SECTION A – MULTIPLE CHOICE

1. What is tensile strain, and how does it affect your body? (2)

   (a) The ratio of change in length to the original length, when stress is induced in a body such that the body is subjected to two equal and opposite pulls.
   (b) The ratio of the original length to the change in length and when the compression in a body when subjected to three opposite pulls.
   (c) The ratio of tensile force to the change in length, and when the compression strain in a body when subjected to the body.
   (d) The ratio of change in length to the tensile force applied and when the tension strain and stress in a body when subjected to the material.

2. Hooke's law declares which of the following relationships? (2)

   (a) The amount of stress you have is directly proportional to the amount of stress you have within the limits of proportionality.
   (b) The stress level is inversely proportional to the amount of stress.
   (c) The square of tensile stress equals to the compressional stress.
   (d) The square of stress is inversely proportional to stress within the limits of proportionality.

3. A 75 N tensile force is applied to a circular wire, resulting in a stress of 4.07 MPa. Calculate the diameter of the wire (2)

   (a) $4.84382547 \times 10^{-3}$ m
   (b) 4.86582×10^{6} m^2
   (c) 4.3×10^{-6} mm
   (d) 3.83125×10^{-4} m^2

4. The proportionality limit is determined by and how? (2)

   (a) Cross-sectional area, because the proportionality limit is proportional to the area of cross-section.
   (b) Type of loading, because the loading type will have influence on the proportionality limit.
   (c) Type of material
   (d) All of the mentioned

5. What exactly is the safety factor? (2)

   (a) The stress-to-strain ratio
   (b) The percentage of allowable stress to maximum stress.
   (c) The proportion of maximum stress to maximum allowable stress.
   (d) The ratio of longitudinal strain to stress

6. A tensile test yielded the following results in the Lab: specimen diameter 15 mm; gauge length 40 mm; load at limit of proportionality 85 kN; extension at limit of proportionality 0.075 mm; maximum load 120 kN; final length at point of fracture 55 mm. The Young's modulus of elasticity is (2)

   (a) 256.6 GPa
   (b) 256 Pa
   (c) 525.1 Pa
   (d) 526 KPa

7. From question 6, determine the ultimate tensile strength of the material (2)

   (a) 679 MPa
   (b) 524 Pa
   (c) 525.1 Pa
   (d) 526. GPa

8. From question 6, calculate the stress at the proportionality limit (2)

   (a) 481 MPa
   (b) 402 GPa
   (c) 245.1 Pa
   (d) 481 GPa

9. From question 6, calculate the elongation percentage? (2)

   (a) 37.5 %
   (b) 36 %
   (c) 42 %
   (d) 15 %

10. A sound has an intensity of 3×10^{-8} W m^{-2}. What is the sound level of this sound? (2)

   (a) 3×10^{-8} dB
   (b) 4.48 dB
   (c) 44.8 dB
   (d) 75.2 dB

11. The correct definition for the amplitude of a wave is (2)

   (a) The maximum displacement of the particles of the medium from the rest position
   (b) The distance between a wave crest and a wave trough
   (c) The distance between two successive wave crests
   (d) The number of wave crests passing a point in 1 seconds

12. The wavelength of a wave is correctly defined as (2)

   (a) the maximum displacement of the medium's particles from rest
   (b) the distance between a wave crest and a wave through
   (c) the time interval between two successive wave crests
   (d) the number of wave crests passing through a given point in one second

13. In front of an audio system, a dB meter reads 62 dB. The volume has been increased, and the meter now reads 82 decibels. Clearly, the sound was amplified:

   (a) twice as loud
   (b) half as loud
   (c) 20 times as loud
   (d) 100 times as loud

14. What sound intensity is 3 dB louder than a sound intensity of 10 μW cm^{-2}? (2)

   A. 20 μW cm^{-2}
   B. 13 μW cm^{-2}
   C. 30 μW cm^{-2}
   D. 25 μW cm^{-2}

15. What is the difference in intensity levels between two sound waves with intensities of 0.1 W m^{-2} and 5.0 W m^{-2}? (2)

    (a) 4.9 dB
    (b) 127 dB
    (c) 110 dB
    (d) 17 dB

16. Mrs Johnson reads a newspaper under the light of a 56 cd lamp suspended 1.7 m above her. When the lamp burns out, she can only find a replacement lamp that is 75 cd. The height of this lamp above her book, in order to maintain the same level of illumination as before, is (2)

    (a) 1.7 m
    (b) 1.97 m
    (c) 3.4 m
    (d) 0.85 m

17. A 150-cm distance separates an 81-cd lamp from a 100-cd lamp. Where will a photometer balance on a straight line between them? (2)

    A. 71 cm from the 81 cd lamp
    B. 75 cm from the 81 cd lamp
    C. 100 cm from the 100 cd lamp
    D. 50 cm from the 100 cd lamp

18. In the case of a simply supported beam, the bending moment at the supports is always (2)

    (a) Zero
    (b) Positive
    (c) Negative
    (d) Depends upon loading

19. At the free end, a 6 m long cantilever beam carries a 10 kN point load. In the beam, the maximum bending moment is (2)

    (a) 0 N.m
    (b) - 60 N.m
    (c) 16 N.m
    (d) - 10 N.m

20. The rate at which the bending moment changes is equal to (2)

    (a) The shear force
    (b) Slope
    (c) Deflection
    (d) None of these

TOTAL SECTION A: 40

SECTION B

QUESTION 1

1.1 Define the term luminous flux (2)

1.2 The illumination provided by a light source at a distance of 5 m from it is 12 000 lux.

Calculate the luminous intensity of the source (2)

1.3 A 5.0 m street lamp placed directly above a walkway generates a 5 000 lumen flux.

Calculate the lamp's luminous intensity (2)

1.4 Calculate the illumination directly below the lamp in question 1.3 (2)

1.5 In question 1.3, calculate the illumination at a point on the sidewalk 12 m from the lamp's base (2)

[10]

QUESTION 2

2.1 What is the definition of convection? (2)

2.2 A quantity survivor designed a wall made up of three layers of chipboard, fibreglass, and stock brick, each with a thickness of 4.0, 38.0, and 10.0 mm, respectively, as shown in Figure 1.

Given: $K_{chipboard} = 0.12\ Wm^{-1}\ {}^{o}C^{-1}$,

$K_{stock\text{-}brick} = 0.05\ Wm^{-1}\ {}^{o}C^{-1}$

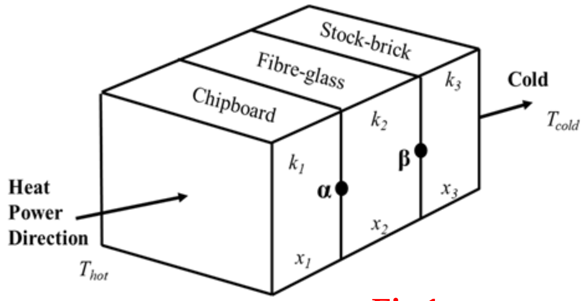


Fig 1

2.2.1 If the thermal resistance of the wall is 0.44 $W^{-1}m^2\ {}^{o}C$, what is the thermal conductivity of the fiberfiberglass (3)

2.2.2 When the hot temperature is 35 ^{o}C and the cold temperature is 17 ^{o}C, what is the thermal power transmission through the wall if it is 8.4 m long and 2.5 m high? (3)

2.2.3 What is the temperature at point α and β? (4)

[12]

QUESTION 3

3.1 The centre of gravity is the ratio of ________ to _________ (2)

(a) The ratio of the centroid and weight to the total weight
(b) The addition of centroid and weight to the total weight
(c) The product of centroid and weight to the total mass
(d) The subtraction of centroid and weight to the total weight

3.2 Consider the composite lamina of homogeneous density shown in **Fig. 2**, calculate the centroid on the diagram, and tabulate the results for all sections. (14)

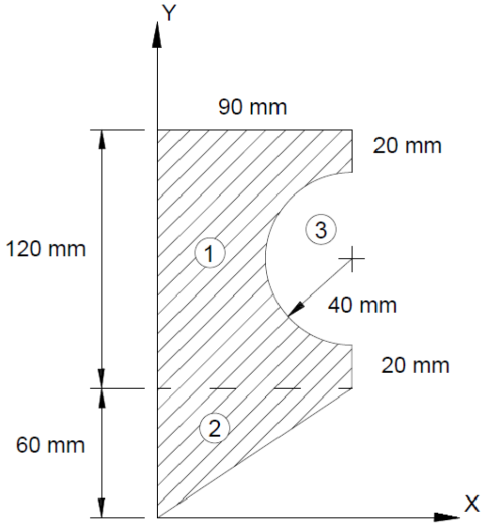


Fig. 2

[16]

QUESTION 4

4.1 The diagram shows a loaded framework. Determine the reaction forces R_L and R_R and the magnitude and nature of the forces in the members. **Tabulate your results using Bow's notation.**

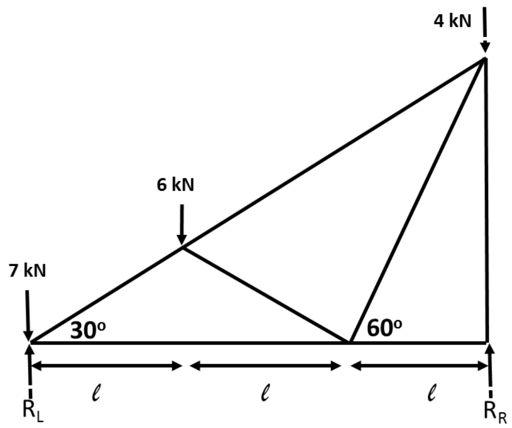


Fig. 3

[22]

Success is no accident. It is hard work, perseverance, learning, studying, sacrifice and most of all, love of what you are doing or learning to do.

The End

Good luck

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. $W_{loss} = \rho_l gV_b$
6. $RDs = \frac{W\ in\ air}{W\ in\ air - W\ in\ water}$
7 $RDl = \frac{W\ in\ air - W\ in\ liquid}{W\ in\ air - W\ in\ water}$
8. $W = \rho gV$
9. $P_1 + 1/2\rho v_1^2 + \rho gh_1 = P_2 + 1/2\ \rho v_2^2 + \rho gh_1$
10. $V_1A_1 = V_2A_2$

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. $v = f\lambda$
2. B = 10 LOG (I_1/I_0)
3. I = P/4ПR^2

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

10. AREA OF A SPHERE

$A = 4\pi r^2$

11. VOLUME OF A SPHERE

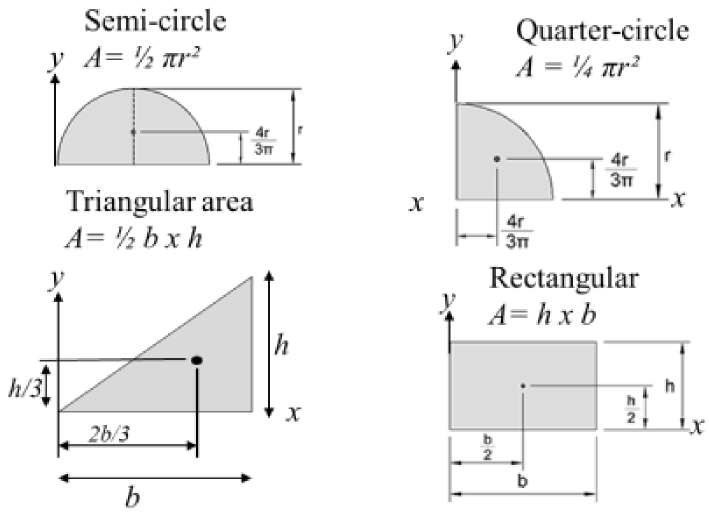
$V = 4/3\ \pi r^3$

12. ILLUMINATION

$E = I/d^2$
$E = I/d^2 \cos\theta$

13. Stress = F/A
14. Strain = X/L_o
15. Young's modulus
$E = F.L_o/X.A$

16 Stress $F/A = E\lambda\Delta T$



Centroids

$$\bar{x} = \sum_{i=1} \frac{A_i\, x_i}{A_i}$$

$$\bar{y} = \sum_{i=1} \frac{A_i\, y_i}{A_i}$$