Mark Scheme (Results)

June 2018

BTEC Level 3 National 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.

BTEC Next Generation Mark Scheme

Applied Science Unit 3

Question Number	Answer	Additional Guidance	Mark
1 (a)	results table containing: • suitable headings with units (1) • measurements consistently recorded to the same precision (1) • repeats and means given (1)	unit isn't required on mean column ignore hanging zeros	3.
1 (b)	• labels and units for axes (1) • suitable scales (1) • all points plotted correctly **and** suitable line (1)	x = % and y = g spread of plots should cover at least half graph paper given in both directions allow appropriate curve +/- ½ small square if numbers of 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 (c)(i)	any two from: as concentration of the pectinase increases the mass of apple juice produced increases (1) comment on whether the relationship between concentration and mass is proportional or not (1) comment on plateau (1)	Answer consistent with results and graph Accept positive correlation Accept examples to support the description of the relationship Ignore reference to anomalous results	2
1 (c)(ii)	answer consistent with results (1)	allow percentage read off graph between 2 points if shows an optimum.	1
1 (c)(iii)	(lowest percentage that) gives maximum/highest/ most mass of juice produced (1)		1

1 (d)	to evenly distribute the {apple puree/ substrate} and {pectinase/ enzyme} (1)	Accept: enzyme can react with all the puree to increase the amounts of each one in contact with each other to mix homogenised to make sure there are lots of collisions speeds up reaction ignore to break up cells mechanically	1

1 (e)	any three from:	ignore references to volume	3
	stop filtering {on time/ after five minutes/ all at the same time} (1)		
	ensure the balance is on a {flat/level} surface (1)		
	{read balance/ record mass} to same number of decimal place (1)	ignore use a balance that can give 2 decimal places	
	calibrate/re-set/ tare the balance (1)	ignore use the same balance	
	cleaning the equipment (1)		
	any other valid comment on experimental technique (1)		
1 (f)(i)	any two from:		2
	low enzyme activity/slow to react/takes longer (1)	ignore no activity/ not functioning properly/denatures/ dies	
	fewer {(enzyme substrate) collisions/ enzyme-substrate complexes} (1)		
	less energy for collisions (1)		

| 1 (f) (ii) | any two from four:
enzyme {activity low/ has no activity/ doesn't work/ not active/decreased rate of reaction/can't break down the puree} (1)

(a high temperature/above optimum) denatures the enzyme/ breaks hydrogen bonds (1)

<u>active site</u> loses shape/deforms/unravels (1)

substrate no longer fits/cannot bind/cannot form ES complexes (1) | ignore enzyme breaks down/ dies | 2 |
| | | total | 18 marks |

Question Number	Answer	Additional Guidance	Mark
2 (a)(i)	no <u>significant</u> difference(1) between the (mean) mass of juice extracted from Jazz and Gala apples (1) OR the type of apple will have no effect on the mass of juice extracted (1) any difference is due to chance (1) OR any difference between mean mass of juice extracted from Jazz and Gala apples (1) Is due to change (1)		2

2 (a)(ii)		4.9 or 4.95 or 4.96 or 5 alone gets 6 marks ecf throughout the response	6
	difference in the mean substitution (1) 113.8- 160 evaluation (1) = 46.2	ignore – sign 46.2 alone gains 2 marks	
	standard error: substitution (2) $(13.93^2/10 + 26^2/10)$ OR 19.4 + 67.6 OR 87		
	OR Substitution $(13.93/10 + 26/10)$ (1) OR $(13.93^2 + 26^2)$ (1) OR $(13.93^2/10)$ (1) OR $(26^2/10)$ (1)	87 alone gains 2 marks	
	square root (1) $\sqrt{87.00449} = 9.3276$	accept 9.33	
	t: (1) $(46.2 / 9.3276)$ (1) = 4.956	accept 4.9 or 4.95 or 4.96 or 5	

2 (a)(iii)	substitution (1) (10 + 10) - 2 evaluation (1) 18	18 alone is awarded full marks	2
2 (a)(iv)	2.101	ecf with 2aiii Accept answer circled in the table	1
2 (a)(v)	(the null hypothesis should be) {rejected/not accepted} (1) (because) {there is a <u>significant</u> difference/ difference not due to chance} (between the mean mass of juice extracted from Jazz and Gala apples) (1) (because) 4.953/t-test value is more than 2.101/critical value (and is above the 95% confidence level/at the p = 0.05 significance level) (1)	accept at the 95% confidence level ignore "the 'results' are significant" ecf from t-value and critical value for whole response	3
		total	14 marks

Question Number	Answer	Additional Guidance	Mark
3 (a)(i)	the apples were pureed/smashed/ mashed/ broken up/mixed together (1) (so any differences in ripeness) were averaged out/ spread throughout the puree (1)	ignore reference to ideas of repeating to get an average	2
3 (a)(ii)	any two from: • {size of chunks/ lumps/surface area/consistency} of the pureed apples (1) • juice absorbed by the filter • pH/acidity of the mixture (1) • damage to the apple before pureeing (1) • varieties/types of apples (1) • freshness/ age of pectinase (1) • fluctuations in water bath temperature due to other users (1)	ignore temperature unqualified, ripeness/ age of apples ignore how much juice filtered through in 5 minutes as this is the dependent variable ignore apparatus errors, such as uncalibrated balance, pulp stuck on sides of beaker	2

3 (b)	• Take/repeat more samples (for the same concentrations of pectinase) (1) • To give more accurate results/ more reliable results/ assess the reliability/ identify anomalies (1) • use a different method for measuring the apple juice (1) • so that none is absorbed by the filter paper (1) Comment consistent with graph • use intermediate values for pectinase concentration (around the optimum) (1) • to more clearly define the levelling off section of the line (1) Or • carry out the experiment for concentrations of pectinase above 2%(1) • in order to extend the range of results (1)	only award this if their graph shows a levelling off. only award if their graph does not level off.	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 that 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 that 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 that 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

Question number	Indicative content
5	An evaluation that makes reference to: • measure suitable/specific lengths • a means of measuring the length in smaller units e.g. a ruler with mm scale • the connections to the putty must be the same each time • keep current small, not to raise the temperature of the putty • only have a current in the circuit when the readings are being taken/ use the switch • a means of accurately cutting the putty in the same way each time • keep a constant cross section for the putty • the graph shows a pattern/negative correlation • no line of best fit • no repeat readings are taken for each length • result at 10 cm on the graph appears to be an anomaly as it does not follow the pattern of the other results • data is not spread evenly across all lengths/ there are gaps in the readings • take additional readings where there are gaps, additional readings at 3, 4, 5 and 13 cm • the data does not support the conclusion • the current of the conducting putty cylinder decreases as the length of the conducting putty cylinder increases
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
		Total marks 8

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