



Mark Scheme (Results)

January 2021

Pearson BTEC Nationals

In Applied Science (31627H1P)

Unit 5: Principles and Applications of Science II -
Physics

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Unit 5: Principles and Applications of Science II

General marking guidance

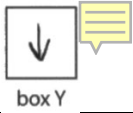
- All learners must receive the same treatment. Examiners must mark the first learner in exactly the same way as they mark the last.
- Marking grids should be applied positively. Learners must be rewarded for what they have shown they can do, rather than be penalised for omissions.
- Examiners should 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.

BTEC Next Generation Mark Scheme

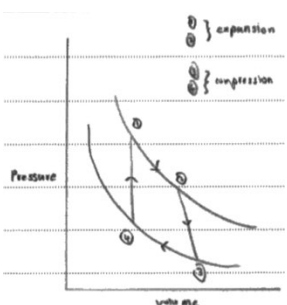
Question Number	Answer	Additional Guidance	Mark
1 (a)(i)	<p>arrow pointing to the vertically down (in box Y)</p>  <p>box Y</p>	<p>accept anticlockwise arrow anywhere on the system</p> <p>reject arrows pointing both ways</p>	1
1 (a)(ii)	D (275 K)		1
1 (a)(iii)	<p>award one mark for identification and one additional mark for appropriate expansion</p> <p><i>identification</i> removes /transfers{(thermal) energy/heat} from the refrigerant/to the surrounding (1)</p> <p><i>expansion</i> (so, condenses) the vapour into a liquid OR changes or turns the gas into a liquid (1)</p>	<p>ignore condenses the liquid</p> <p>ignore water or air</p>	2

Question Number	Answer	Additional Guidance	Mark
2 (a)	<p>any two from:</p> <p>(front is) streamlined/aerodynamic (1)</p> <p>(gives) less {drag/(air) friction/wind resistance} (1)</p> <p>reduces turbulence (1)</p>	<p>accept small surface area (at the front of the car)</p> <p>ignore smooth surface</p>	2
2 (b)	<p>Award two marks for any linked pair from the identification and one mark for expansion</p> <p>Identification above aerofoil air travels a smaller/shorter distance above the aerofoil (1)</p> <p>Expansion (slower air) creates a higher pressure on the top (of the aerofoil) (1)</p> <p>OR</p> <p>Identification below aerofoil air travels a longer/greater distance below the aerofoil (1)</p> <p>Expansion (faster airflow) under the aerofoil creates a lower pressure below (of the aerofoil) (1)</p> <p>AND</p> <p>Expansion so a pressure difference is applied/created in the correct direction/downwards (1)</p>	<p>ignore travels slower</p> <p>ignore travels faster</p> <p>accept a correct comparison of pressures top and bottom</p> <p>allow air on top of the aerofoil applies downward pressure</p> <p>ignore the contact force is increased</p>	3
Total			5 marks

Question Number	Answer	Additional Guidance	Mark
3 (a)(i)	B		1
3 (a)(ii)	A (creep)		1
3 (a)(iii)	(when stretched it) keeps its shape/remains stretched/ withstand strain/will not return to its original shape/malleable	ignore elastic/elasticity/plastic/plasticity ignore stress	1
3 (b)	<p>extension (1) 0.505 – 0.500</p> <p>substitution (1) 2.0 = k (0.505 – 0.500)</p> <p>rearrangement (1) $k = \frac{2.0}{0.005}$</p> <p>evaluation (1) 400 (Nm⁻¹)</p>	<p>400 (Nm⁻¹) for 4 marks with no working shown</p> <p>substitution and rearrangement in either order</p> <p>award 1 mark if 0.005 or 5 x 10⁻³ seen</p> <p>2.0 = k 0.005</p> <p>award 2 marks for $k = \frac{2.0}{0.505}$ OR $k = \frac{2.0}{0.500}$</p> <p>award 3 marks for 3.96 OR 0.0025 OR 0.01</p>	4
Total			7 marks

Question Number	Answer	Additional Guidance	Mark
4 (a)(i)	<p>substitution (1) $5 \times 10^5 = m \times 4200 \times 80$</p> <p>rearrangement (1) ($m =$) $\frac{5 \times 10^5}{4200 \times 80}$</p> <p>evaluation (1) 1.5 (kg)</p>	<p>1.5kg for 3 marks with no working shown</p> <p>substitution and rearrangement in either order</p> <p>$500\ 000 = m \times 4200 \times 80$</p> <p>$\frac{500\ 000}{336\ 000}$</p> <p>accept an algebraic rearrangement</p> <p>accept any answer rounding up to 1.5 (kg)</p> <p>allow 2 marks for a power of 10 error</p> <p>accept 0.4 OR 0.672 or 67200 or 0.0000744 OR 0.33 OR 1.05×10^{-4} for 2 marks</p>	3
4 (a)(ii)	<p>molecules close together/in contact (in liquid) (1)</p> <p>so, there are (stronger) forces between the molecules (in the water) (1)</p> <p>the particles (in water) gain energy (1)</p> <p>(when heated the molecules) are able to separate/move apart (in gas) (1)</p> <p>there are (almost) no forces between the molecules (in the steam) (1)</p>	<p>accept particles/atoms/molecules</p> <p>accept molecules rolling over/sliding over each other</p> <p>allow kinetic /potential /internal energy if mentioned</p> <p>spacing of particles increases</p> <p>accept forces weaken/intermolecular forces break</p>	4
4 (b)	B J kg ⁻¹		1
Total			8 marks

Question Number	Answer	Additional Guidance	Mark
5 (a)(i)	<p>volume difference of ΔV (1) $6.0 \times 10^{-4} - 1.0 \times 10^{-4}$</p> <p>substitution (1) $205\,000 \times 5 \times 10^{-4}$</p> <p>evaluation (1) 102.5 (J)</p>	<p>allow 102 to 103 (J) for 3 marks with no working shown</p> <p>$5 \times 10^{-4} / 0.0005$ seen for 1 mark</p> <p>allow 2 marks where (ΔV used is 1×10^{-4}) 20.5 (ΔV used is 6×10^{-4}) 123 (ΔV used is 7×10^{-4}) 143.5</p> <p>allow 1 mark for a power of 10 error for 20.5, 123 or 143.5</p>	3
5 (a)(ii)	<p>transfer/convert thermal energy (1)</p> <p>into kinetic energy/ mechanical/ does work (1)</p>	<p>accept heat</p> <p>ignore energy lost to surroundings/dissipated</p>	2
5 (b)	<p>In an adiabatic expansion, $\Delta U = (-) W$ (1)</p> <p>In an isothermal expansion, $\Delta U = 0$ or zero (1)</p>	<p>only allow in order given</p> <p>ignore minus +/- before W</p> <p>allow no change (in ΔU /internal energy)</p>	2

Question number	Indicative content.	6 marks
5 (c)	<p>Learners:</p> <ul style="list-style-type: none"> • may include other valid suggestions, not listed below, which should be credited • may cover a number of examples from the list below • would not be expected to cover all points to get full marks. <p>For 'real' petrol engine</p> <ul style="list-style-type: none"> • the numbers add to 100 (%) • the petrol engine is less efficient than the ideal engine cycle • identifies that only the 35% is useful work /it is 35% efficient • identifies that 65% is 'waste' • a lot of energy (65%) is 'lost'/transferred to the surroundings • this lost energy is transferred mostly as thermal/heat energy / (the engine transfers thermal energy to the surroundings in a practical engine cycle) • some energy lost is transferred as sound • the work output is smaller • can improve efficiency by reducing friction • can improve efficiency by making intake/exhaust faster <p>For ideal engine</p> <ul style="list-style-type: none"> • no/little energy is transferred to the surroundings in an ideal energy cycle • it is much more/100% efficient • there are no frictional losses in the ideal engine • the work output is greater • power output is more <p>using a correctly for a correctly labelled diagram of the ideal engine cycle (Otto Cycle) to compared with figure 5</p>  <p>ideal engine cycle diagram</p> <p>Diagram comparison</p> <ul style="list-style-type: none"> • the corners are drawn sharp • sharp corners in the ideal engine because (we assume that) no time is taken for gas to be introduced/released • there is no intake/exhaust loop drawn in the ideal engine cycle • the area of the graph in the petrol engine is less 	
<p>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*.</p>		

Level	Mark	Descriptor
Level 0	0	No rewardable material.
Level 1	1–2	<ul style="list-style-type: none"> • Adequate interpretation, analysis and/or evaluation of the scientific information with generalised comments being made • Generic statements may be presented rather than linkages being made so that lines of reasoning are unsupported or partially supported • The discussion shows some structure and coherence
Level	Mark	Descriptor
Level 2	3–4	<ul style="list-style-type: none"> • Good analysis, interpretation and/or evaluation of the scientific information • Lines of argument mostly supported through the application of relevant evidence • The discussion shows a structure which is mostly clear, coherent and logical
Level 3	5–6	<ul style="list-style-type: none"> • 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 • The discussion shows a well-developed structure which is clear, coherent and logical
		Total 13 marks



Llywodraeth Cynulliad Cymru
Welsh Assembly Government

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