higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

ENGINEERING PHYSICS N5

28 November 2024

This marking guideline consists of 8 pages.

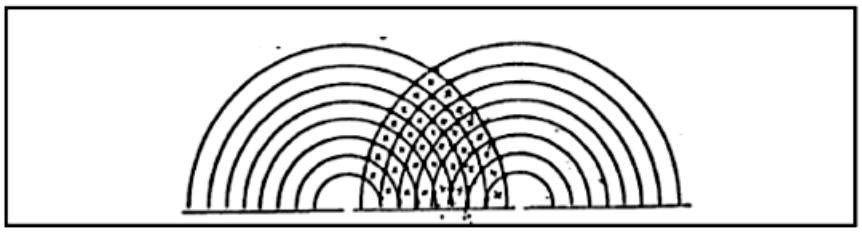
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QUESTION 1

1.1
1.1.1 True
1.1.2 True
1.1.3 True
1.1.4 True
1.1.5 False
1.1.6 False
1.1.7 False
1.1.8 True
1.1.9 True
1.1.10 True

(10 × 1) (10)

1.2



- 'x' shows where waves weaken one another.
- '.' shows where waves reinforce one another.
- At the 'x' positions it will appear dark and the '.' position the light will be bright. We see a series of dark and light strips. (2)

1.3 $\left(P + \frac{n^2 . a}{v^2}\right)\checkmark(V - n.b)\checkmark = n R_0 T\checkmark$ (3)

1.4 1.4.1 $\mathbf{E}mf = BLv$

$= 3 \times 0.45 \times 30\checkmark$

$= 40.5\ V\checkmark$ (2)

1.4.2 $I = \frac{V}{R}$

$= \frac{40.5}{0.32}\checkmark$

$I = 126.563\ A\checkmark$

$F = BIL$

$= 3 \times 126.563 \times 0.45\checkmark$

$F = 170.860\ N\checkmark$ (4)

1.5
- v = velocity of the molecule
- R_0 = Gas constant/Universal gas constant
- T = absolute temperature
- M = molecular mass (4)

[25]

QUESTION 2

2.1 $\mathrm{R} = \mathrm{C_p} - \mathrm{C_v}$

$120 = 370 - C_v$

$C_v = 250\frac{J}{Kg}.K$✓

$\gamma = \frac{\mathrm{C_p}}{\mathrm{C_v}}$

$= \frac{370}{250}$

$= 1.48$ ✓

$\mathrm{P_2} = (\frac{\mathrm{V_1}}{\mathrm{V_2}})^{\gamma}\mathrm{P_1}$

$= \left(\frac{0.09}{0.27}\right)^{1.48} \times 20000$ ✓

$= 3934.509$ Pa✓ (6)

2.2 $\mathrm{F} = \frac{\mathrm{G} \times \mathrm{m_1} \times \mathrm{m_2}}{\mathrm{r}^2}$

$0.025 \times 10^3 = \frac{6.673 \times 10^{-11} \times 50 \times \mathrm{m_2}}{(840 \times 840)}$✓✓

$\mathrm{m_2} = 5{,}287 \times 10^{16}$✓ (3)

2.3 $\mathbf{V} = \mathrm{R_g} \times \mathrm{I_g}$

$= 60 \times 1.85 \times 10^{-3}$✓

$= 0.111$ V✓ (2)

2.4 $r_2 = 1.4 - 0.4 = 1$✓

$$\frac{I_1}{r_1^2} = \frac{I_2}{r_2^2}$$

$$\frac{400}{(0.4)^2} = \frac{I_2}{(1)^2}$$✓✓

$I_2 = 2500\ cd$✓ (4)

2.5 $$T_2 = \frac{P_2V_2}{mR}$$

$$= \frac{0.44 \times 10^5 \times 0.056}{0.85 \times 195}$$✓✓

$T_2 = 14.866\ K$✓

$U = m\ C_v \Delta t$

$= 0.85 \times 148 \times (369 - 14.866)$ ✓✓

$U = 44550.057\ J$✓ (6)

2.6 $$v^2 = \frac{GM}{r}$$

$$r = \frac{6.673 \times 10^{-11} \times 1.99 \times 10^{30}}{(5.2 \times 10^6)^2}$$✓

$= 4910972{,}633m$✓

$$v = \frac{2\pi r}{T}$$

$$T = \frac{2\pi (4910972{,}633)}{5.2 \times 10^6}$$✓

$= 5.934\ sec$✓ (4)

[25]

QUESTION 3

3.1
- It either real or virtual.
- It has distance from its mirror.
- It is upright or virtual.
- It is enlarged or reduced. (2)

3.2 $PV = m\,RT$

$m = \frac{190000 \times 6}{306 \times 395}$ ✓✓

$= 9.432\ Kg$ ✓ (3)

3.3 The electrostatic force✓ between two-point charges is directly proportional✓ to the product of their charges and inversely proportional✓ to the square of the distance between them.✓

It is a VECTOR quantity.✓ (5)

3.4 $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$

$\frac{1}{R_p} = \frac{1}{4} + \frac{1}{3}$ ✓

$\frac{1}{R_p} = \frac{7}{12}$

$R_p = 1.714\ \Omega$ ✓

$R_T = R_p + R_3$

$R_T = 1.714 + 6$

$R_T = 7.714\ \Omega$ ✓

$I_T = \frac{V}{R}$

$I = \frac{12}{7.714}$ ✓

$I = 1.556\ A$ ✓ (5)

3.5 The rate of diffusion is inversely proportional to the square root of their respective densities✓ and their respective molecular masses.✓ (2)

3.6 3.6.1

$$f_1 = \frac{1}{D_1}$$

$$f_1 = \frac{1}{20}\checkmark$$

$$f_1 = 0.05 \text{ m}$$

$$f_1 = 0.05 \times 1000$$

$$f_1 = 50 \text{ mm}\checkmark$$

$$\frac{1}{f_1} = \frac{1}{a} + \frac{1}{b}$$

$$\frac{1}{50} = \frac{1}{120} + \frac{1}{b}\checkmark$$

$$\frac{1}{b} = \frac{1}{50} - \frac{1}{120}$$

$$\frac{1}{b} = \frac{7}{600}$$

$$b = 85.714 \text{ mm}\checkmark$$

$$V = \frac{85.714}{120}\checkmark$$

$$V = 0.714\checkmark$$ (6)

3.6.2

$$f_2 = \frac{1}{D_2}$$

$$f_2 = \frac{1}{12}\checkmark$$

$$f_2 = 0.083 \text{ m}$$

$$f_2 = 0.083 \times 1000$$

$$f_2 = 83 \text{ mm}\checkmark$$ (2)

[25]

QUESTION 4

4.1 4.1.1 Is the number of magnetic field lines✓ passing through a given closed circuit.✓

4.1.2 The attraction between two or more✓ different molecules.✓

4.1.3 Is the energy that moves from one place to another✓ in a form that can be described as waves or particles.✓

(3 × 2) (6)

4.2
- C_p is the specific heat capacity at constant pressure.
- C_v is the specific heat capacity at constant volume. (2)

4.3 4.3.1

$$B = \frac{\mu \times I}{2\pi \times r}$$

$$= \frac{4\pi \times 10^{-7} \times 2}{2\pi \times 0.02} \checkmark$$

$$= 2 \times 10^{-5}\ \text{Wb/m}^2 \checkmark \quad (2)$$

4.3.2 Number of windings:

$$1\ \text{Rev} = \pi D$$

$$= \pi \times 0.02$$

$$= 0.063\ \text{m} \checkmark$$

$$N = \frac{12}{0.063}$$

$$N = 190.476 \checkmark$$

$$B = \frac{\mu_0 \times N I}{2\pi r}$$

$$= \frac{4\pi \times 10^{-7} \times 190.476 \times 2}{2\pi \times 0.01} \checkmark$$

$$B = 0.008\ \text{Wb/m}^2 \checkmark \quad (4)$$

4.4
- A semi permeable membrane is stretched over one end of a container with two open ends.
- The container is then half-filled with a sugar solution and placed in a bowl of water with the narrow end up.
- The sugar solution will slowly rise in the tube and cannot go back because it mixes with sugar to form further sugar solution.
- Diffusion of water molecules with the sugar solution takes place in one direction only. (4)

4.5 Surface tension is caused by the lateral forces of attraction✓ between molecules on the surface of a liquid.✓ It seems as if a membrane is stretched over the surface of the liquid.✓ (3)

4.6 $\mathbf{F} = \mathrm{mg}$

$= 0.008 \times 9.8$✓

$= 7.84 \times 10^{-3}\ \mathrm{N}$✓

$\mathrm{T} = \dfrac{\mathrm{F}}{2\mathrm{L}}$

$= \dfrac{7.84 \times 10^{-3}}{2 \times 0.24}$✓

$\mathrm{T} = 0.016\ \mathrm{N/m}$✓ (4)

[25]

TOTAL: 100

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