Mark Scheme (Results)

June 2019

Pearson BTEC Level 3 Nationals Extended Certificate – Applied Science

Unit 3: Science Investigation Skills

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Unit 3: Science Investigation Skills

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

Section 1 - Chemistry

Question Number	Answer	Additional guidance	Mark
1 (a)	results table containing: • suitable headings with units (1) • measurements consistently recorded to the same number of decimal places (1) • repeats and means calculated (1)		3
1 (b)(i)	correct substitution and evaluation for 3 foods (4) OR correct substitution and evaluation for 2 foods (3) OR correct substitution for 2 foods (2) OR correct substitution for one food (1)	calculations will need to be based on learner's results and need to be checked	4
1 (b)(ii)	• labels and units for axes (1) • suitable scales (1) • all bars drawn correctly (1)	allow axes either way around spread of data covers half graph paper 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 (b)(iii)	any two from: all foods give out heat energy (1) {marshmallow / learners lowest result} gives out less {heat/energy} (than the rest of the foods) (1) {popcorn / learners highest result} gives out the most {heat / energy} than the rest of the foods (1)	allow no pattern to results (1)	2
1 (c)	any two from • yellow flame (1) • different sized flames (1) • soot/smoke (1) • foods turned black (1) • some foods {ignited quicker than others / burned for longer} than others (1) • (water) bubbling / boiling / steam (1) • food melted / broke up • food fell off the needle (1) • {fat/grease} came away from the food / the food dripped (1) • flames observed moving up and around the outside of the calorimeter (1) • some food left over after burning (1) allow any other valid answer	ignore conclusions such as popcorn has the biggest temperature change	2

1 (d)	Any two from: draw water up to the {(graduation) mark/ line} (1) read from bottom of meniscus (1) release water touching the pipette on the side of the calorimeter to release last drops / ensure there are no air bubbles (1)	 allow suck up water to the {(graduation) mark/ line} allow read at eye level	2
1 (e)	to reduce {heat loss / heat energy} escaping	allow to prevent / stop heat loss ignore so temperature does not escape allow so heat is trapped ignore so water does not evaporate	1
1 (f)(i)	sharp needle / hot calorimeter / {hot/boiling} water / flame / burning food / Bunsen burner / food	allow fire for flame	1
1 (f)(ii)	cuts (from needle) (1) do not touch end of sharp needle (1) OR burns (from hot calorimeter/flame/burning food) (1) do not touch until cool / use tweezers or clamp to move calorimeter / mounted needle for food (1) OR scalding (from hot water) (1) wait until cool before pouring away (1) OR	ignore cuts from broken glasswear	2

	burns from hair catching fire (1) tie hair back (1) OR burns from Bunsen burner (1) put Bunsen burner on safety flame (when not in use) (1) OR allergic reaction (from allergies to food) (1) wear gloves / do not touch the food (1)		
		total	20 marks

Question Number	Answer	additional guidance	Mark
2 (a)	uncertainty (1) 0.5 substitution (1) = (0.5) x 100 (= 2.1) 23.00 **AND** = (0.5) x 100 (= 1.1) 45.00 addition (1) =2.1 + 1.1 (= 3.2)	3.2 alone scores 3 marks allow 3.27, 3.28, 3.29, 3.3 allow for max 2 marks = 0.5 x 100 = 2.2 (1) 22.00 2.27 x 2 = 4.5 (1)	3
2 (b)(i)	there is no significant difference between {maize crackers / popped popcorn / rice cakes} and {maize crackers / popped popcorn / rice cakes} (1) because the error bars overlap (1)	allow standard deviation / range for error bar throughout	4

	there is a significant difference between marshmallows and the {other foods / maize crackers / popped popcorn / rice cakes} (1) the error bars do not overlap (1)		
2 (b)(ii)	popped popcorn (is the least reliable) (1) because it has largest error bar (1)	 allow standard deviation / range for error bar allow temperature range spans 10-50°C	2
2 (c)(i)	$\frac{4653 + 4732 + 4685 + 4666}{4} = 4684$ (1)	allow $\frac{4653 + 4685 + 4666}{3} = 4668$ check table for answer. if more than one answer is given mark answer on answer line.	1
2 (c)(ii)	Any two from: drafts / no way of stopping {heat/energy} loss from sides / heat escaped (to surroundings) / no lid on calorimeter (1) distance of {food / flame} from bottom of calorimeter (1) manufacturer's equipment more accurate so measures complete energy change (1) food was difficult to ignite / kept going out (1) food burnt when not under calorimeter (1)	 allow manufacturers carry out large scale testing ignore different volume of water ignore different amount of rice cake	2

		ignore human error	
		total	12 marks

Question Number	Answer	Additional guidance	Mark
3 (a)	the volume of water (1) the distance the burning food was held from the bottom of the calorimeter (1)	allow mass of water ignore initial temp of water / room temp	2
3 (b)	any two from: to work out the {change/loss} in mass (1) some food might not have burned (1) measure of mass of food burned for calculation <u>per gram</u> (1)	allow see how much food has been burned	2
3 (c)	two pairs from : different {types/brands} of food / try protein based foods / fat based foods (1) e.g to see if protein gives off more heat energy than carbohydrates (1) OR crush all foods before burning (1) e.g to see if surface area had an effect (1) OR time how long the food takes to burn (1) e.g to see if heat energy is released quicker with some foods (1) OR try {more/other/different} carbohydrate foods (1)		4

	e.g to see if all carbohydrate foods give off the same heat energy (1)	ignore more / different amounts of water ignore references to accuracy ignore repeats ignore different method e.g different material for calorimeter	
		total	8 marks

Section 2 - Biology

Question Number	Indicative content
4	**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.** A plan that makes reference to: • a hypothesis/prediction ○ *e.g. As light intensity increases more oxygen bubbles are released indicating that the rate of photosynthesis has increased.* • equipment, techniques and/or procedures ○ *e.g. equipment* > *pond weed* > *boiling tube* > *water* > *light source/ lamp* > *ruler* > *timer* > *heat shield* ○ *e.g. Method* > *Leave for five minutes for the pondweed to acclimatise/equilibrate/reach to the new light intensity.* > *Count the number of bubbles given off in one minute.* > *Move the light 10 cm further back.* > *Leave for five minutes for the pondweed to acclimatise/equilibrate/reach again.* > *Count the number of bubbles given off in one minute/ collect oxygen in a gas syringe.* > *Repeat by moving the lamp away by 10 cm intervals until 50 cm is reached.* > *Repeat experiment so that 3 full sets of results have been collected.* *Allow any other valid method* *e.g. depth of water as changing light intensity* • risks and hazards ○ *e.g. care with glass ware* ○ *e.g. light source can get hot* • control variables

	○ *e.g. species and size of pondweed, volume of water, temperature* • dependant variable- how it will be measured, units and the precision of measurements to be taken ○ *e.g. the number of bubbles of oxygen given off in one minute, count with no unit, speed of bubbles could cause issue with precision, bubbles not all of same size/volume, not all bubbles are pure oxygen – some may also contain carbon dioxide (from respiration)* • independent variable- the range of measurements/ categories to be used and how they will be measured, the intervals to take measurements, ○ *e.g. the light intensity/ distance of light source from the pond weed, distances in cm 10, 20, 30, 40, 50 (5 measurements) measured with a ruler* ○ *e.g. relationship between distance and light intensity (e.g. inverse square law/ reciprocal) or use of light meter* • data analysis ○ *e.g. collect results in a table* ○ *highlight anomalous results and repeat if possible* ○ *calculate means, excluding anomalous results* ○ *produce graph* ○ *draw conclusion against hypothesis.*

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	1-4	• 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 for Question 4= 12 marks

Question Number	Indicative content
5	**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.** An evaluation that makes reference to: Method • no indication that temperature is controlled • not stated volume of water/buffer solution • no reference to controlling sunlight intensity • amount of cotton wool not specified • volume of pH solution not given • not indicated how seedlings will be measured accurately • not indicated if seeds are all the same age/ condition • not clear if the seeds should be watered once or every day until they are measured • not sure for how long it is grown • not clear if all plants are measured at the same time results • no repeats, so hard to tell if results are reliable/unable to spot anomalies • should use more than one seed on cotton wool/reasons why just using one seed not good • data which does not fully support the conclusion • reference to amounts of growth at each pH conclusion • outside range hasn't been investigated • values between the pH values haven't been investigated to give an exact optimum pH • results in soil could be different from those obtained on cotton wool • concerns over validity of conclusion • alternative conclusions could be that a range between 6.5 and 7.5 is best for growth or that seedlings need to be grown at a pH below 8.

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 focussed and developed and draw upon 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