Mark Scheme (Results)

Summer 2017

BTEC Level 3 Firsts in Applied Science

Unit 3: Science Investigation Skills (31619H)

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Unit 3: Science Investigation Skills – 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	Correct Answer	Additional guidance	Mark
1(a)	Results table containing: • suitable headings with units (1) • measurements consistently recorded to the same precision **(1)** • repeats for height given and means calculated **(1)**	ignore hanging 0s ignore pH repeats ignore anomalies ignore missing units on means column allow 2 tables one for height and one for pH as long as both correct	**(3)**
1 (b)	Any two from: • number of seeds germinating **(1)** • colour of plants/stem/leaves **(1)** • direction of plant growth (1) • dead plants (1) • size of leaves (1) • number of leaves (1)	ignore comments about soil allow more than one shoot/stem (from one seed)	**(2)**
1 (c)	Any three from: always cut from where the plant exits the soil (1) needs to be held straight (1) always include leaves/do not include leaves (1) measure between the same two points (on plant) (1)	ignore comments about ruler allow always cut from the same place each time allow use string to measure allow using white background	**(3)**
1 (d)	 • (rinsing the pH probe) removes soil from other samples (1) • (distilled water) has a neutral pH (1)	ignore de ionised allow remove substances ignore clean the probe allow tap water may have different pH	**(3)**

	• no cross-contamination /no effect on pH (1)	ignore recalibrating allow to prevent anomalous results allow other soil can affect pH allow no contamination	
1 (e)	• Percentage error of height reading = +/- 0.5 x 100/height reading **(1)**		**(1)**
1 (f)	• Labels and units for axes **(1)** • Suitable scales **(1)** • All points plotted correctly **and** suitable line of best fit **(1)**	allow axes either way around spread of plots covers half graph paper allow appropriate curve +/- ½ small square if numbers on the x or y axis are taken directly from the table in the order of the table then allow a maximum of 1 mark for the first marking point	**(3)**
1 (g)	 • as pH increased height of plant increased (at low pH) **(1)** • gives optimum pH for grass growth **(1)** • after optimum pH the grass did not grow as tall (1) OR • simple pattern described (1)	Answer consistent with result from graph or table allow no relationship if appropriate	**(3)**

	• relationship given (1)		
	• use of data(1)		
		Total marks	**(18)**

Question number	Correct Answer	Additional guidance	Mark
2 (a)(i)	• Mean calculated correctly **(1)** 24		**(1)**
2 (a)(ii)	• For each number subtract the mean **(1)** and square the result **(1)** • Add up these values **(1)** and divide by one less than the sample number **(1)** • Square root this number to get the standard deviation **(1)**	correct answer with no working gains full marks $22 – 24 = -2$ $-2^2 = 4$ $24 – 24 = 0$ $0^2 = 0$ $26 – 24 = 2$ $2^2 = 4$ $4 + 0 + 4 = 8$ $8/2 = 4$ $\sqrt{4} = 2$ Allow ECF at any stage	**(5)**
2 (b)(i)	Any two from: • different pH of soil **(1)** • different type of soil **(1)** • different use of field **(1)** • different shade/light (1) • different level of grazing (1) • different levels of trampling (1) • qualified different levels of pollution (1) • different levels of competition (1)	ignore amount of water/acid rain	**(2)**
2(b)(ii)	<table><tr><td></td><td>**grass cover%**</td><td>**no grass cover %**</td></tr><tr><td>**Observed**</td><td>25</td><td>75</td></tr><tr><td>**Expected**</td><td>35</td><td>65</td></tr></table> •	All 3 must be correct for the mark	**(1)**

| 2 (b)(iii) | • $\underline{(O - E)^2}$ for grass and no grass $\quad\quad\quad E$ **(2)**

 • χ^2 = 2.86 + 1.54 = 4.40 **(1)**

 • n = 2 – 1 = 1 degree of freedom **(1)**

 • (at n = 1 critical value is at 5% value is 3.841) 4.40> 3.841 so there is a significant difference between the observed and expected results (results are not consistent) | (at n = 1 critical value is at 5% value is 3.841) 4.40> 3.841 so there is a significant difference between the observed and expected results (results are not consistent) seen gains all 5 marks

 ECF throughout Grass 25 – 35 = -10 -10² = 100 100/35 = 2.86 (1) No grass 75 – 65 = 10 10² = 100 100/65 = 1.54 (1)

 accept 4.396

 allow 4.40 > 3.841 so results are not consistent | **(5)** |
| | | Total | **14 marks** |

Question number	Correct Answer	Additional guidance	Mark
3 (a) i	• the areas are close together (**1**)		**(2)**

	• so will have same/similar weather conditions **(1)**		
3 (a) ii	Any two from: • type of soil **(1)** • mineral content of soil **(1)** • shade **(1)** • grazing/trampling **(1)** • viability of seeds **(1)** • disease/infestation **(1)**	ignore references to water/carbon dioxide	**(2)**
3 (b)	Any two **linked** pairs • repeat the experiment for different (inner city) nature reserves **(1)** • in order to extend the range of results **(1)** • take/repeat more samples in the same areas of the reserve **(1)** • to give more reliable results **(1)** • sow different types of plant seed **(1)** • in order to see if pH affects type of plant **(1)**		**(4)**
		Total	**8 marks**

Question number	Indicative content
4	A plan that makes reference to: • a hypothesis • equipment techniques and/or procedures • risks • control variables • dependent variables – how it will be measured, units and the precision of measurements to be taken • independent variable – the range of measurements/categories to be used and how they will be measured, the intervals to take measurements • data analysis.

Mark scheme (Award up to 12 marks) Refer to the general marking guidance found in this document on how to apply levels- based mark schemes*.

Level	Mark	Descriptor
Level 0	0	No awardable content.
Level 1	1–3	• Limited attempt at a hypothesis is made. • Demonstrates limited knowledge and understanding of scientific concepts, procedures, processes and techniques with a basic description of the plan to investigate the scientific scenario given. • Provides a rationale for the method suggested and generic statements may be presented rather than linkages being made so that lines of scientific reasoning are unsupported or unclear. • The plan will not be logically ordered with significant gaps that will not lead to reliable results being collected.
Level 2	4–6	• An explanation for the hypothesis is given which is partially supported by scientific understanding. • Demonstrates adequate knowledge and understanding of scientific concepts, procedures, processes and techniques with a partial description of the plan to investigate the scientific scenario given. • Provides a rationale for the method which has occasional linkages present so that lines of scientific reasoning are partially supported. • The plan will generally be in a logical sequence and will yield some results.
Level 3	7–9	• An explanation for the hypothesis is given which is supported by scientific understanding. • Demonstrates good knowledge and understanding of scientific concepts, procedures, processes and techniques with a clear description of the plan to investigate the scientific scenario given. • Provides a rationale for the method which has linkages present so that lines of scientific reasoning are supported. • The plan will be in a logical sequence but with minor omissions of steps and will yield reliable results.
Level 4	10–12	• An explanation for the hypothesis is given which is fully supported by scientific understanding. • Demonstrates comprehensive knowledge and understanding of scientific concepts, procedures, processes and techniques with

		a step-by-step description of the plan to investigate the scientific scenario given.
		• Provides a rationale for the method which has consistent linkages present so that lines of scientific reasoning are fully supported.
		• The plan will be in a logical sequence and will lead to a reliable set of results being collected.
Total marks 12		

Question number	Indicative content
5	An evaluation that makes reference to:
	• metals may be different size/surface area
	• not stated volume of acid
	• not stated concentration of acid
	• not sure how long timed for
	• temperature not controlled
	• not indicated how bubbles are to be counted
	• gas syringe will give more accurate results
	• no repeats, so hard to tell if results are anomalous
	• data supports conclusion

Mark scheme (Award up to 8 marks) Refer to the general marking guidance found in this document on how to apply levels- based mark schemes*.

Level	Mark	Descriptor
	0	No awardable content.
Level 1	1–2	• Adequate interpretation and analysis of the scientific information.
		• Generic evaluative comments made with little linkage to supporting evidence/reference to context.
		• A conclusion may be presented, but will lack focus and be superficial and underdeveloped.
Level 2	3-5	• Good analysis and interpretation of the scientific information.
		• Evaluative comments with supporting evidence/reference to context and a partially developed chain of reasoning.
		• Conclusion will be mostly focused and developed and draw on some of the information presented before.
Level 3	6-8	• Comprehensive analysis and interpretation of all pieces of scientific information.
		• Evaluative comments supported by relevant reasoning and appropriate reference to context.
		• Conclusion will be clear and concise and well-developed drawing upon the most relevant information presented before.
		Total marks 8

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