



higher education  
& training

Department:  
Higher Education and Training  
REPUBLIC OF SOUTH AFRICA

# MARKING GUIDELINE

NATIONAL CERTIFICATE  
ENGINEERING PHYSICS N5

31 JULY 2018

This marking guideline consists of 8 pages.

**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  | True  |
| 1.1.7  | False |
| 1.1.8  | True  |
| 1.1.9  | False |
| 1.1.10 | False |

(10 × 1) (10)

1.2

$$P = \rho gh$$

$$= 13600 \times 9,8 \times 0,9 \checkmark$$

$$= 119952 \text{ Pa} \checkmark$$

$$PV = mRT$$

$$V = \frac{4 \times 360 \times 373}{119952} \checkmark$$

$$V = 4,478 \text{ m}^3 \checkmark \quad (4)$$

1.3

1.3.1

$$R = \frac{R_0}{M}$$

$$= \frac{8314}{28} \checkmark$$

$$= 296,9 \text{ J/Kg K} \checkmark \quad (2)$$

1.3.2

$$P_1 V_1 = mRT_1$$

$$m_1 = \frac{2,1 \times 10^5 \times 0,4}{296,9 \times 291} \checkmark \checkmark$$

$$m_1 = 0,972 \text{ kg} \checkmark \quad (3)$$

1.3.3

$$M_2 = 0,972 + 0,4 = 1,372 \text{ kg}$$

$$V_1 = V_2 \text{ and } T_1 = T_2$$

$$P_2 V_2 = mRT_2$$

$$P_2 = \frac{1,372 \times 296,9 \times 291}{0,4} \checkmark \checkmark$$

$$P_2 = 296\,344,797 \text{ Pa} = 296,345 \text{ kPa} \checkmark \quad (3)$$

$$1.4 \quad F = \frac{Gm_1m_2}{r^2}$$

$$r = \sqrt{\frac{Gm_1m_2}{F}}$$

$$r = \sqrt{\frac{6,673 \times 10^{-11} \times 50 \times 0,3}{250 \times 1000}} \checkmark \checkmark$$

$$r = 6,328 \times 10^{-8} m \checkmark$$

(3)  
[25]**QUESTION 2**

$$2.1 \quad 2.1.1 \quad R = C_p - C_v \\ = 250 - 92 \\ = 158 \text{ J / kg K } \checkmark$$

$$PV = mRT$$

$$m = \frac{150 \times 1000 \times 0,4 \times 10^{-3}}{158 \times 303} \checkmark$$

$$m = 1,253 \times 10^{-3} \text{ kg } \checkmark$$

(3)

$$2.1.2 \quad \gamma = \frac{c_p}{c_v}$$

$$= \frac{250}{92}$$

$$= 2,717 \checkmark$$

$$P_1V_1^\gamma = P_2V_2^\gamma$$

$$V_2^{2,717} = \left(\frac{150}{500}\right) \times (0,4 \times 10^{-3})^{2,717} = 1,758 \times 10^{-10} \checkmark$$

$$V_2 = 2,568 \times 10^{-4} \text{ m}^3 \checkmark$$

(3)

$$2.1.3 \quad \frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$T_2 = \frac{500 \times 2,568 \times 10^{-4} \times 303}{150 \times 4 \times 10^{-4}} \checkmark \checkmark$$

$$T_2 = 648,42 \text{ }^\circ\text{C } \checkmark$$

(3)

$$\begin{aligned}
 2.1.4 \quad \rho &= \frac{m}{V} \\
 &= \frac{1,253 \times 10^{-3}}{0,4 \times 10^{-3}} \\
 &= 3,133 \text{ kg/m}^3 \checkmark \\
 \bar{v} &= \sqrt{\frac{3P}{\rho}} \\
 &= \sqrt{\frac{3 \times 150 \times 1000}{3,133}} \checkmark \\
 &= 378,989 \text{ m/s} \checkmark
 \end{aligned} \tag{3}$$

- 2.2 A – Thermometer  
 B – Capillary tube  
 C – Mercury  
 D – Ruler  
 E – Stirrer  
 F – Gas burner
- (6)

2.3  $F = 140 \text{ mm}$  ,  $a = 300 \text{ mm}$

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

$$\frac{1}{100} = \frac{1}{220} + \frac{1}{b} \checkmark$$

$$\frac{1}{b} = \frac{1}{100} - \frac{1}{220}$$

$$\frac{1}{b} = \frac{3}{550} \checkmark$$

$$b = 183,333 \text{ mm} \checkmark$$

$$\text{Size : } V = \frac{b}{a} = \frac{183,333}{220} \checkmark$$

$$V = 0,833 \checkmark$$

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

$$0,833 \times \text{Size of the object} = \text{Size of the image}$$

$$\text{Size of the image} = 0,833 \times 50 \checkmark$$

$$\text{Size of the image} = 41,65 \text{ mm} \checkmark$$

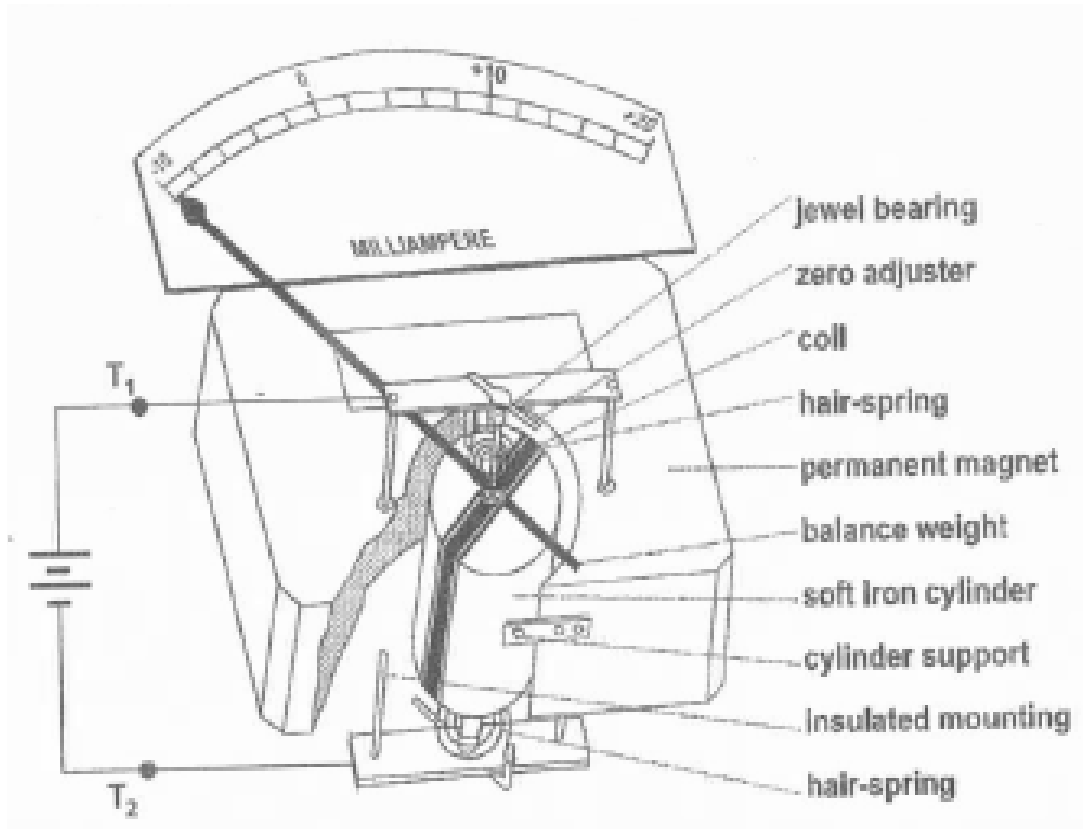
(7)

**QUESTION 3**

- 3.1 A – Lens of the eye  
 B – Retina  
 C – Eye spot  
 D – Optic nerve  
 E – Blind spot  
 F – Cornea  
 G – Iris

(7)

3.2



(10)

3.3

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

$$= \frac{0,098}{2 \times 0,16} \checkmark$$

$$= 0,306 \text{ N/m} \checkmark$$

(2)

3.4

- 3.4.1 Surface tension is the lateral force of attraction between the molecules on the surface of a liquid that causes the liquid to behave as if it were covered with a membrane.
- 3.4.2 When two different substances are placed next to each other, the movement of their molecules may cause them to form a homogeneous mixture.
- 3.4.4 Osmosis is diffusion that takes place in one direction only.

(3 × 2) (6)

**[25]**

**QUESTION 4**

4.1 4.1.1 Meniscus convex lens

4.1.2 One-sided convex lens

(2 × 1) (2)

4.2 
$$\frac{1}{F} = \frac{1}{a} + \frac{1}{b}$$

$$\frac{1}{-200} = \frac{1}{100} + \frac{1}{b} \checkmark$$

$$\frac{1}{b} = \frac{1}{-200} - \frac{1}{100}$$

$$\frac{1}{b} = \frac{-3}{200} \checkmark$$

$$b = -66,667 \text{ mm} \checkmark$$

$$b = 66,667 \text{ mm behind the mirror} \checkmark \quad (4)$$

4.3 
$$n = \frac{\sin \frac{(A + D_m)}{2}}{\sin \frac{A}{2}}$$

$$1,5 = \frac{\sin \frac{(30 + D_m)}{2}}{\sin \frac{30}{2}}$$

$$1,5 = \frac{\sin \frac{(30 + D_m)}{2}}{0,259} \checkmark$$

$$\sin \frac{(30 + D_m)}{2} = 1,5 \times 0,259$$

$$\sin \frac{(30 + D_m)}{2} = 0,389 \checkmark$$

$$\frac{(30 + D_m)}{2} = 22,892$$

$$(30 + D_m) = 2 \times 22,892 \checkmark$$

$$D_m = 45,784 - 30$$

$$D_m = 15,784^\circ \checkmark$$

(4)

$$\begin{aligned}
 4.4 \quad \sin \theta_c &= \frac{1}{n} \\
 \sin \theta_c &= \frac{1}{1,47} \checkmark \\
 \theta_c &= 42,865^\circ \checkmark
 \end{aligned}
 \tag{2}$$

$$\begin{aligned}
 4.5 \quad D &= \frac{1}{f} \\
 &= \frac{1}{0,2} \\
 &= 5 \text{ diopters } \checkmark
 \end{aligned}
 \tag{1}$$

$$\begin{aligned}
 4.6 \quad E &= \frac{I}{r^2} \\
 &= \frac{72}{(0,6)^2} \checkmark \\
 &= 200 \text{ lux } \checkmark
 \end{aligned}
 \tag{2}$$

- 4.7
- 4.7.1 To determine the wavelength of a light
- 4.7.2 To find the plane of polarisation of a polarised ray of light
- 4.7.3 To determine the strength of the poles of a magnet
- 4.7.4 To measure the consumption of electricity or electrical energy
- 4.7.5 To test the radiation of various surfaces
- (5 × 1) (5)

$$\begin{aligned}
 4.8 \quad B &= \frac{\mu_0 I}{2\pi r} \\
 &= \frac{4\pi \times 10^{-7} \times 18}{2\pi \times \frac{80}{1000}} \checkmark \\
 &= 4,5 \times 10^{-5} \text{ Wb/m}^2 \checkmark
 \end{aligned}
 \tag{3}$$

$$\begin{aligned}
 4.9 \quad r &= 2f \\
 &= 2 \times 300 \checkmark \\
 &= 600 \text{ mm } \checkmark
 \end{aligned}
 \tag{2}$$

**[25]**

**TOTAL: 100**