



**higher education  
& training**

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Department:  
Higher Education and Training  
**REPUBLIC OF SOUTH AFRICA**

# **MARKING GUIDELINE**

**NATIONAL CERTIFICATE**

**ENGINEERING PHYSICS N5**

**30 November 2023**

**This marking guideline consists of 9 pages.**

**QUESTION 1**

- 1.1      1.1.1      True  
           1.1.2      True  
           1.1.3      False  
           1.1.4      False  
           1.1.5      False  
(5 × 1)      (5)
- 1.2      1.2.1      It is the force of attraction between the molecules of different substances.  
           1.2.2      It is the relationship of the speed of light in a specific medium.  
(2 × 2)      (4)
- 1.3      • Step-up transformer  
           • Step-down transformer  
(2)
- 1.4      1.4.1      m/s and scalar  
           1.4.2      N and vector  
(2 × 2)      (4)
- 1.5      1.5.1      Periscope  
           1.5.2      • Flames  
                   • Electric light  
                   • Candles  
(Any 1 × 1)  
 (2 × 1)      (2)
- 1.6      1.6.1      Ratio =  $\frac{N_p}{N_s}$  or Ratio =  $\frac{N_1}{N_2}$   
                   =  $\frac{3600}{800}$  ✓  
                   = 4 : 1 ✓
- 1.6.2       $\frac{N_p}{N_s} = \frac{V_p}{V_s}$  or  $\frac{N_1}{N_2} = \frac{V_1}{V_2}$   
 $N_p \times V_s = V_p \times N_s$  or  $N_1 \times V_2 = V_1 \times N_2$   
 $\frac{V_s}{900} = \frac{220}{3600}$  ✓  
 $V_s = 55 \text{ V}$  ✓

$$1.6.3 \quad \frac{N_p}{N_s} = \frac{I_s}{I_p} \quad \text{or} \quad \frac{N_1}{N_2} = \frac{I_2}{I_1}$$

$$N_p \times I_p = N_s \times I_s \quad \text{or} \quad N_1 \times I_1 = N_2 \times I_2$$

$$\frac{I_s}{3600} = \frac{4}{900} \checkmark$$

$$I_s = 16 \text{ A} \checkmark$$

$$1.6.4 \quad P = V_1 \times I_1 \quad \text{or} \quad P = V_p \times I_p$$

$$= 55 \times 16 \checkmark$$

$$P = 880 \text{ W} \checkmark$$

$$P = V_2 \times I_2 \quad \text{or} \quad P = V_s \times I_s$$

$$= 220 \times 4 \checkmark$$

$$P = 880 \text{ W} \checkmark$$

(4 × 2) (8)  
[25]

## QUESTION 2

$$2.1 \quad 2.1.1 \quad R = C_p - C_v$$

$$= 385 - 210$$

$$= 175 \text{ J/Kg} \cdot \text{K} \checkmark$$

(1)

$$2.1.2 \quad \gamma = \frac{C_p}{C_v}$$

$$= \frac{385}{210}$$

$$= 1.833 \checkmark$$

(1)

$$2.1.3 \quad PV = mRT$$

$$V = \frac{0.8 \times 175 \times 283}{4 \times 1000} \checkmark \checkmark$$

$$V = 9.905 \text{ m}^3 \checkmark$$

(3)

$$2.1.4 \quad P_1 V_1^\gamma = P_2 V_2^\gamma \quad V_2 = \frac{1}{3} \times 9.905 = 3.302 \text{ m}^3 \text{ m}^3$$

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

$$= \left(\frac{9.905}{3.302}\right)^{1.833} \times 4 \times 1000 \checkmark \checkmark$$

$$P_2 = 29960.074 \text{ Pa} \checkmark$$

OR

$$P_2 = 299.6 \text{ KPa} \checkmark$$

(3)

$$2.1.5 \quad \frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$T_2 = \frac{29960.074 \times 3.302 \times 283}{4 \times 1000 \times 9.905} \checkmark$$

$$T_2 = 706.629 \text{ K} \checkmark$$

Or

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

$$T_2 = \frac{29.96 \times 3.302 \times 283}{4 \times 9.905} \checkmark$$

$$T_2 = 706.628 \text{ K} \checkmark$$

(2)

$$2.2 \quad 2.2.1 \quad B = \frac{\mu_0 \times I}{2r}$$

$$= \frac{4\pi \times 10^{-7} \times 9}{2 \times (0.18)} \checkmark$$

$$= 3.142 \times 10^{-5} \text{ Wb/m} \checkmark$$

(2)

$$2.2.2 \quad N = 1440 \times 07 = 1008 \text{ turns} \checkmark$$

$$B = \frac{\mu_0 \times NI}{L}$$

$$= \frac{4\pi \times 10^{-7} \times 1008 \times 9}{0.7} \checkmark$$

$$= 0.016 \text{ Wb/m} \checkmark$$

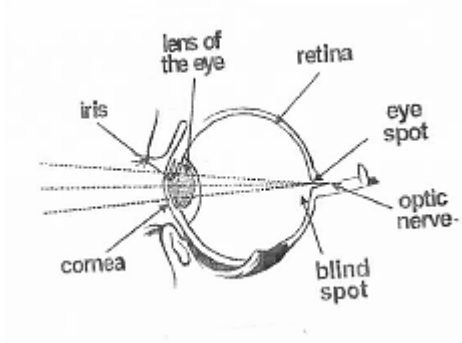
(3)

2.3 2.3.1 To find the plane of polarisation of polarised rays of light  
2.3.2 To produce velocity, frequency and period of the sound

(2 × 1) (2)

- 2.4
- Tourmaline crystals
  - Polaroid plate
  - Sugar solution
- (3)

2.5



(1,5 mark for the correct diagram) (1,5)  
 (½ mark for each correctly labelled part) (3,5)

(5)  
**[25]**

**QUESTION 3**

3.1 3.1.1

$$v = \frac{\text{height of the image}}{\text{height of the object}}$$

$$= \frac{800}{200}$$

$$= 4 \checkmark$$

$$V = \frac{b}{a}$$

$$4 = \frac{b}{200} \checkmark$$

$$b = -800 \text{ mm} \checkmark$$

(3)

3.1.2

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

$$\frac{1}{f} = \frac{1}{200} - \frac{1}{800} \checkmark$$

$$\frac{1}{f} = \frac{3}{800}$$

$$f = 266.667 \text{ mm} \checkmark$$

(2)

3.2

$$n = \frac{\sin \frac{(A + D_m)}{2}}{\sin \frac{A}{2}}$$

$$1.3 = \frac{\sin \frac{(20 + D_m)}{2}}{\sin \frac{20}{2}} \checkmark$$

$$1.3 = \frac{\sin \frac{(20 + D_m)}{2}}{0.174}$$

$$\sin \frac{(20 + D_m)}{2} = 1.3 \times 0.174$$

$$\sin \frac{(20 + D_m)}{2} = 0.226 \checkmark$$

$$\frac{(20 + D_m)}{2} = 13.062$$

$$(20 + D_m) = 2 \times 13.062 \checkmark$$

$$D_m = 26.124 - 20$$

$$D_m = 6.124^\circ \checkmark$$

(5)

3.3

$$3.3.1 \quad E = \frac{\Delta L}{L_0}$$

$$\Delta L = E \times L_0$$

$$= 0.4 \times 4 \checkmark$$

$$E = 1.6 \text{ m} \checkmark$$

(2)

$$3.3.2 \quad A = \pi r^2$$

$$= \pi \times \left(\frac{15}{1000}\right)^2 \checkmark$$

$$A = 7.069 \times 10^{-4} \text{ m}^2 \checkmark$$

(2)

$$3.3.3 \quad \sigma = \frac{F}{A}$$

$$= \frac{45000}{7.067 \times 10^{-4}} \checkmark \checkmark$$

$$\sigma = 63658226.06 \text{ Pa} \checkmark$$

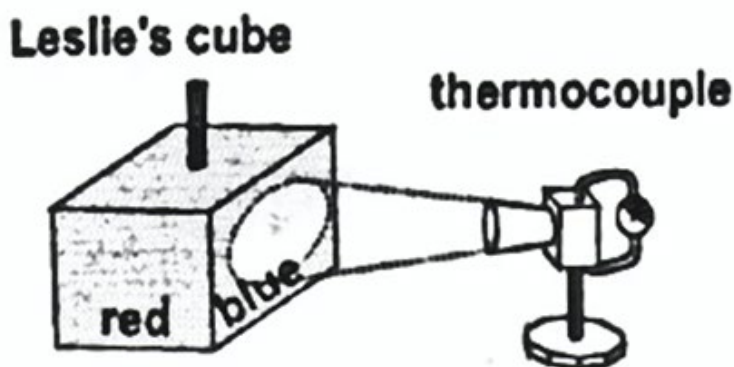
(3)

- 3.4 3.4.1 • The shinier the surface area, the less heat will be absorbed  
 • The duller the surface area, the more heat will be absorbed  
 (Any 1 × 2)
- 3.4.2 The more heat radiated and the more it will be absorbed. (2 × 2) (4)
- 3.5  $v = f \cdot \lambda$   
 $= 45 \times 2.45 \checkmark$   
 $v = 110.25 \text{ m/s} \checkmark$  (2)
- 3.6 Longitudinal wave  $\checkmark$   
 Transverse wave  $\checkmark$  (2)  
**[25]**

**QUESTION 4**

- 4.1 4.1.1  $A = \pi \times D \times h$   
 $= \pi \times \frac{60}{1000} \checkmark \times 1.2 \checkmark$   
 $= 0.226 \text{ m}^2 \checkmark$
- 4.1.2  $Q = e \delta T^4 A$   
 $= 0.3 \times 4.75 \times 10^{-8} \checkmark \times (301)^4 \times 0.226 \checkmark$   
 $= 26.436 \text{ J/s} \checkmark$
- 4.1.3 Light energy = electrical energy – heat energy  
 $= 80 - 26.436 \checkmark \checkmark$   
 $= 53.564 \text{ J/s} \checkmark$  (3 × 3) (9)

4.2



(ONE mark for each correct label) (4)  
 (ONE mark for the correct diagram) (1) (5)

- 4.3
- It consists of a paper with a grease spot.
  - Place a light ( $L_1$ ) of unknown intensity at a distance of ( $r_1$ ) from the screen.
  - Place a light ( $L_2$ ) of unknown intensity at a distance of ( $r_2$ ) from the screen.
  - If only  $L_1$  is shining, the grease spot will appear dark when seen from the left and bright when seen from the right. (4 × 2) (8)

4.4

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

$$= \frac{6.673 \times 10^{-11} \times 0.68 \times (3 \times 0.82)}{(2.4)^2} \checkmark \checkmark$$

$$F = 1.607 \times 10^{-11} \text{N} \checkmark \quad (3)$$

**[25]**

**TOTAL: 100**