

APOLLO

Thermodynamics

HL

Physics

First assessment 2025

15 questions | mark schemes

Mark-scheme answers

Physics HL | Paper 1A | May 2025 TZ1 | Q13 | 1 marks

13. C

Physics HL | Paper 1A | May 2025 TZ2 | Q12 | 1 marks

12. D

Physics HL | Paper 1A | May 2025 TZ3 | Q14 | 1 marks

14. D

Physics HL | Paper 1A | May 2025 TZ3 | Q15 | 1 marks

15. A

Physics HL | Paper 1A | May 2025 TZ3 | Q16 | 1 marks

16. C

3.	a	ALT 1 Use of $pV = nRT$ to get $T_B = 1200 \text{ «K»}$ AND $P_C = \left\langle \frac{P_A V_A^{\frac{5}{3}}}{V_C^{\frac{5}{3}}} = \frac{(2 \times 10^6)(1 \times 10^{-3})^{\frac{5}{3}}}{(1 \times 10^{-2})^{\frac{5}{3}}} \Rightarrow 43089 \text{ «Pa»} \checkmark \right.$ $T_C = 4.3 \times 10^4 \times 1200 / 2.0 \times 10^5$ OR $T_C = 258 \text{ «K»} \checkmark$ ALT 2 $P_C = \left\langle \frac{P_A V_A^{\frac{5}{3}}}{V_C^{\frac{5}{3}}} = \frac{(2 \times 10^6)(1 \times 10^{-3})^{\frac{2}{3}}}{(1 \times 10^{-2})^{\frac{2}{3}}} \Rightarrow 43089 \text{ «Pa»} \checkmark \right.$ Use of $p_C V_C = nRT_C = (43089)(1 \times 10^{-2}) = (0.2)(8.31) T_C$ OR $T_C = 259 \text{ «K»} \checkmark$	<i>Must see full substitution OR answer to 3 (or more) significant figures.</i>	2
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– 10 –

2225–6721M

3.	b	Use of $\Delta U = -3/2 n R \Delta T \checkmark$ $W = \langle (3/2)(0.2)(8.31)(1200-259) \rangle = \langle - \rangle 2350 \text{ «J»} \checkmark$		2
3.	c	work done by the gas in the isothermal process is larger $\checkmark$ net work is done by the gas $\checkmark$ net/total work is positive $\checkmark$ work done by the gas is greater than work done on the gas $\checkmark$		1 max

– 11 –

2225–6721M

Question	Answers	Notes	Total
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Mark-scheme answers

Physics HL | Paper 1A | Nov 2025 TZ1 | Q14 | 1 marks

14. D

Physics HL | Paper 1A | Nov 2025 TZ1 | Q15 | 1 marks

15. A

Physics HL | Paper 1A | Nov 2025 TZ3 | Q14 | 1 marks

14. A

Physics HL | Paper 1A | Nov 2025 TZ3 | Q15 | 1 marks

15. C

Physics HL | Paper 1A | Nov 2025 TZ3 | Q16 | 1 marks

16. C

5.	a	ALTERNATIVE 1 $\Delta U = \frac{3}{2} R n \Delta T = \frac{3}{2} P \Delta V \quad \checkmark$ $Q = \frac{3}{2} P \Delta V + P \Delta V = \frac{5}{2} P \Delta V \quad \checkmark$ $Q = \frac{5}{2} \times 22 \times 10^3 \times (3.2 - 4.5) \times 10^{-2} = -7.15 \times 10^2 \approx -700 \text{ J} \quad \checkmark$ ALTERNATIVE 2 $Q = \frac{3}{2} R n \Delta T + P \Delta V = \frac{3}{2} \frac{P V}{T} \Delta T + P \Delta V \quad \checkmark$ temperature at C: $\frac{560 \times 3.2}{4.5} = 398 \text{ K} \quad \checkmark$ $Q = \frac{3}{2} \times \frac{1000}{560} \times (398 - 560) + 22 \times 10^3 \times (3.2 - 4.5) \times 10^{-2} = -7.15 \times 10^2 \text{ J} \quad \checkmark$	<i>Do not penalize absence of minus sign</i> <i>Allow use of $n = 0.21 \text{ mol}$</i>	[3]
5.	b	$Q_{\text{in}} = \langle \Delta U + W = 0 + 480 \rangle \Rightarrow 840 \text{ J} \quad \checkmark$ ALTERNATIVE 1 $\eta = \frac{W}{Q_{\text{in}}} = \frac{Q_{\text{in}} - Q_{\text{out}}}{Q_{\text{in}}} \quad \checkmark$ $\eta = \frac{840 - 715}{840} = 0.149 \approx 0.15 \quad \checkmark$ ALTERNATIVE 2 Net work done $(125 \pm 20) \text{ J}$ by counting squares in loop $\checkmark$ $\eta = \frac{125}{840} = 0.15 \pm 0.02 \quad \checkmark$	Allow $\eta = 0.17$ if rounded 700 J is used Award [3] for a CNA	[3]

Question	Answers	Notes	Total
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Mark-scheme answers

Physics HL | Paper 1A | Specimen 2025 | Q10 | 1 marks

10. D

Physics HL | Paper 1A | Specimen 2025 | Q11 | 1 marks

11. A

Physics HL | Paper 1A | Specimen 2025 | Q12 | 1 marks

12. D