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Mark Scheme (Results)

Summer 2017

BTEC Level 3 Firsts in Applied Science

Unit 1: Principles and Applications of
Science (31617H)



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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 – Structure and Functions of Cells and Tissues

Question Number	Answer	Additional guidance	Mark
1(a) (i)	D		1
1(a) (ii)	<p>one from:</p> <p>digest {antigens / bacteria / viruses / foreign particles / pathogens} (1)</p> <p>and:</p> <p>break down {worn out components of the cell / waste materials / waste products} (1)</p>	<p>answers can be in either order</p>	2
1(b)	<p>conversion (1) 18000 (μm)</p> <p>substitution (1) 18 000 / 45</p> <p>evaluation (1) 400(x)</p> <p>OR</p> <p>conversion (1) 0.045</p> <p>substitution (1) 18/0.045</p> <p>evaluation (1) 400(x)</p>	<p>400(x) alone gains all 3 marks</p> <p>ECF from first MP</p> <p>400(x) to any factor of 10 (2)</p>	3
1(c)	Group of {similar/ specialised} cells carrying out a specific function.		1
Total 7 Marks			

Question Number	Answer	Additional guidance	Mark
2(a)	Dopamine (1)		1
2(b)	<p>L-Dopa is precursor of Dopamine (1)</p> <p>L-Dopa increases the amount of Dopamine {stored in / released by} the presynaptic neuron (1)</p> <p>(therefore) normal levels of Dopamine stimulate the postsynaptic neuron (1)</p>	allow 'the neurotransmitter' in all mark points	3
Total 4 Marks			

Question Number	Answer	Additional guidance	Mark
3(a)	<p>Name of technique: Gram stain</p> <p>Result for Gram-positive: Purple</p> <p>Result for Gram-negative: Pink/Red</p>	<p>allow violet (1)</p> <p>allow any other correct technique</p>	3
3(b)	<p>Gram-negative bacteria have an outer cell membrane / a cell membrane that surrounds the cell wall (1)</p> <p>that prevents penicillin from disrupting / damaging the cell wall (1)</p>	<p>allow two double lipid membranes</p> <p>allow protects the cell wall</p> <p>Penetrate is insufficient</p>	2
Total 5 Marks			

Question number		Additional guidance	Mark
4a	Squamous		1
4b	any one from: to help with {the blood flow / immune response / coagulation / blood vessel lumen diameter size} (1)		1
4c	(cholesterol) combines with fatty substances / cellular waste products / calcium / fibrin (to form plaque / atheroma) (1) (plaque / atheroma) slowly builds up (1) cells in the artery walls multiply in response (1) the artery {lumen becomes narrow / hardens / stiffens} (1)	Allow thickens artery wall (1) ignore blocked	4
Total 6 Marks			

Question Number	Answer	Additional guidance	Mark
5(a)	cell wall (1) vacuole (1)	Allow tonoplast	2

Question number	Indicative content
5b	<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>contains many chloroplasts for housing chlorophyll to trap sunlight energy chloroplasts absorb sunlight energy sunlight energy needed for photosynthesis</p> <p>chloroplasts can be moved by cytoskeleton upwards to absorb more sunlight on dull days chloroplasts can be moved downwards to avoid damage if sunlight is too intense absorb optimum sunlight</p> <p>large vacuoles so chloroplasts are pushed to outer edges of the cell Also so there is a short diffusion distance for carbon dioxide Also they store water and dissolved substances from photosynthesis</p> <p>clear cell walls to allow sunlight to penetrate sunlight energy needed for photosynthesis</p> <p>cells are elongated and cylindrical many closely packed together increased surface area for absorption of sunlight energy</p> <p>have mitochondria that create ATP to support photosynthesis.</p> <p>they have a plasma membrane cylindrical shape with air spaces to allow diffusion of carbon dioxide in to the cell to allow water in to the cell carbon dioxide and water are reactants of photosynthesis allow oxygen out of the cell allow glucose out of the cell oxygen and glucose are products of photosynthesis</p>

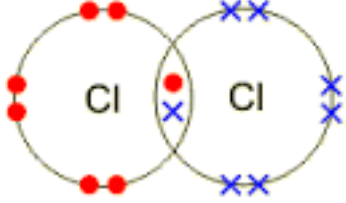
Mark scheme (award up to 6 marks) refer to the guidance on the cover of this document for how to apply levels-based mark schemes*.

<i>Level</i>	<i>Mark</i>	<i>Descriptor</i>
	0	<i>No awardable content</i>
Level 1	1-2	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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
Total 8 Marks		

Section B – Periodicity and properties of elements

Question Number	Answer	Additional Guidance	Mark
6(a)	A - CO		1
6(b)	substitution (1) Fe (55.8 x 2) + O (16.0 x 3) evaluation (1) =159.6	correct answer alone scores 2 marks allow 160 for 2 marks allow 71.8 / 72 for 2 marks	2
6(c)	+3	allow plus three allow plus 3 reject -3 reject Fe ³⁺	1
Total 4 Marks			

Question Number	Answer	Additional Guidance	Mark
7 (a)	energy required to remove <u>one mole</u> of electrons (1) from (one mole of) atoms in their gaseous state (1)		2
7 (b)(i)	Any two from three electron is harder to remove (from beryllium) / electron is easier to remove (from lithium) (1) (Lithium and beryllium are in the same period) but there is an increased nuclear charge (in beryllium)/ beryllium has (one) more proton(s) than lithium ORA(1) (Beryllium nucleus) has a greater (force of) attraction to the electron ORA (1)		2
7(b)(ii)	electron is easier to remove (1) first electron removed is in the 2p subshell (1)	allow 3 rd subshell ignore ideas about shielding	2

Question Number	Answer	Additional Guidance	Mark
8 (a)	<p>one shared pair of electrons between the two chlorine atoms (1)</p> <p>the rest of the molecule correct (1)</p> 	<p>accept dots, crosses or a mixture of both</p> <p>ignore any inner shells drawn even if incorrect</p> <p>ignore brackets unless charges are shown</p> <p>if charge is drawn molecule max 1 mark</p>	2
8 (b)(i)	<p>(chlorine atom) gains electron(s) (1)</p> <p>1/an electron (1)</p>	<p>reject chlorine shares one electron for both marks</p>	2

8 (b)(ii)	<p><u>moles of sodium</u> $\frac{4.6}{23} = 0.2$ (1)</p> <p><u>ratio of sodium to sodium chloride</u> 1:1 (1)</p> <p><u>theoretical yield</u> $0.2 \times 58.5 = 11.7$ (1)</p> <p><u>percentage yield</u> $\frac{7.5}{11.7} \times 100 = 64.1$ (1)</p> <p>OR</p> <p><u>moles of sodium</u> $\frac{4.6}{46} = 0.1$ (1)</p> <p><u>ratio of sodium to sodium chloride</u> 1:1 (1)</p> <p><u>theoretical yield</u> $0.1 \times 117 = 11.7$ (1)</p> <p><u>percentage yield</u> $\frac{7.5}{11.7} \times 100 = 64.1$ (1)</p>	<p>64.1 % with no working scores 4 marks</p> <p>allow 2:2</p> <p>If no other marks scored allow 1 mark for % yield = actual/theoretical yield x 100</p>	4
Total 8 Marks			

Question Number	Answer	Additional Guidance	Mark
9 (a)	Any two from corrosion resistant (1) malleable (1) low density (1) forms aluminium oxide (1) non-toxic (1)	ignore water resistant ignore will not rust ignore is not reactive allow durable allow flexible ignore ductile allow lightweight insoluble in the drink (1)	2
9 (b)	any four from regular layers of {atoms / ions / cations} (1) in a (giant) lattice (1) metal cations/positively charged ions (1) surrounded by {a sea of / delocalised / free} electrons (1) metallic bonding (1) electrostatic attraction between {nuclei of/ cations/positively charged ions} and electrons forms the (metallic) bond (1)	allow diagram to show correct points. reject molecules reject negative ions ignore negative ions	4

Question number	Indicative content
9(c)	<p>potassium most reactive:</p> <ul style="list-style-type: none"> • potassium is in group 1 • potassium is in period 4 • 2.8.8.1 / $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$ • one electron in the outer shell • therefore only 1 electron to remove to gain a stable structure • and this electron is in the fourth electron shell • potassium has the biggest atomic radius • therefore large amount of shielding from inner shells • so relatively easy to remove the electron. <p>sodium is less reactive:</p> <ul style="list-style-type: none"> • sodium is in group 1 • but sodium is in period 3 • 2.8.1 / $1s^2 2s^2 2p^6 3s^1$ • one electron in the outer shell • therefore still 1 electron to remove to gain a stable structure • and this electron is in the third electron shell • sodium has a smaller atomic radius than potassium • so outer electron closer to the nucleus • therefore less shielding • so harder to remove the electron. <p>magnesium is the least reactive of the three:</p> <ul style="list-style-type: none"> • magnesium is also in period 3 • but in group 2 • 2.8.2 / $1s^2 2s^2 2p^6 3s^2$ • two electrons in outer shell • therefore needs to lose 2 electrons to gain a stable structure • removal of 2 electrons requires more energy than removal of 1 electron • same amount of shielding in sodium and magnesium • therefore magnesium has an increased nuclear charge to sodium whilst still being in the same period • so electrons in the same s subshell are attracted more strongly to the nucleus • therefore more energy needed to remove the electrons.

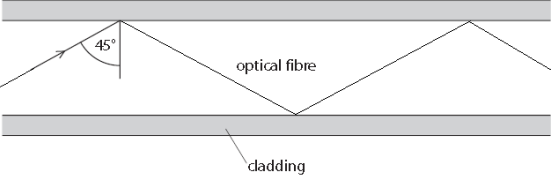
Mark scheme (award up to 6 marks) refer to the guidance on the cover of this document for how to apply levels-based mark schemes*.

Level	Mark	Descriptor
Level 0	0	No rewardable material.
Level 1	1–2	<ul style="list-style-type: none"> • 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	Mark	Descriptor
Level 2	3–4	<ul style="list-style-type: none"> • Demonstrates good knowledge and understanding by selecting and applying some relevant scientific knowledge facts/concepts to provide the discussion being presented.

		<ul style="list-style-type: none"> • 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"> • 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
Total 12 Marks		

Section C – Waves in communication

Question Number	Answer	Additional guidance	Mark
10a	Either 1.5 (cm) (1) Or -1.5 (cm) (1)		1
10b	2.0(s)		1
10c	substitution (1) $0.075 = f \times 0.05$ rearrangement (1) $f = \frac{0.075}{0.05}$ evaluation (1) 1.5 (Hz)	substitution and rearrangement in either order	3
			Total 5 Marks

Question Number	Answer	Additional guidance	Mark
11ai	Analogue: continuously variable (signal) / (signal) can have any value (1)	allow a diagram / graph	1
11aii	Digital: two values only / on or off / 0 and 1	allow any binary allow a diagram / graph	1
11b	<p>ray reflecting at boundary at top and bottom of the fibre with continuous lines (1)</p> <p>ray reflecting with angle of incidence and reflection equal by eye (1)</p> 	do not allow line going into the shaded area	2
11c	<p>any two linked pairs the signal can be regenerated (1) so it can travel greater distances/further without any degradation / attenuation (1)</p> <p>OR</p> <p>the signal can {carry more information (in the same time)/can carry many television channels (at the same time)/need less bandwidth} (1) so cables can be thinner(1)</p> <p>OR</p> <p>noise can be removed from the signal/less interference (1) so that a clearer output / better quality is produced compared to an analogue signal (1)</p> <p>OR</p> <p>signals can be used directly by computers /digital signals do not need to be converted (1) ORA so processing time is lower(1)</p>	<p>ORA for each</p> <p>do not accept that digital signals are faster than analogue signals</p> <p>ignore references to aerials</p>	4

Total 8 Marks

Question Number	Answer	Additional guidance	Mark
12a	<p>Any two from:</p> <p>visible light is electromagnetic but sound is {vibration / mechanical} (1)</p> <p>visible light travels in a vacuum but sound needs a material medium (1)</p> <p>sound has a lower {frequency / higher wavelength} / ORA (1)</p> <p>visible light can be polarised but sound cannot (1)</p> <p>visible light carries much more energy (1)</p>	<p>ignore visible light moves faster than sound</p> <p>ignore descriptions of longitudinal and transverse waves</p> <p>allow any named medium</p>	2
12b	<p>Substitution (1)</p> $30 = \frac{100}{r^2}$ <p>Or</p> $30r^2 = 100$ <p>Rearrangement (1)</p> $r = \sqrt{\frac{100}{30}}$ <p>Evaluation (1)</p> <p>1.83 (m)</p>	<p>1.8257(m) rounded correctly gains three marks</p> <p>substitution and rearrangement in either order</p> <p>allow formula rearrangement, e.g. $r^2 = \frac{k}{I}$</p>	3
Total 5 Marks			

Question Number	Answer	Additional guidance	Mark
13a	<p>any one linked pair;</p> <p>some of the radio waves (with frequencies between 5×10^9 and 3×10^7 Hz) reach the Earth's surface (1)</p> <p>so (radio waves) lose no information in transmission/a clear signal is received (1)</p> <p>OR</p> <p>not all visible light (with a frequency of about 4 to 7×10^{14}Hz) reaches the Earth's surface (1)</p> <p>so (visible light) loses some information in transmission / signal is not clearly received (1)</p> <p>AND</p> <p>radio wave frequency is much lower (than that of visible light) (5×10^9 to 3×10^7 Hz compared with 4 to 7×10^{14} Hz for light) (1)</p> <p>so (radio waves) would take longer (than light waves) to transfer the same amount of information (1)</p> <p>OR</p> <p>visible light has a higher frequency than radio waves (1)</p> <p>so (visible light) would take less time to transfer the same amount of information (1)</p>	<p>ignore radio waves travel slower/light waves travel faster</p> <p>allow light absorbed more by atmosphere than radio waves</p>	4
13b	<p>1.28 seconds (1)</p> <p>because all electromagnetic waves travel at the <u>same speed</u> (in a vacuum/space) (1)</p>	<p>allow the same time as signal A</p> <p>allow both travel at the speed of light</p>	2

Question number	Indicative content
13c	<p>Infrared</p> <p>Strengths</p> <ul style="list-style-type: none"> • does not interfere with other devices as the frequency is higher than Bluetooth® • better quality and clearer communication between devices due to higher frequency /lower wavelength used <p>Weaknesses</p> <ul style="list-style-type: none"> • needs line of sight /not able to transmit through most materials • will only work over short distances because infrared is absorbed/scattered by the air • works with one device at a time • sunlight and other sources of infrared interfere with the signal • transmitter and receiver have to be stationary, so cannot be used when moving around <p>Bluetooth®</p> <p>Strengths</p> <ul style="list-style-type: none"> • does not need to be in direct line of sight /works through walls • Bluetooth can be used on more than one device at the same time • can be used from a mobile device <p>Weaknesses</p> <ul style="list-style-type: none"> • low bandwidth because of frequency of transmission • interference with other Bluetooth devices on similar radio frequencies if close by <p>Evaluation justified in terms of points made from indicative content</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*.

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 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	<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 drawn from the context • Demonstrate 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	<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 drawn from the context

		<ul style="list-style-type: none">• The comparison shows a logical chain of reasoning which is supported throughout by sustained application of relevant evidence
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Total 10 Marks

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