UNIVERSITY
OF
JOHANNESBURG

FACULTY OF SCIENCE

DEPARTMENT OF APPLIED PHYSICS AND ENGINEERING MATHEMATICS

NATIONAL DIPLOMA IN ANALYTICAL CHEMISTRY

MODULE PHYSICS PHY 1XA1

CAMPUS **DFC**

JUNE EXAMINATION

DATE: 30/05/2018	**SESSION: 12:30 – 15:30**
ASSESSOR	**MS T.B. MOIPOLAI**
INTERNAL MODERATOR	**DR B.V. KHESWA**
DURATION 3 HOURS	**MARKS 100**

NUMBER OF PAGES: 7 PAGES INCLUDING INFORMATION SHEETS

INSTRUCTIONS: CALCULATORS ARE PERMITTED (ONLY ONE PER STUDENT).
MATHEMATICAL INSTRUMENTS ARE PERMITTED.

ANSWER ALL QUESTIONS IN THE ANSWER BOOK PROVIDED

QUESTION 1

1.1. State any three derived SI units. (3)

1.2. What prefixes are used in the decimal system for the following powers of ten?

1.2.1. 10^9 (1)

1.2.2. 10^{-1} (1)

1.2.3. 10^{-3} (1)

1.3. Evaluate

$$8.98 \times 10^9 N\, m^2 C^{-2} \left[\frac{(2 \times 10^{-3}\, C)(3 \times 10^{-6}\, C)}{4\pi(3.5 \times 10^{-3}\, m)^2}\right]$$

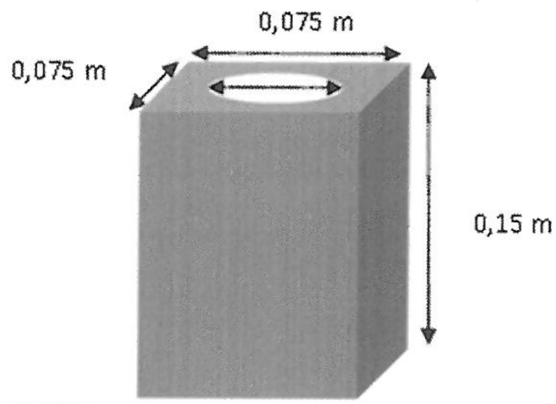
The final answer must have two significant figures and must be in scientific notation. (4)

1.4. If a company produces 2 000 kg of sugar every month, how much sugar does it produce in Mg per decade? (5)

1.5. Convert 60 N cm^{-2} to N m^{-2}. (3)

1.6. Distinguish between *area* and *volume*. (2)

1.7. Determine the volume (in m^3) of the material (grey) in the object shown in *Figure 1*. The object has a hollow cylinder inside. (7)



cylinder diameter = 0,005 m

Figure 1

1.8. Convert the volume calculated in question 1.7 to cm^3. (3)

[30]

QUESTION 2

2.1. Distinguish between a *vector* quantity and a *scalar* quantity. (2)

2.2. Calculate the resultant of the five forces shown in the diagram, using the ***component method***. The calculation should include a vector diagram showing the x- and y-component of the resultant force. (10)

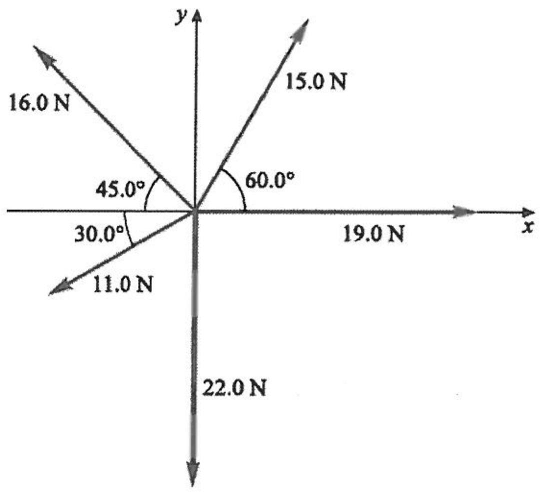


Figure 2

2.3. Define translational equilibrium. (2)

2.4. For the system in *Figure 3*, determine the values of T_1 and T_2 if the suspended weight is 600 N. (7)

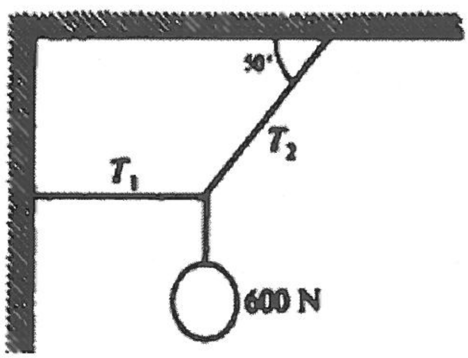


Figure 3

2.5. Define force of friction. (2)

2.6. A 20 kg box slides down an incline as shown in *Figure 4*. The coefficient of friction between the box and the incline is 0.3. Calculate the acceleration of the box. (7)

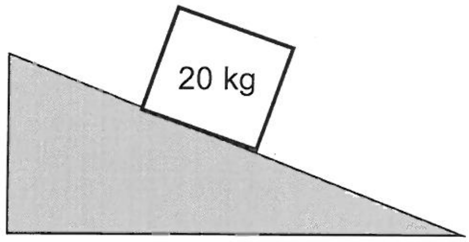


Figure 4

[30]

QUESTION 3

3.1. Distinguish between density and relative density. (2)

3.2. The mass of the planet Saturn is 5.64×10^{26} kg and its radius is 6.00×10^{7} m. Calculate its density. (7)

3.3. Three immiscible liquids (they do not mix) are poured into a 1 litre measuring cylinder whose mass is 300 g. The liquids were added in the following order:

500 cm^3 of liquid A whose density is 2.6 g.cm^{-3}

followed by **250 cm^3 of liquid B whose density is 1 g.cm^{-3}**

and finally **a certain volume of liquid C**

If the total mass of the cylinder containing the three liquids is 2170 g, what is the density of liquid C? (10)

3.4. What is the mass of a 1 m length of copper wire whose diameter is 0.81 mm? (6)

[25]

QUESTION 4

4.1. State two of the conditions for work to be done. (2)

4.2. State two differences between a conservative force and a dissipative force. (4)

4.3. Define *power*. (1)

4.4. A 1200 kg car is driving down a hill inclined at 30° as shown in *Figure 5*. At a time when the car's speed is 12 m.s^{-1}, the driver applies the brakes. Calculate the magnitude of the resultant force $\mathbf{F_R}$ if the car stops after travelling another 100 m from the time the brakes were applied. (8)

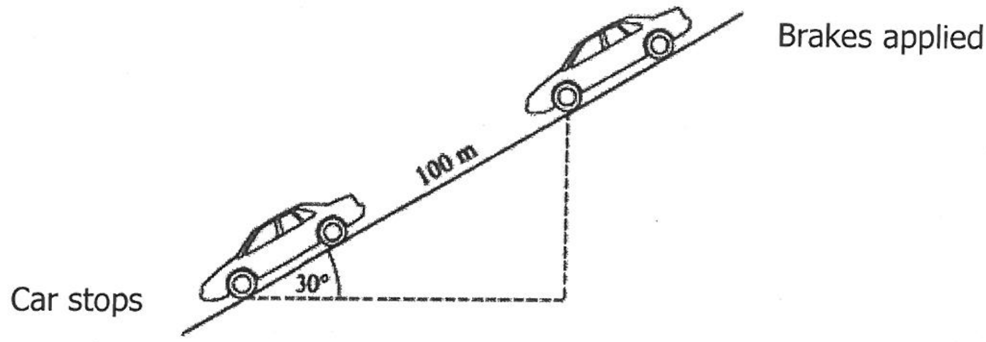


Figure 5

[15]

TOTAL MARKS [100]

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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. $W = F \times s$
10. $E_p = mgh$
11. $E_k = \frac{1}{2}mv^2$
12. $p = m \times v$

FLUIDS

1. $P = \rho g h$
2. $W = \rho g V$

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

4. $P_1V_1 = P_2V_2$
5. $W_{loss} = \rho_l g V_b$
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. $W = \rho g V$
9. $P = F / A$

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. $P = \frac{W}{t}$

SOUND

1. $v = f\lambda$

CONSTANTS

1. $g = 9{,}8\ ms^{-2}$
2. $c = 3\times10^{8}\ ms^{-1}$
3. $e^{-} = 1{,}6\times10^{-19}\ C$

4. LINEAR EXPANSIVITIES (in $°C^{-1}$ or K^{-1})

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

5. SPECIFIC HEAT CAPACITIES (in $Jkg^{-1}\ °C^{-1}$)

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	= $3{,}35 \times 10^{5}$
Steam	= $2{,}26 \times 10^{6}$

7. 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 °C