Mark Scheme (Results)

January 2019

BTEC Level 3 National in Applied Science/Forensic and Criminal Investigation
Unit 1: Principles and Applications of Science I – Physics (31617H/1P)

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Unit 1: Applications of Science I – sample marking grid
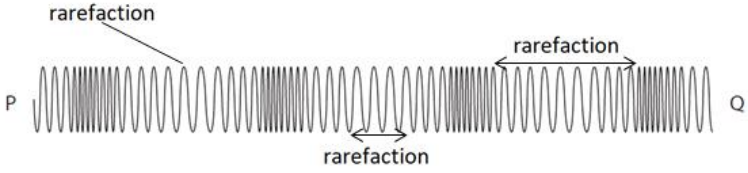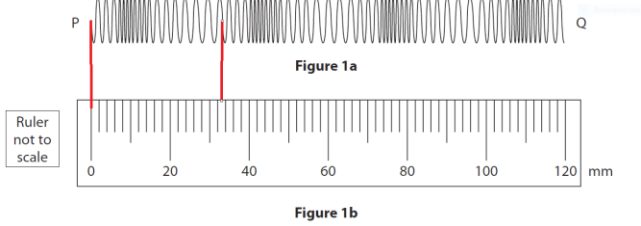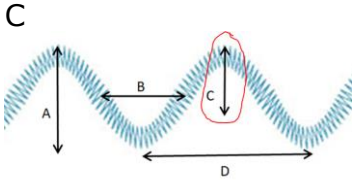
General marking guidance

- 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.
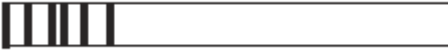
Specific marking guidance

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.

Section C – Waves in communication

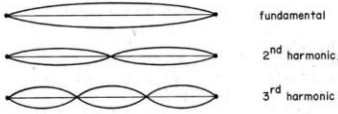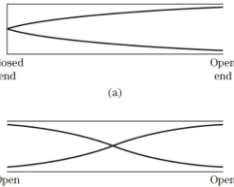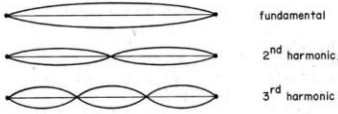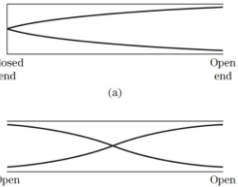| Question Number	Answer	Additional guidance	Mark
1 (a)(i)	Any point or length between two compressions labelled on the diagram.	Only ignore spelling as 'rarefraction' if the correct region has been indicated	1
1 (a)(ii)	33(mm) /3.3cm	accept any number between from30 to 34 (mm) inclusive accept any number between 3.0 cm and 3.6 cm inclusive	1
1 (a)(iii)	Any **one** from: (slinky) pushed/pulled (1) (hand) moves backwards/forwards (1) AND Any **one** from: {in line with/along/ parallel to} the slinky (1) {in line with/along/parallel to} the direction of the wave/displacement/propagation (1)		2
1 (b)	C		1
		total	5 marks

Question Number	Answer	Additional guidance	Mark
2 (a)	C		1
2 (b)	Award **two** marks for identification and **one** additional mark for appropriate justification. Identification element Q (1) element R (1) Justification idea of all the (spectral) lines {match up/are there}/ 10 lines match up (1) or reverse argument none of the spectral lines match for P and S (1)	Identification of PQRS,PQS or PRS no mark Identification of PQR or QRS one mark only awarded if Q and R identified	3
2 (c)	D one wavelength		1
		total	5 marks

Question Number	Answer	Additional Guidance	Mark
3 (a)	Award one mark for an identification and one mark for a linked expansion: storms/we t weather/being below ground level/terrain/ large buildings (1) (causing) attenuation / reduction in intensity/absorption of signal (1) OR reflection (from large buildings or hills)/ overlapping signals (1) (Causing) destructive superposition/interference (1) OR system capacity/network overload(1) (due to) too few frequencies available / large volume of calls(1) OR lack of specific network coverage net (1) (due to) mismatch between mobile and transmitter(1) OR signal not available at ground level(1) (due to) network shadow/ too close to transmitter(1)	accept equivalent word for large accept too many callers using the network	2

3 (b)		award full marks for 45 (km) without working shown	4
	substitution I and k(1)		
	$9.0 \times 10^{-10} = \dfrac{1.8}{r^2}$	substitution and rearrangement in either order	
	rearrangement (1) $(r=) \sqrt{\dfrac{1.8}{9.0 \: x \: 10^{-10}}}$ or	correct rearrangement using I = 1.5Wm^{-2} gains a compensatory 1 mark	
	$r = \sqrt{\dfrac{k}{I}}$ or		
	$r^2 = \dfrac{k}{I}$		
	or	2 000 000 000m 2 x 10^{9}m gains 2 marks	
	$(r^2 =) \dfrac{1.8}{9.0 \: x \: 10^{-10}}$	accept any value that rounds to 45000m	
	evaluation of square root 45000(m) (1)		
		2 000 000km 2x 10^6 gains 3 marks	
	conversion 45(km) (1)	allow any value of distance in metres to be converted to km for 1 mark	
		accept any value that rounds to 45(km) power of ten error gains 3 marks	
3 (b)			4

	Alternative method	rearrangement and substitution in either order	
	$$\frac{I_1}{I_2} = \frac{r_2{}^2}{r_1{}^2}$$ rearrangement (1) $$r_1{}^2 = \frac{r_2{}^2 \times I_2}{I_1}$$ substitution (1) $$(r_1{}^2=) \frac{1.1 \times 1.1 \times 1.5}{9.0 \times 10^{-10}}$$ evaluation 45 000(m) (1) conversion 45(km) (1)	accept any value that rounds to 45(km) power of ten error gains 3 marks	
3 (c)(i)	Any one reason from: frequency {hopping/jumping}/adaptive frequency hopping (AFH)/ frequency hopping spread spectrum (FHSS)(1) time division multiplexing(TDM)/ channel hopping(1) direct sequence spread (DSSS)(1)	allow change Wi-Fi frequency band from 2.4GHz to 5 GHz	1
3 (c)(ii)	Any two from: tethering a mobile phone for (hands free) use in a car (1) wireless headphones/speakers/mouse and keyboards (1) file/data transfer (1) opening car/garage doors/gates (1) accept any correct alternative response	do not accept generalised statements such as 'connects two or more devices' 'communication over short distances'	2
		total	9 marks

Question	Answer	Additional Guidance	Mark

Number			
4 (a)	substitution (1) $(\sin C) = \dfrac{1}{1.52}$ evaluation (1) 0.658 conversion (1) 41.1(°)	Award full marks for an answer which rounds down to 41(°) do not accept 0.65 accept 0.66 evaluated or on the answer line for 2 marks answer 40. 5(4)° gains 2 marks award full marks for correct answer without working shown	3
4 (b)	Award one mark for an identification and one mark for a linked expansion: identification (cladding) increases the critical angle/ increases the angle of <u>reflection</u> / reflects at a larger angle(1) expansion (giving)fewer reflections (1) less energy/data loss (1) distance travelled is smaller (1) time of transmission shorter(1) dispersion of signal reduced(1) OR identification only rays close to the axis are transmitted (1) expansion rays at less than the critical angle are refracted into cladding and disperse (1)	do not accept 'the signal/ light travels faster/ quicker unless it is clear that this refers to the shorter time for transmission.	2
		total	4 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. Similarities: • both use oscillations/vibrations • both have stationary/standing waves set up • both produce the sound due to resonance • the pitch/frequency of the note produced can be changed • harmonics can be formed to vary the quality of note produced Differences:

Waves on strings	Waves in a pipe
String vibrates	Air vibrates
Wave is transverse	Wave is longitudinal
Stationary/standing wave has a node at each end Credit diagrams showing waves on strings. e.g fundamental 2nd harmonic 3rd harmonic	Stationary/standing wave for closed pipe has node at closed end and antinode at open end For an open pipe there is an antinode at both ends and the node is at the centre for the lowest frequency (fundamental). Credit diagrams showing waves in pipes e.g Closed end Open end (a) Open Open
Lowest frequency that can be produced on a string (fundamental) is when the wavelength of the wave is 2l where l is the length of the string	The lowest frequency that can be produced in a closed pipe (fundamental) is when the wavelength of the wave is 4l where l is the length of the pipe. For an open pipe the lowest frequency that can be produced (fundamental) is when the wavelength of the wave is 2l where l is the length of the pipe
Frequency/pitch can be	Frequency/pitch can be

	changed by altering length, tension and mass per unit length of string	changed by altering the pressure of the air and length of air column using stops.
	This indicative content can be obtained from any labelled diagrams showing waves on strings and pipes	

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 and understanding of scientific facts/concepts to the given context with generalised comments 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	• Demonstrates good knowledge and understanding by selecting and applying some relevant scientific facts/concepts to provide the comparison being presented • 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	• Demonstrates comprehensive knowledge and understanding by selecting and applying relevant knowledge of scientific facts/concepts to provide the comparison being presented • Line(s) of argument consistently supported throughout by sustained application of relevant evidence drawn from the context • The comparison shows a logical chain of reasoning which is supported throughout by sustained application of relevant evidence

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