



higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

POWER MACHINES N5

17 August 2026

This marking guideline consists of 5 pages.

QUESTION 1

- 1.1 1.1.1 Considering only 1 kg of a substance (2)
- 1.1.2 The pressure does not change (2)
- 1.1.3 The sum of the kinetic and potential energy of molecules of a substance (3)

1.2 1.2.1 $p = \frac{1\,560}{v^{1,3}} = 1\,560 v^{-1,3}$ (2)

1.2.2

$$W = \int_{v_1}^{v_2} p \, dv$$

$$= \int_{v_1}^{v_2} \frac{1\,560}{v^{1,3}} \, dv = 1\,560 \int_{v_1}^{v_2} v^{-1,3} \, dv$$

$$= \frac{1\,560}{0,3} \left[\frac{1}{v^{0,3}} \right]_{0,025}^{0,04}$$

$$= \frac{1\,560}{0,3} \left[\frac{1}{0,025^{0,3}} - \frac{1}{0,024^{0,3}} \right] = 2\,680,17 \, J \approx 2\,680 \, J$$

OR

At point 1, $v = 0,025 \, m^3$: $p_1 = \frac{1\,560}{0,025^{1,3}} = 188,713 \, kPa$

At point 2, $v = 0,04 \, m^3$: $p_2 = \frac{1\,560}{0,04^{1,3}} = 102,435 \, kPa$

For a polytropic process, $W = \frac{p_1 v_1 - p_2 v_2}{n - 1}$

$$= \left[\frac{188,713 \times 0,025 - 102,435 \times 0,04}{0,3} \right] \times 10^3 = 2\,680,08 \, J$$

$\approx 2\,680 \, J$

(11)
[20]

QUESTION 2

2.1 Free-air delivery (2)

2.2 2.2.1
$$P_{ind} = \frac{nm_1RT_1}{n-1} \left[r_p^{\frac{n-1}{n}} - 1 \right] \checkmark$$

$$= \frac{1,29 \times 1,6 \checkmark \times 0,287 \times 313 \checkmark}{0,29} \left[\left(\frac{620}{98} \right)^{\frac{0,29}{1,29}} - 1 \right]$$

$$= 328,583 \text{ kW} \checkmark$$
 (4)

2.2.2
$$p_1 v_{ind} = m_1 RT_1 \checkmark \Rightarrow v_{ind} = \frac{1,6 \times 0,287 \times 313}{98 \checkmark} = 1,467 \checkmark \text{ m}^3/\text{s}$$
 (3)

2.2.3
$$\eta_{vol} = \frac{v_{ind}}{v_s} \checkmark \Rightarrow v_s = \frac{1,467}{0,73 \checkmark} = 2 \checkmark \text{ m}^3/\text{s}$$

$$\frac{p_1 v_{ind}}{T_1} = \frac{p_{atm} v_{atm}}{T_{atm}} \checkmark \Rightarrow v_{atm} = \frac{290 \times 98 \times 1,467}{313 \times 101 \checkmark} = 1,319 \checkmark \text{ m}^3/\text{s}$$
 (6)
[15]

QUESTION 3

3.1 3.1.1 The phase change temperature at a given pressure (2)

3.1.2 It increases the feed water temperature.
OR
 It increases the plant's efficiency. (2)

3.1.3 The neutron absorbers or the rods that contain neutron poison
OR
 In a nuclear reactor, the rods that regulate the fission chain reaction (3)

3.2 3.2.1
$$m_s = \frac{\dot{m}_s}{\dot{m}_{oil}} = \frac{90}{11 \checkmark} = 8,18 \checkmark \text{ kg}_s/\text{kg}_{oil}$$
 (2)

3.2.2
$$h_f = 174 \frac{\text{kJ}}{\text{kg}} \checkmark ; h_{ex} = h_f + x h_{fg} \checkmark = 712 \checkmark + 0,98 \times 2\,054 \checkmark$$

$$= 2\,724,92 \frac{\text{kJ}}{\text{kg}} \checkmark$$
 (5)

3.2.3
$$\dot{H}_{ex} = \dot{m}_s h_2 \checkmark = 90 \times 60 \checkmark \times 2\,724,92 = 14\,714\,568 \checkmark \frac{\text{kJ}}{\text{h}}$$
 (3)

3.2.4
$$\eta = \frac{m_s(h_{ex} - h_{in})}{CV \times m_F} \checkmark = \frac{8,18(2\,724,92 - 174)}{31 \checkmark \times 10^3} = 67,311\% \checkmark$$
 (3)

QUESTION 4

4.1 Logarithmic mean temperature difference (2)

4.2 The pressure exerted by a gas in a mixture of gases
OR
 The pressure a gas would have if alone it occupied the volume of a mixture of gases, at the same temperature (3)

4.3 $\dot{v}_s = N v_s \checkmark \dots \dots 1$

$$v_s = \frac{\pi}{4} d^2 l = \frac{\pi}{4} \times (0,12)^2 \times 0,2 = 2,262 \times 10^{-3} \checkmark m^3$$

$$\dot{m}_a = \dot{m}_s \times ratio = \frac{6\,000 \times 0,8}{1\,000 \checkmark} = 4,8 \, kg/h = 0,08 \checkmark kg/min$$

$$p_c \dot{v}_a = \dot{m}_a R T_c \checkmark \Rightarrow v_{ind} = \frac{0,08 \times 0,287 \times (38 + 273)}{5,5 \checkmark} = 1,298 \checkmark m^3/min$$

$$\eta_{vol} = \frac{v_{ind}}{v_s} \checkmark \Rightarrow v_s = \frac{1,298}{0,9} = 1,442 \checkmark m^3/min$$

$$From\ 1\ above, N = \frac{1,443 \times 10^3}{2,262} = 637,489 \checkmark r/min \quad (10)$$

[15]

QUESTION 5

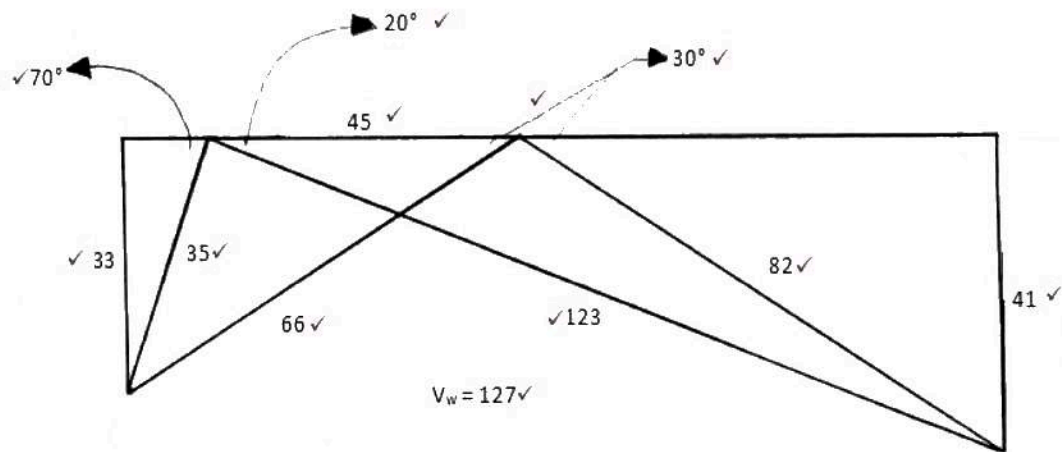
5.1 $\cos 30^\circ = \frac{h}{l} \Rightarrow h = 0,27 \cos 30^\circ \checkmark = 0,2338 \, m \checkmark$

$$\omega = \sqrt{\frac{g}{h}} \checkmark = \sqrt{\frac{9,81}{0,2338}} = 6,478 \checkmark \frac{rad}{s}$$

$$\sin 30^\circ = \frac{r}{l} \Rightarrow r = 0,27 \sin 30^\circ = 0,135 \, m \checkmark$$

$$F = m r \omega^2 \checkmark = 1,5 \times 0,135 \checkmark \times 6,477^2 = 8,495 \, N \checkmark \quad (8)$$

5.2



(12)
[20]

QUESTION 6

6.1 It converts direct current electricity into alternating current electricity. (3)

6.2 6.2.1 False
6.2.2 False

(2 × 1) (2)

6.3 $P_{sol} = AG\eta n \Rightarrow A = \frac{2 \times 10^6}{1,2 \times 10^3 \times 0,24 \times 0,75} = 9\,259,26 \, m^2$

$$A = na \Rightarrow n = \frac{9\,259,26}{2,26} = 4\,097 \, panels$$

$$P_{sol} = \frac{E_{DC}}{t} \Rightarrow E = 2 \times 10^6 \times 11 \times 318 = 6,996 \, GWh$$

(5)
[10]

TOTAL: 100