of 0.09 atm to a pressure in

1.4.1. KPa. (2)

1.4.2. Pa. (2)

1.4.3. mmHg. (2)

**(15)**

## QUESTION 2

2.1. A cylinder is filled with water so that the force at its circular base is **F** N. If the pressure measures **P** kPa, show that the radius of the cylinder's base is given as

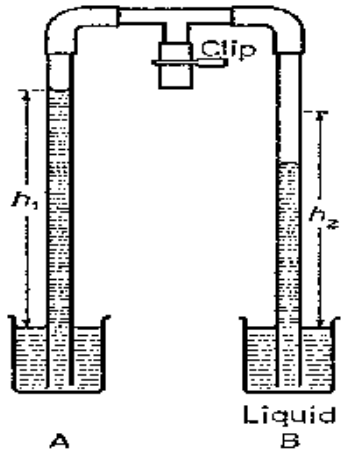
$$r = \sqrt{\frac{F}{\pi P}}$$ (6)

2.2. A skateboarder lands on all four wheels after riding a railing. If the skateboarder has a mass of $9 \times 10^5$ mg and the area on the bottom of a single wheel is $1 \times 10^{-4}$ $m^2$, what pressure does the skateboard put on the ground? (6)

**(12)**

## QUESTION 3

3.1. Complete the free-body diagram given below to show that the relative density of a liquid using Hare's apparatus is given by $RD_\ell = \rho_\ell / \rho_w$ and $RD_\ell = h_w / h_\ell$. (10)




3.2. With the aid of a free-body diagram show that a gas pressure due to manometer apparatus is given as $P_{gas} = P_{atm} + P_\ell$. (5)

3.3. In an experiment, the following readings were obtained: Weight of the solid in air = 4 N. Weight of solid in water = 3.7 N. Weight of solid in liquid = 3.8 N. Calculate the RD of the liquid. (4)

**(19)**

## QUESTION 4

4.1. Define the *coefficient of linear expansion*. (4)

4.2. A copper rod is 2.5 mm long at 5 °C. Calculate its length when heated to 15 °C. (4)

4.3. A rectangular copper sheet has length 10 cm and width 8 mm at 40 °C. Calculate the area at 120 °C. (4)

4.4. Calculate the temperature change required, to increase the area of brass plate by 3%. (5)

**(17)**

## QUESTION 5

5.1. Define the *coefficient of cubic expansion*. (4)

5.2. A steel cube has a volume of 10 cm × 10 cm × 10 cm at 10 °C. Calculate the volume of the cube at 120 °C. (5)

5.3. With the aid of free body diagram use the following constrains to explain how the apparent expansion of liquids depends on the container:

5.3.1. $\beta_\ell > 3\alpha_{container}$. (2)

5.3.2. $\beta_\ell = 3\alpha_{container}$. (2)

5.3.3. $\beta_\ell < 3\alpha_{container}$. (2)

**(15)**

## QUESTION 6

6.1. Name and explain three factors on which the amount of heat gained or lost depends on. (6)

6.2. Define

6.2.1. *Heat Capacity*. (3)

6.2.2. *Specific Heat Capacity*. (3)

6.2.3. *Latent Heat*. (3)

6.3. 2 mg of water is heated from 20 °C to 70 °C. Calculate the heat gained by the water. (5)

**(20)**

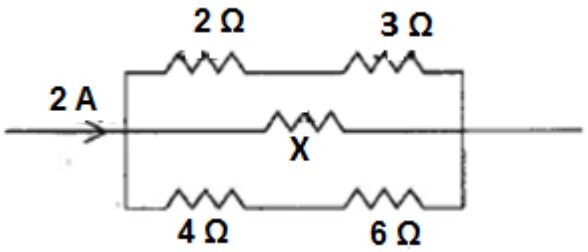
## QUESTION 7

7.1. State *ohm's law*. (4)

7.2. Determine the resistance of a conductor for which a potential difference of 400 V across its ends, causes a current of 100 A to pass through it. (4)

7.3. Calculate the resistance of 1000 m of copper wire with cross-sectional area 1 $mm^2$. The resistivity of copper is 1 .72 × $10^{-8}$ Ω m. (6)

7.4. From the circuit below if the potential difference across the 6 Ω resistor is 3 V, calculate the resistance X (8)




**(22)**

**Total Marks [120]**

University of Johannesburg

# PHYSICS INFORMATION SHEET

## OPTICS

1. $f = \frac{R}{2}$
2. $m = \frac{v}{u}$
3. $m = \frac{v}{f} - 1$
4. $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$
5. ${}_1n_2 = \frac{\sin i_1}{\sin i_2}$
6. $n = \frac{c}{v}$
7. $n = \frac{\text{real depth}}{\text{apparent depth}}$
8. $\sin c = \frac{n_1}{n_2}$
9. $n_1 \sin i_1 = n_2 \sin i_2$
10. ${}_1n_2 = \frac{n_2}{n_1}$
11. $A = r_1 + r_2$
12. $\sin i_1 = n \sin r_1$
13. $\sin i_2 = n \sin r_2$
14. $D = (i_1 + i_2) - A$
15. $n = \frac{\sin\left(\frac{A+D}{2}\right)}{\sin\frac{A}{2}}$
16. $P = \frac{1}{f}$
17. $n\lambda = d \sin\theta$
18. $d = t\left(1 - \frac{1}{n}\right)$

## MECHANICS

1. $v = u + at$
2. $v^2 = u^2 + 2as$
3. $s = ut + \frac{1}{2}at^2$
4. $s = vt - \frac{1}{2}at^2$
5. $s = \left(\frac{u+v}{2}\right)t$
6. $F = ma$
7. $F_f = \mu N$
8. $W = mg$
9. $E_p = mgh$
10. $E_k = \frac{1}{2}mv^2$

## FLUIDS

1. $P = \rho gh$
2. $W = \rho gV$

$$RD = \frac{\rho_{substance}}{\rho_{water}} = \frac{m_{substance}}{m_{water}}$$

4. $P_1V_1 = P_2V_2$
5. $W_{loss} = \rho_t g V_b$
6. $RDs = \frac{W \text{ in air}}{W \text{ in air} - W \text{ in water}}$
7. $RDl = \frac{W \text{ in air} - W \text{ in liquid}}{W \text{ in air} - W \text{ in water}}$
8. $W = \rho gV$

## HEAT

1. $\alpha = \frac{\Delta l}{l_1 \Delta t}$
2. $V_2 = V_1[1 + 3\alpha\Delta t]$
3. $\beta = 2\alpha$
4. $\gamma = 3\alpha$
5. $\frac{V_1}{T_1} = \frac{V_2}{T_2}$
6. $\frac{P_1}{T_1} = \frac{P_2}{T_2}$
7. $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$
8. $Q = mc\Delta t$

9. $T = t + 273$

10. $Q = m\ell$

**ELECTRICITY**

1. $V = IR$
2. $R = \frac{\rho\ell}{A}$
3. $R_t = R_o(1 + \alpha\Delta t)$
4. $emf = I(R + r)$
5. $W = VIt$
6. $P = VI$
7. $P = \frac{W}{t}$
8. $F = K\frac{|q_1||q_2|}{r^2}$
9. $E = K\frac{|q|}{r^2}$

**SOUND**

1. $v = f\lambda$

**CONSTANTS**

1. $g = 9{,}8\, ms^{-2}$
2. $c = 3 \times 10^8\, ms^{-1}$
3. $e^- = 1{,}6 \times 10^{-19} C$
4. k = 8.99 $\times 10^9$ N.m$^2$/C$^2$

**LINEAR EXPANSIVITIES**
(in ºC$^{-1}$ or K$^{-1}$)

| | | |
|---|---|---|
| Aluminium | = | 2,2 x 10$^{-5}$ |
| Brass | = | 1,9 x 10$^{-5}$ |
| Brick | = | 9,5 x 10$^{-6}$ |
| Concrete | = | 1,2 x 10$^{-5}$ |
| Copper | = | 1,7 x 10$^{-5}$ |
| Glass | = | 8,5 x 10$^{-6}$ |
| Iron | = | 1,2 x 10$^{-5}$ |
| Pine | = | 3,4 x 10$^{-7}$ |
| Pyrex glass | = | 3,9 x 10$^{-4}$ |
| Steel | = | 1,1 x 10$^{-5}$ |

**SPECIFIC HEAT CAPACITIES**
(in Jkg$^{-1}$ ºC$^{-1}$)

| | | |
|---|---|---|
| Aluminium | = | 910 |
| Copper | = | 380 |
| Glass | = | 700 |
| Glycerine | = | 2 500 |
| Ice | = | 2 100 |
| Pyrex glass | = | 837 |
| Rubber | = | 1 700 |
| Steam | = | 1 800 |
| Steel | = | 460 |
| Stone | = | 900 |
| Water | = | 4 200 |
| Wood | = | 1 700 |

6. SPECIFIC LATENT HEAT
(in Jkg$^{-1}$)

| | | |
|---|---|---|
| Ice | = | 3,35 x 10$^5$ |
| Steam | = | 2,26 x 10$^6$ |

RELATIVE DENSITIES

| | | |
|---|---|---|
| Alcohol | = | 0,8 |
| Copper | = | 9 |
| Glycerine | = | 1,26 |
| Gold | = | 19,3 |
| Lead | = | 11,3 |
| Mercury | = | 13,6 |
| Plastic | = | 1,43 |
| Tin | = | 7,3 |
| Water | = | 1 |

8. STANDARD PRESSURE

101,3 kPa = 76 cmHg

9. STANDARD TEMPERATURE

273 K = 0 ºC