

APOLLO

Thermal energy transfers

HL

Physics

First assessment 2025

11 questions | mark schemes

Mark-scheme answers

Physics HL | Paper 1A | May 2025 TZ1 | Q10 | 1 marks

10. A

Physics HL | Paper 1A | May 2025 TZ2 | Q9 | 1 marks

9. C

Physics HL | Paper 1A | May 2025 TZ3 | Q10 | 1 marks

10. A

Physics HL | Paper 1A | May 2025 TZ3 | Q12 | 1 marks

12. C

2.	a		ALT 1 (in solids) reference to particle/atomic vibrations OR kinetic energy transferred ✓ via collisions OR between adjacent particles/atoms ✓ ALT 2 (in metallic conductors) reference to motion of electrons ✓ that collide with atoms/ions ✓		[2]
	b		$\ll \frac{\Delta Q}{\Delta t} = kA \frac{\Delta T}{\Delta x} = \frac{1.3 \times 18 \times (22 - 13)}{0.25} \gg 8.4 \times 10^2 \quad \checkmark$ Unit is W / Js ⁻¹ / kgm ² s ⁻³ ✓	Ignore the sign in MP1	[2]
	c	i	Identifies gradient as rate of thermal energy transfer OR temperature difference is decreasing ✓		[1]
	c	ii	ALT 1 $N_0 = \frac{PV}{kT_0}$ and $N = \frac{PV}{kT}$ OR 295 and 279 seen ✓ $\frac{\Delta N}{N_0} = \frac{\frac{k \times 279}{PV} - \frac{k \times 295}{PV}}{\frac{k \times 295}{PV}} \quad \checkmark$ $\ll \frac{\Delta N}{N_0} = \frac{16}{279} = \gg 0.057 \text{ OR } 5.7 \% \quad \checkmark$		[3]

– 7 –

2225 – 6715M

			ALT 2 $NT = \text{constant}$ OR $nT = \text{constant}$ OR 295 AND 279 seen ✓ $\ll \frac{N_2}{N_1} \text{ OR } \frac{n_2}{n_1} = \gg \frac{295}{279} \text{ seen} \quad \checkmark$ 5.7 % ✓	Award only MP1, [1] max, if work shown in Celsius	
	d		The heat transfer is irreversible / spontaneous / from hot to cold OR Heat is removed from the room, so entropy decreases ✓ The same heat is deposited at a lower temperature, so outside entropy increase is larger ✓ The entropy change of the Universe/isolated system always increases ✓	For MP1, allow an argument stating that the entropy of the room may have increased due to the increase in mass.	[2 max]

– 8 –

2225 – 6715M

Question	Answers	Notes	Total
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7.	a	i	Weight and Buoyancy drawn in proper directions (by eye) and correctly identified ✓	Allow any sensible identification of the forces (e.g. mg for F_g) Do not allow "gravity" for weight.	1
7.	a	ii	Weight = $\rho_c \cdot A \cdot H \cdot g$ OR Buoyancy = $\rho_w \cdot A \cdot D \cdot g$ ✓ $\rho_c \cdot A \cdot H \cdot g = \rho_w \cdot A \cdot D \cdot g$ ✓ «algebraic manipulation to show the relationship»		2

– 18 –

2225 – 6721M

7.	b		When cork is released, upthrust/buoyant force is larger than weight OR buoyant force is increased when cork submerged. ✓ «net» force/acceleration is proportional to displacement OR quotes $a = \omega^2 x$ OR $a \propto x$ ✓ «net» force/acceleration is in opposite direction of displacement OR «net» force/acceleration is directed towards equilibrium ✓		2 max
7.	c	i	solid state volume is less than liquid state OR molecules/particles/atoms are closer in solids so volume is smaller ✓ Same mass in smaller volume «so larger density» OR More mass per unit volume ✓		2
7.	c	ii	4 «°C» ✓	Allow 3.9 °C - 4.1 °C. Accept answer in Kelvin (e.g. 277 K) if proper unit shown.	1

7.	d	i	$\llcorner (H - 32) / H = 920 / 1030 \text{ so } H = 300 \text{ «m» OR } D = 268 \text{ «m» } \checkmark$ $m = 920 \times 300 \times 4200 \text{ OR } 1.16 \times 10^9 \text{ «kg» } \checkmark$	Must see either full substitution or answer to 3 or more significant figures.	2
7.	d	ii	$\frac{1}{40} m_{12} = (\frac{1}{40} m + m)v \checkmark$ $v = 0.29 \text{ «m s}^{-1}\text{» } \checkmark$		2
7.	e	i	use of $\Delta T = 6 \text{ «}^\circ\text{C}\text{» } \checkmark$ $\frac{\Delta Q}{\Delta t A} = \llcorner \frac{2.3 \cdot 6}{0.019} = \gg 730 \text{ «W m}^{-2}\text{» } \checkmark$		2

7.	e	ii	$m = (\rho A)(22) = (1000)(A)(22) = 22000A \text{ AND } \Delta T = 2 \text{ «}^\circ\text{C}\text{» } \checkmark$ $Q/A = \llcorner mc\Delta T \gg = (22)(1000)(4200 \cdot 2) = 1.85 \times 10^8 \text{ «J m}^{-2}\text{»}$ OR $Q/A = \llcorner mL \gg = (22)(1000)(330000) = 7.26 \times 10^9 \text{ «J m}^{-2}\text{» } \checkmark$ $Q/A = 7.4 \times 10^9 \text{ «J m}^{-2}\text{» } \checkmark$		3
7.	e	iii	«the thicker the layer the» lower the rate of transfer $\checkmark$		1
7.	e	iv	if solid water were denser than liquid, ice layer would sink OR water at 4°C sinks to bottom $\checkmark$ ice layer «would isolate water below ice to» maintain conditions «above freezing » $\checkmark$ this insulates the lake OR prevents the lake from freezing completely $\checkmark$		2 max

Question	Answers	Notes	Total
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Mark-scheme answers

Physics HL | Paper 1A | Nov 2025 TZ1 | Q10 | 1 marks

10. D

Physics HL | Paper 1A | Nov 2025 TZ3 | Q10 | 1 marks

10. D

Physics HL | Paper 1A | Nov 2025 TZ3 | Q11 | 1 marks

11. D

Physics HL | Paper 1A | Specimen 2025 | Q13 | 1 marks

13. A

8.	a		$(0.030 \times 0.7 \times 10^3 \times 5) + (0.030 \times 220 \times 10^3) + (0.030 \times 2.13 \times 10^3)(T - 47)$ $= (0.150 \times 2.13 \times 10^3)(240 - T)$ One heat capacity term correctly substituted ✓ latent heat correctly substituted $(0.030 \times 220 \times 10^3)$ ✓ $T = 190^\circ\text{C}$ ✓		3
8.	b	i	Experimental temperature will be lower ✓ Heat loss to the environment ✓		2
8.	b	ii	Insulate the container OR Carry out experiment quicker OR Use larger volumes of substances ✓		MAX 1

Question	Answers	Notes	Total
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