Mark Scheme (Results)

January 2020

Pearson BTEC Level 3 – Applied Science

Unit 5: Principles and Applications of Science II - Physics (31627H)

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Unit 5: Principles and Applications of Science II – sample marking grid
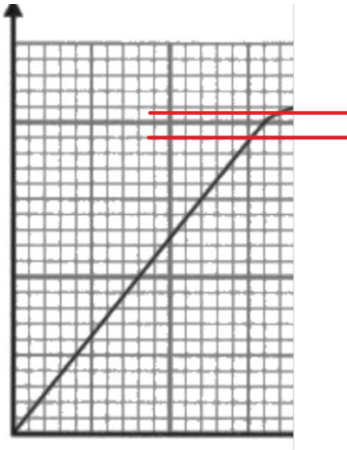
General marking guidance

- All learners must receive the same treatment. Examiners must mark the first learner in exactly the same way as they mark the last.
- Marking grids should be applied positively. Learners must be rewarded for what they have shown they can do, rather than be penalised for omissions.
- Examiners should mark according to the marking grid, not according to their perception of where the grade boundaries may lie.
- All marks on the marking grid should be used appropriately.
- All the marks on the marking grid are designed to be awarded. Examiners should always award full marks if deserved. Examiners should also be prepared to award zero marks, if the learner's response is not rewardable according to the marking grid.
- Where judgement is required, a marking grid will provide the principles by which marks will be awarded.
- When examiners are in doubt regarding the application of the marking grid to a learner's response, a senior examiner should be consulted.

Specific marking guidance

The marking grids have been designed to assess learner work holistically.
Rows in the grids identify the assessment focus/outcome being targeted. When using a marking grid, the 'best fit' approach should be used.

- Examiners should first make a holistic judgement on which band most closely matches the learner's response and place it within that band. Learners will be placed in the band that best describes their answer.

- The mark awarded within the band will be decided based on the quality of the answer, in response to the assessment focus/outcome and will be modified according to how securely all bullet points are displayed at that band.

- Marks will be awarded towards the top or bottom of that band, depending on how they have evidenced each of the descriptor bullet points.

Question Number	Answer	Additional guidance	Mark
1 (a)	**D** Nm^{-2}		1
1 (b)	substitution (1) $\dfrac{0.008}{0.4}$ evaluation (1) 0.02	allow for full marks 0.02 without working shown allow for Δx 0.392 or 0.408 allow 0.98 for 1 mark allow 1 mark for power of 10 error ignore units allow 2.0×10^{-2} or any other correct standard form value	2
1 (c)	 correct placing of X between agreed points (must be below the start of the curve) accept other markings such as a line or arrow graph to be added at pre-stand with agreed limits		1
1 (d)	**A** Repeated loading and unloading.		1
		Total	5 marks

Question Number	Answer	Additional guidance	Mark
2 (a)(i)	**C** Temperature		1
2 (a)(ii)	layer(s) (1) same (1) 2 (1) 'There is a steady flow of water in the pipe and the **layer(s)** of water do not mix. The velocity of the water at points A and B is the **same**. The velocity of the water is greatest at point **2**.	ignore repeat of the stem e.g. 'streamline' allow alternative words that have the same meaning stream(s) constant/equal two	3
2 (a)(iii)	the {flow rate/velocity/speed} of water increases (in the narrow pipe) (1) (so water) pressure decreases (1)	allow faster allow drops /falls	2
2 (b)	the Oobleck becomes {'thicker'/less runny/more viscous} (1) (because) a sudden (sheer) stress/force is applied (by jumping on it) (1) (so the) Oobleck becomes {more rigid/able to withstand impact/resists movement/ resists deformation} (1)	allow viscosity changes allow pressure ignore, 'acts like a solid'	3
		Total	9 marks

Question Number	Answer	Additional guidance	Mark
3 (a)(i)	energy supplied/transferred	allow heat supplied/transferred	1
3 (a)(ii)	**Identification** (slowly filling the balloon) needs time for energy transfer from the surroundings to the helium gas (1) OR to reach thermal equilibrium between the surroundings and the helium gas (1) **Expansion** so the expansion is isothermal(1)	answers must refer to the gas, not the balloon allow the idea that particles/molecules slowly gain energy allow an answer using $Q = \Delta U + W$, where $\Delta U = 0$	2
3 (b)(i)	**B** Average kinetic energy of atoms.		1
3 (b)(ii)	substitution (1) $\dfrac{3.0 \times 10^5 \ (\times\ 0.1)}{283} = \dfrac{P_2\ (\times\ 0.1)}{333}$ rearrangement (1) $\dfrac{3.0 \times 10^5 \times\ 333}{283} \quad (=\quad P_2)$ evaluation (1) 3.53×10^5 (Pa)	allow for full marks 3.53×10^5 without working shown allow 106.(01) seen as correct evaluation of LHS of equation for 1 mark allow $\dfrac{99\ 900\ 000}{283}$ or $\dfrac{999 \times 10^5}{283}$ allow 353003.534 (Pa) for 3 marks or any value rounding to 353000(Pa) allow 3.5×10^5 when correct working is shown allow a power of 10 error for 2 marks	3
		Total	7 marks

Question Number	Answer	Additional guidance	Mark
4 (a)	**part E** {no change/constant} (in pressure) (1) **part F** (pressure) {increases/rises} (1) **part G** {rapid/sharp/great} increase (in pressure) (1) **part H** (pressure) {decreases/falls/drops} (rapidly) (1)	ignore references to volume allow isobaric change allow quick allow any other valid alternative wording for each term	4
4 (b)	substitution (1) $0.4 = 1 - \dfrac{T_c}{2800}$ rearrangement (1) $T_c = 2800 \times 0.6$ evaluation (1) 1680 (K)	allow for full marks 1680(K) without working shown allow 2 marks for $0.6 = \dfrac{T_c}{2800}$ allow for 2 marks 3920(K),1121(K), 1119(K) do not allow1120 (K) if no other mark seen allow 1 mark for calculating the difference 1 – 0.4 or 0.6 seen	3
		total	7 marks

Question Number	Answer	Additional guidance	Mark
5 (a)(i)		allow for full marks 304(K) without working shown	4
		substitution and rearrangement can be in any order	
	substitution (1)		
		allow θ or T etc as equivalent for (T − 289)	
	5000 = 0.08 x 4200 x (T − 289)		
	OR		
	5000 = 0.08 x 4200 x ΔT		
	rearrangement (1)	allow rearrangement in symbols	
	(T − 289) = $\frac{5000}{0.08 \times 4200}$		
	OR		
	ΔT = $\frac{5000}{0.08 \times 4200}$		
	addition (1)		
	T = 289 + $\frac{5000}{0.08 \times 4200}$		
	OR		
	ΔT = 14.9	14.9 seen =3 marks allow values rounding to 14.9 for 3 marks	
	evaluation (1)		
	304 (K)	allow answers rounding to 304K, e.g. 303.88 K	
	OR		
	14.9 + 289	allow values rounding to 274(K) for 3 marks	
		award Q = mcΔT if no other mark seen for 1 mark	

| 5 (a)(ii) | Award **one** mark for an identification and **one** additional mark for an appropriate expansion.

Identification
the water temperature will be lower (1)

Expansion

(because) not all the energy supplied by the heater will be transferred to the water (1)

OR

(because) energy is transferred
or
{lost/ wasted} to the surroundings (1) | allow 'cools down'

allow dissipated

allow 'heat' for 'energy'
ignore 'temperature lost'
ignore 'energy is lost'
without qualification | 2 |

Question number	Indicative content
5 (b)	**Similarities** The particles at all points are either moving or oscillating (vibrating)/all the particles have (average) kinetic energy. At P and Q the molecules are held by strong intermolecular forces. At Q and S the (average) kinetic energy of the molecules remains the same/the potential energy changes. At R and T the particles are gaining/increasing (average) kinetic energy/moving faster. At P, R and T the temperature is increasing At Q and S the temperature is constant **Differences** The forces between the molecules are strongest at P. The (average) energy of the molecules would be different at Q and S. At T the forces are {the least/no intermolecular forces}. The force between the particles is (gradually) decreasing (from P to T). The molecules have the greatest (average) kinetic energy at T. The particles are moving most rapidly at T compared to the other points. The particles at P {are only able to oscillate/vibrate about a fixed point/have no translational motion}.

Mark scheme (award up to 6 marks) refer to the guidance on the cover of this document for how to apply levels-based mark schemes*. AO3 and AO4

Level	Mark	Descriptor
	0	No awardable content.
Level 1	1–2	• Adequate interpretation, analysis and/or evaluation of the scientific information with generalised comments being made. • Generic statements may be presented rather than linkages to the context being made so that lines of reasoning are unsupported or partially supported. • The comparison will contain some similarities and differences showing some structure and coherence.

Level 2	3–4	• Good analysis, interpretation and/or evaluation of the scientific information. • Lines of argument mostly supported through the application of relevant evidence drawn from the context. • Demonstrates an awareness of both similarities and differences leading to a comparison which has a structure which is mostly clear, coherent and logical.
Level 3	5–6	• Comprehensive analysis, interpretation and/or evaluation of all pieces of scientific information. • Line(s) of argument consistently supported throughout by sustained application of relevant evidence drawn from the context. • The comparison shows a logical chain of reasoning which is supported throughout by sustained application of relevant evidence.