higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

ENGINEERING PHYSICS N5

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This marking guideline consists of 8 pages.

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QUESTION 1

1.1 1.1.1 This is the diffusion that takes place in one direction only.✓✓ (2)

1.1.2 This is the amount of light radiated by a black container with a surface area of 100 mm^2 filled with liquid platinum allowed to set (at 2 500 °C).✓✓ (2)

1.1.3 This is the force of attraction between the molecules of two different substances.✓ (1)

1.1.4 This is the force of attraction between the molecules of a liquid.✓ (1)

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

1.1.6 The volume of a given mass of a gas is inversely proportional to the pressure upon it, if the temperature is kept constant.✓✓ (2)

1.1.7 The lateral force of attraction between the molecules of a liquid that are on line on the surface of the liquid, causes the liquid to behave as if it were covered with a membrane.✓✓ (2)

1.2 1.2.1 $$B = \frac{\mu_o I}{2\pi r}$$

$$= \frac{4\pi \times 10^{-7} \times 12}{2\,\pi \times \frac{400}{1000}}\checkmark$$

$$= 6 \times 10^{-6} Wb/m^2 \checkmark$$ (2)

1.2.2 $$B = \frac{\mu_o I}{2r}$$

$$= \frac{4\,\pi \times 10^{-7} \times 12}{2 \times \frac{140}{1000}}\checkmark$$

$$= 5{,}386 \times 10^{-5} Wb/m^2 \checkmark$$

(2)

1.2.3 $$N = 1200 \times 0{,}5 = 600\ turns\checkmark$$

$$B = \frac{\mu_o NI}{L}$$

$$= \frac{4\,\pi \times 10^{-7} \times 600 \times 12}{0{,}5}\checkmark$$

$$= 0{,}018\ Wb/m^2\checkmark$$ (3)

1.3 1.3.1 $v = \frac{1\,200}{3,6} = 333,333\ m/s$

$emf = BLv$
$= 10^{-6} \times 14 \times 333,333$ ✓
$= 4,667 \times 10^{-3}\ V$ ✓

1.3.2 $\Delta t = \frac{1}{f} = \frac{1}{20} = 0,05\ s$

$E = \frac{N\Delta\emptyset}{\Delta t}$

$= \frac{100 \times (24-2) \times 10^{-4}}{0,05}$ ✓

$= 4,4\ V$ ✓

(2 × 2) (4)
[23]

QUESTION 2

2.1 2.1.1 $\Delta l = \varepsilon \times l_o$

$= 0,3 \times 3,5$ ✓
$= 1,05\ m$ ✓

2.1.2 $d = \frac{40}{1000}$ = 0,04 m

$r = \frac{d}{2} = \frac{0,04}{2} = 0,02\ m$

$A = \pi r^2$
$= \pi \times (0,02)^2$ ✓
$= 1,257 \times 10^{-3} m^2$ ✓

Or
$A = \frac{\pi\, d^2}{4}$

$= \frac{\pi\,(0,04)^2}{4}$ ✓
$= 1,257 \times 10^{-3}\ m^2$ ✓

2.1.3 $\delta = \frac{F}{A}$

$= \frac{50 \times 10^3}{1{,}257 \times 10^{-3}}$ ✓

$= 39777247{,}41\ Pa \ \ = 39{,}777\ MPa$✓

2.1.4 $\in = \frac{\delta}{\varepsilon}$

$= \frac{39777247{,}41}{0{,}3}$ ✓

$= 132590824{,}7\ \ Pa \ \ = 1{,}326\ GPa$✓

(4 × 2) (8)

2.2 2.2.1 Used in photocopy machines (Any relevant answer)

2.2.2 To determine the velocity of the sound in a gas

2.2.3 To polarise the light

(3 × 1) (3)

2.3
- It may be allowed to pass through.
- It may be totally reflected.
- Light may be both reflected and allowed to pass through. (3)

2.4
- Candle
- Flames
- Electric lights (Any 2 x 1) (2)

2.5 2.5.1 F = 140 mm, a = 300 mm

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

$\frac{1}{140} = \frac{1}{300} + \frac{1}{b}$✓

$\frac{1}{b} = \frac{1}{140} - \frac{1}{300}$

$\frac{1}{b} = 3{,}809 \times 10^{-3}$✓

$b = 262{,}536\ mm$ ✓ (3)

2.5.2 $Size : V = \frac{b}{a} = \frac{262,536}{300}$✓

$V = 0.875$ ✓ (2)

2.5.3 $V = \frac{size\ of\ the\ image}{size\ of\ the\ object}$

$V \times Size\ of\ the\ object = Size\ of\ the\ image$

$Size\ of\ the\ image = 0,875 \times 80$✓

$Size\ of\ the\ image = 70\ mm$✓ (2)
[23]

QUESTION 3

3.1 3.1.1 $P_1V_1^{1,4} = P_2V_2^{1,4}$

$V_2^{1,4} = \frac{P_1}{P_2} \times V_1^{1,4}$

$= \frac{1,6}{5,2} \times (6)^{1,4}$ ✓

$= 3,780$✓

$V_2 = (3,780)^{\frac{1}{1.4}}$✓

$V_2 = 2,585\ m^3$✓

3.1.2 $PV = mRT$

$m = \frac{PV}{RT}$

$m = \frac{1,6 \times 1000 \times 6}{180 \times 303}$✓✓

$m = 0,176\ kg$ ✓

(2 × 3) (6)

3.2 3.2.1
- A = air pressure
- m = mercury
- b = flexible rubber pipe
- c = closed volume of the gas
- d = thermometer
- e = ruler
- x = difference in height from A to f (6)

3.2.2 To measure the gas temperature (1)

3.3 $F = G\frac{m_1 m_2}{r^2}$

$= \frac{6{,}673 \times 10^{-11} \times 20 \times 0{,}3}{(0{,}18)^2}$✓

$= 1{,}236 \times 10^{-8} N$✓ (2)

3.4 $l = \frac{180}{1000} = 0{,}18\ m$

$T = \frac{F}{2l}$

$= \frac{0{,}0095}{2 \times 0{,}18}$✓

$= 0{,}026\ N/m$✓ (2)

3.5 $E_{k\ contained} = Heat\ energy\ absorbed\ by\ bullet$

$\frac{1}{2}mv^2 = mc\Delta t$

$\frac{1}{2} \times \frac{70}{1000} \times (420)^2 = \frac{70}{1000} \times 136{,}2 \times \Delta t$ ✓

$6174 = 9{,}534 \times \Delta t$✓

$\Delta t = 647{,}577° C$✓

$\Delta t = 647{,}577\ K$✓ (4)

3.6
- Larger coil surface
- More turns in the coil
- A higher magnetic flux
- A weaker hair spring (4)

[25]

QUESTION 4

4.1 4.1.1 $R = C_p - C_v$

$= 360 - 220$

$= 140$ J/Kg.K✓ (2)

4.1.2 $PV = mRT$

$$V = \frac{0{,}2 \times 140 \times 323}{3 \times 10^5}$$✓

$V = 0{,}0301\ m^3$✓ (3)

4.1.3 $\gamma = \frac{C_p}{C_v}$

$= \frac{360}{220}$✓

$= 1{,}636$✓ (2)

4.1.4 $V_2 = \frac{1}{3} \times V_1$

$= \frac{1}{3} \times 0{,}0301$

$= 0{,}01\ m^3$✓

$P_1 V_1^{\gamma} = P_2 V_2^{\gamma}$

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

$= \left(\frac{0.0301}{0.01}\right)^{1.636} \times 3 \times 10^5$✓✓

$= 1\,819\,935.689\ Pa = 1{,}820\ MPa$✓ (4)

4.1.5 $\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$

$$T_2 = \frac{1\,819\,935{,}689 \times 0{,}01 \times 323}{3 \times 10^5 \times 0{,}0301}$$✓✓

$T_2 = 650{,}985\ °C$ ✓ (3)

4.2 $PV = nRT$

$$PV = \frac{m}{M} \times RT$$

$$V = \frac{mRT}{M \times P}$$

$$= \frac{0{,}6 \times 8314 \times 350}{42 \times 2 \times 10^5}$$ ✓✓✓

$V = 0{,}208\ m^3$ ✓ (4)

4.3 4.3.1 The galvanometer (1)

4.3.2
- A = jewel bearing
- B = zero adjuster
- C = coil
- D = hair spring
- E = permanent magnet
- F = balance weight
- G = soft iron cylinder
- H = cylinder support
- I = insulated mounting
- J = hair spring (10)

[29]

TOTAL: 100

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