



Mark Scheme

September 2016

Pearson BTEC Level 3 – Applied Science

Unit 1: Principles and Applications of
Science I

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Unit 1: Principles and Applications of Science I – sample mark scheme

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.
- Crossed-out work should be marked, UNLESS the learner has replaced it with an alternative response.
- You will not see 'or words to that effect' (OWTTE). Alternative correct wording should be credited in every answer, unless the mark scheme has specified specific wording that must be present.
- Round brackets () indicate words that are not essential, e.g. '(hence) distance is increased'.
- Error carried forward (ECF), means that a wrong answer given in an earlier part of a question is used correctly in a later part of a question.
- / indicates that the responses are alternatives and either answer should receive full credit.

Specific marking guidance for levels-based mark schemes*

Levels-based mark schemes (LBMS) have been designed to assess learners' work holistically. They consist of two parts: indicative content and levels-based descriptors. Indicative content reflects specific content-related points that a learner might make. Levels-based descriptors articulate the skills that a learner is likely to demonstrate, in relation to the assessment outcomes being targeted by the question. Different rows in the levels, represent the progression of these skills.

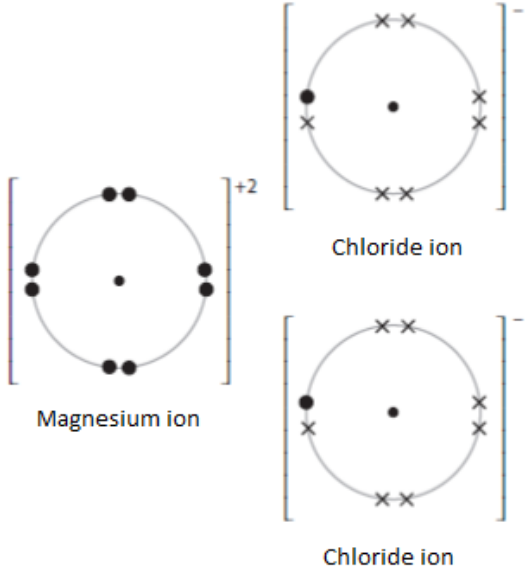
When using a levels-based mark scheme, the 'best fit' approach should be used.

- 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/objective 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.

Section A - Periodicity and properties of elements

Question Number	Answer	Additional guidance	Mark
1 (a)(i)	B		1
1(a)(ii)	D		1
1(a)(iii)	A		1
1(b)	(period) 2 /two		1
1(c)	$(1s^2 2s^2)2p^6 3s^1$ Or $(1s^2 2s^2)2p_x^2 2p_y^2 2p_z^2 3s^1$		1
Total Marks 5			

Question Number	Answer	Additional guidance	Mark
2 (a)	Any one from the following points: <ul style="list-style-type: none"> • Fertiliser • Mineral supplement • Ice control • Dust control • Coagulant for making food • Spa treatment 	Any appropriate use	1

2(b)	Substitution (1) $(\text{Mg}) 24.3 + \text{Cl} (35.5 \times 2)$ Evaluation (1) 95.3	95.3 alone gains both marks	2
2 (c)	 <p>Correct dot and cross diagram of magnesium chloride is 3 marks;</p> <p>Correct formula Mg Cl_2 (1)</p> <p>Correct charge on each ion $\text{Mg}^{2+} \text{Cl}^-$ (1)</p> <p>Correct number of electrons from magnesium to each ion on the outer shell (1)</p>	Ignore inner shells. Reject covalent bonding. Ignore whether dots or crosses.	3
2 (d)	Conversion (1) $\frac{50}{1000} (= 0.05)$ Substitution (1) 0.05×0.2 Evaluation (1) 0.01 (moles)	0.01 alone scores 3 marks ECF from first MP Conversion and substitution can be done in any order	3
Total marks 9			

Question Number	Answer	Additional guidance	Mark
3 (a)	atoms are in rows/layers (1) that slip/move over each other (1) so metal can be drawn into wires without breaking (1)		3
3 (b)	metallic structure (1) delocalised electrons (1) (electrons) carry (electric) charge (1)	accept metallic bonding accept sea of electrons	3
Total marks 6			

Question Number	Answer	Additional guidance	Mark
4 (a) (i)	air contains oxygen (1) if oxygen is limited/incomplete combustion (carbon monoxide forms) (1)	if oxygen in the air is limited carbon monoxide forms (2)	2
4 (a) (ii)	$\text{Si} + \text{O}_2 \rightarrow \text{SiO}_2$ (2) lhs (1) rhs (1)	maximum one mark for incorrect balancing accept correct multiples	2

Question number	Indicative content
4b	<p>structure:</p> <ul style="list-style-type: none"> • Elements on left hand side form ionic oxide compounds • Examples of ionic compounds from period 3 • Elements in centre form giant covalent oxide molecules • Elements on right hand side form small covalent oxide molecules • Examples of covalent compounds from period 3 • Across period oxides change from solids to gases • Phosphorus, sulfur and chlorine form molecular oxides <p>explanation:</p> <ul style="list-style-type: none"> • electronegativity of elements increases as you go across the period • examples of electronegativity differences between element and oxygen from table/own knowledge • elements with similar electronegativities form covalent bonds • elements with different electronegativities form ionic bonds • metal oxides have strong ionic bonds • molecular oxides have weak intermolecular forces • molecular oxides have van der Waals/ dipole dipole forces

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
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 explanation shows some structure and coherence
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 explanation 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 explanation shows a well-developed structure which is clear, coherent and logical

Total Marks 10

Section B - Structures and functions of cells and tissues

Question Number	Answer	Additional Guidance	Mark
5a	X - Acrosome Y- Nucleus		2
5b	<ul style="list-style-type: none"> The tail gives motility (1) which uses large quantity of ATP/energy (1) provided by large numbers of mitochondria (contained in the mid-piece) (1) 		3
Total Marks 5			

Question Number	Answer	Additional Guidance	Mark
6a	70S		1
6b	bacterium capsules are made of polysaccharides (1) which are hydrophilic (1)		2
6c	Conversion (1) $45\ 000\ (\mu\text{m})$ substitution (1) $45\ 000 \div 22\ 500$ evaluation (1) $2\ (\mu\text{m})$	$2\ (\mu\text{m})$ alone gains all 3 marks ECF from first MP Conversion and substitution can be in any order	3
Total Marks 6			

Question Number	Answer	Additional Guidance	Mark
7a	Actin (1) Myosin (1)		2
7b	Controls the uptake and release of calcium ions (1) which controls ATPase activity (1) and therefore the contraction of the muscle (1)	Allow regulate/stores and releases calcium ions. allow Ca ²⁺	3
Total Marks 5			

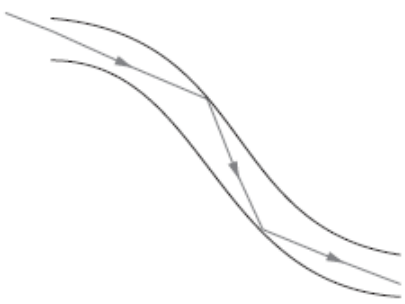
Question Number	Answer	Additional Guidance	Mark
8a	Sodium channels open at -70mV (1) Axon cell becomes more permeable to sodium ions (1) Concentration gradient of sodium ions exists across the membrane (1) Diffusion/influx of sodium ions into the nerve cell (1)		4
8b	Potassium ion channels (1) Close more slowly than sodium channels (1) excess potassium ions diffuse out (of the neuron) (1) Potential difference becomes more negative (than resting potential -70 mV) (1)		4
Total Marks 8			

Question number	Indicative content
9	<p>Answers will be credited according to the learner’s demonstration of knowledge and understanding of the material, using the indicative content and levels descriptors below. The indicative content that follows is not prescriptive. Answers may cover some or all of the indicative content but learners should be rewarded for other relevant answers.</p> <p>squamous epithelium tissue Function: allows materials to pass through by diffusion and filtration</p> <p>one cell thick short diffusion pathway</p> <p>cells are thin and flat large surface area for diffusion of gases</p> <p>good blood supply maintains concentration gradient</p> <p>found in the alveoli</p> <p>Columnar epithelium tissue Function: secretes mucous and enzymes Protect from pathogens</p> <p>Contains goblet cells Produces mucus which moistens and lubricates</p> <p>Ciliated Rhythmic sweeping movement of cilia To remove particles/ irritants/pathogens</p> <p>Found in the small bronchi, trachea and upper respiratory tract</p>
<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
	0	No awardable content
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 explanation shows some structure and coherence
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 explanation 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 explanation shows a well-developed structure which is clear, coherent and logical
		Total Marks 6

Section C -Waves in communication

Question Number	Answer	Additional guidance	Mark
10 a	the amplitude of B is greater than A/ the amplitude of A is less than B (1) the shape of the wave of A is different than B (1)		2
10 b	longitudinal (1)		1
10 c	two waves travelling in opposite directions (1) superposition occurs (1) producing points where the waves are in phase or in antiphase/ nodes and antinodes produced (1)	reference to both constructive and destructive interference	3
			Total Marks 6

Question Number	Answer	Additional guidance	Mark
11 a	D - 		1
11 b	Substitution (1) $1.48 = \frac{3.00 \times 10^8}{x}$ x rearrangement (1) $x = \frac{3.00 \times 10^8}{1.48}$ Evaluation (1) $2.03 \times 10^8 \text{ m/s}$	$2.03 \times 10^8 \text{ m/s}$ scores 3 marks ECF from first MP substitution and rearrangement in either order	3
11 c	because the light in the cable hits the side of the cable at an angle less than the critical angle (1) so light is not reflected (1) OR bending causes more reflections (1) a longer path means more light energy is absorbed by the optical fibre (1)	second mp is dependent on the first	2
11 d	Any two from; (signal) can be regenerated (1) greater distance is possible (1) no attenuation (1)		2
Total Marks 8			

Question Number	Answer	Additional guidance	Mark
12 a	B – interference		1
12 b	<p>must have the same wavelength/frequency (1)</p> <p>have a constant phase difference (1)</p>		2
12 c	<p>Any four from:</p> <p>the light contains many wavelengths(1)</p> <p>(therefore) the light is diffracted/travels in all directions/paths when it leaves the grating(1)</p> <p>the different path difference gives rise to a phase difference in the waves (1)</p> <p>if the phase difference is half a wavelength then the waves that meet will cancel out and there is no light/destructive interference (1)</p> <p>if the phase difference is a wavelength the waves add/constructive interference (1)</p>	All marks could come from a suitably labelled diagram	4
Total Marks 7			

Question Number	Answer	Additional guidance	Mark
13 a	Substitution (1) $3.0 \times 10^8 = 4.5 \times 10^9 \times \lambda$ Rearrangement (1) $3.0 \times 10^8 / 4.5 \times 10^9 = \lambda$ Evaluation (1) 6.7(cm)	6.7(cm) alone gains three marks ECF from first MP substitution and rearrangement can happen in any order	3

Question number	Indicative content
13 b	<p>Microwaves</p> <p>Advantages:</p> <ul style="list-style-type: none"> • can pass through the ionosphere • better satellite communication • have a higher bandwidth • can carry more information • better quality clearer communication <p>Disadvantages:</p> <ul style="list-style-type: none"> • can only be used in line of sight • transmission affected by rain, fog, mist damp conditions • cannot communicate with vessels under water <p>Radiowaves</p> <p>Advantages</p> <ul style="list-style-type: none"> • can reflect off the ionosphere • can reach receivers out of site of the transmitter • are not affected by most weather conditions • can be transmitted underwater <p>Disadvantages:</p> <ul style="list-style-type: none"> • low bandwidth • cannot carry as much information • subject to interference, particularly after sunset

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
Level 0	0	No rewardable material.
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 discussion 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 discussion 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 discussion shows a well-developed structure which is clear, coherent and logical

Total Marks 9

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