Mark Scheme (Results)

June 2018

BTEC Level 3 National in Applied Science
Unit 5: Principles and Applications of Science II – Physics (31627H1P)

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Unit 5: Principles and Applications of Science II

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)(i)	B (energy transferred to the box)		1
1 (a)(ii)	D Nm^{-2}		1
1 (b)	400 (W)	accept 4.0×10^2 (W) reject 400kW/400MW	1
		total marks	3

Question Number	Answer	Additional guidance	Mark
2 (a)	B (velocity: higher, Pressure: lower)		1
2 (b)(i)	Award one mark for an identification and one mark for a linked expansion up to a maximum of two marks: (when cold, the oil) will not {flow /move} through the engine {easily /fast/freely} (1) OR the oil is thicker AND (so) the oil will not reach all parts of the engine (1)	ignore oil is more viscous/oil won't be a good lubricant allow harder for the oil to spread	2
2 (b)(ii)	Award one mark for an identification and one mark for a linked expansion up to a maximum of two marks: (when at a high temperature, the oil) will not coat the moving parts well/oil is {thinner/less dense} (1) (as the oil is thin so will make) engine wear greater/more friction (1) OR the oil will flow {faster/freely/easily/quicker} (1) (so) will not stay in contact with moving parts long enough /more friction/not removing heat fast enough (1)	ignore 'as the oil gets hotter it gets less viscous' as it is in the stem allow more slippery/runnier	2

		total marks	5
Question Number	**Answer**	**Additional guidance**	**Mark**
3 (a)(i)	substitution (1) 497 000 = m x 4 200 x (100-20) rearrangement (1) m = $\frac{497\ 000}{4\ 200 \times 80}$ evaluation (1) 1.479(kg)	Allow substitution and rearrangement in either order. 497 000 = m x 4 200 x (80) m = $\frac{\text{energy supplied}}{\text{shc x temp diff}}$ allow 1.48/1.47 do not allow 1.5 without any working if no other mark scored award one mark for calculation of temperature change 80 seen if reverse calculation seen e.g. 1.5 x 4200 x 80 = 504 000 award up to 2 marks for substitution and evaluation.	3
3 (a)(ii)	substitution (1) E = 1.5 x 2.26 x 10^6 evaluation (1) 3.39 x10^6 (J)	Allow POT for 1 mark allow 3390000/3400000/ 3.4 x10^6 allow answers rounding to 3.3 x 10^6 if 1.48 or 1.47 kg if used	2

3 (b)(i)	Any two from three: there is no <u>net</u> (thermal) heat transfer/input energy is balanced by the output energy (1) energy flows/transfers in (from the heat source) and out of the metal plate (to the surroundings) (1) it reaches a maximum temperature (1)	ignore 'constant'	2
3 (b)(ii)	the amount of thermal energy (added to the metal plate) (1) which gives {a rise/change in temperature of 1K/unit temperature rise/change} (1)	allow heat allow 'by one degree'	2
		total marks	9

Question Number	Answer	Additional guidance	Mark
4 (a)(i)	the total energy (of an isolated system) remains constant/is conserved (1) OR energy cannot be {created/made} or {destroyed/lost} (1)	ignore 'energy conserved' unless qualified allow can't be lost, just transferred'	1
4 (a)(ii)	(W=) work (done by the system)	ignore energy	1

4 (b)(i)	An explanation linking any two from the first three points (the) air is compressed (1) (when the user of the pump pushes down on the pump) the volume decreases (1) (so) air pressure increases (1) AND work is done on the gas (1) (so, the) particles/molecules /air gain/increase <u>kinetic</u> energy (from the moving piston) (1)	ignore comments relating to friction in the pump allow gas for air ignore compression of particles allow <u>kinetic</u> energy transferred to molecules	4
4 (b)(ii)	substitution (1) $2.5 \times 10^5 \times 3.8 \times 10^{-4} = n \times 1.38 \times 10^{-23} \times 303$ rearrangement (1) $N = \frac{2.5 \times 10^5 \times 3.8 \times 10^{-4}}{1.38 \times 10^{-23} \times 303}$ evaluation (1) 2.27×10^{22} (molecules)	Allow substitution and rearrangement in either order. allow $N = \frac{95}{1.38 \times 10^{-23} \times 303}$ OR $\frac{2.5 \times 10^5 \times 3.8 \times 10^{-4}}{4.1(814) \times 10^{21}}$ for 2 marks allow answers rounding to 2.3×10^{22} allow POT error for 2 marks if no other mark scored award 1 mark for correct identification of pV=NkT	3
		total marks	9

Question Number	Answer	Additional guidance	Mark
5 (a)	C malleability		1
5 (b)	(copper can be) {stretched/pulled/put under tension} without breaking/fracturing/cracking (1) (therefore it) can be {drawn /formed} into a wire (1) (because layers of) atoms can slide over each other (1)	ignore comments relating to malleability e.g. hammering/moulding/flexibility	3
5 (c)(i)	conversion (1) 10 cm and 10.4 cm to 0.100 m and 0.104 m/ or 0.004 m difference substitution (1) 100 = 0.5 x F x (0.104 – 0.100) rearrangement (1) $F = \frac{100}{0.5 \times 0.004}$ evaluation (1) 50,000 (N)	Allow conversion/substitution and rearrangement in any order. allow a POT error if the conversion is incorrect to a maximum of 3 marks allow ½ for 0.5 allow 0.4 for sub and rearrangement mark for 0.004 5×10^4(N) allow a mark for 10.4-10.0 if no other mark scored	4

Question number	Indicative content
5 (c)(ii)	**O to A** in the region from O to A the strain is directly proportional to the stress. because Hooke's law is being obeyed so the forces between the particles allow the steel to extend and return to its original length. at A the elastic limit is reached, and the line ceases to be a direct proportion. so from A the material starts to be deformed plastically. after this point if the stress is removed the steel will be permanently longer than it was originally. **B to C** B is called the yield point. the steel yields because the crystals that make up the steel slip against each other. between B and C the wire extends plastically due to slippage of the crystals. the increase in strain is not linear as the slippage is unpredictable as the stress increases the crystals lock against each other. so more force is needed to overcome the crystals locking against each other, which results in more stress needed to produce a strain. between B and C the breaking point is reached. the maximum stress is the ultimate tensile stress of the steel the steel will snap with no further increase in stress until it breaks at C. the stress reduces because a neck forms in the steel. the cross-sectional area of the steel reduces. however, the stress is calculated in terms of the original cross section.

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*.		
Level	**Mark**	**Descriptor**
	0	No awardable content
Level 1	1-2	Demonstrates adequate knowledge of scientific facts/concepts with generalised comments made. Generic statements may be presented rather than linkages being made so that lines of reasoning are unsupported or partially supported. The explanation shows some structure and coherence.
Level 2	3-4	Demonstrates good knowledge and understanding by selecting and applying some relevant scientific knowledge facts/concepts to provide the discussion being presented. Lines of argument mostly supported through the application of relevant evidence. The explanation shows a structure which is mostly clear, coherent and logical.
Level 3	5-6	Demonstrates comprehensive knowledge and understanding by selecting and applying relevant knowledge of scientific facts/concepts to provide the discussion being presented. Line(s) of argument consistently supported throughout by sustained application of relevant evidence. The explanation shows a well-developed structure which is clear, coherent and logical.

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