



# Mark Scheme (Results)

June 2019

Pearson BTEC Level 3 Nationals  
Certificate in Applied Science / Forensic  
and Criminal Investigation

Unit 1: Principles and Applications of  
Science - Physics  
Section C: Waves in Communication



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# Unit 1: Applications of Science I – sample marking grid

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## 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

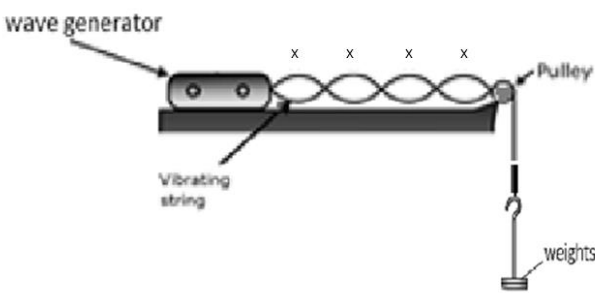
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The marking grids have been designed to assess learner work holistically. Rows in the grids identify the assessment focus/outcome being targeted. When using a marking grid, the 'best fit' approach should be used.

- 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 Template

## Applied Science Unit 1 Physics Series 1906

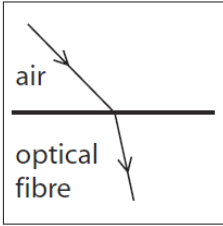
Question Number	Answer		Mark
1 (a)(i)	2		1
1 (a)(ii)		only <b>one</b> correct 'X' is needed as an indication of an antinode above below or in the middle of the string. If more than one is given they must not be contradictory	1
1 (a)(iii)	D resonance		1
1 (a)(iv)	<p>conversion (1)</p> <p>mass of string 2.1g = 0.0021kg</p> <p>substitution (1)</p> $(v =) \sqrt{\frac{3.6}{0.0021}}$ <p>evaluation without square root (1)</p> <p>(√) 1700</p> <p>evaluation (1)</p> <p>41(m/s)</p>	<p>correct answer 41 (m/s) gains full marks</p> <p>conversion and substitution in either order</p> <p>allow <math>(v =) \sqrt{\frac{3.6}{2.1}}</math> for 1 mark</p> <p>accept any value rounding to 1700 gains 3 marks</p> <p>accept any value rounding to 41(m/s)</p> <p>POT error gains 3 marks</p> <p>1.3 gains 3 marks (<math>\mu</math> not converted)</p> <p>1.7 gains 2 marks (no conversion or square root)</p> <p>answers with no working shown gain marks as indicated</p>	4

1 (b)	<ul style="list-style-type: none"> <li>• (use strings of) different mass/weight (per unit length) (1)</li> <li>• (change) the (vibrating) length of the strings (1)</li> </ul>	<p>allow different thickness/width /material/metal</p> <p>any idea of change of length of string e.g. move hand up and down string/bend string/add a 'capo'</p>	2
Total			9 marks

Question Number	Answer	Additional guidance	Mark
2 (a)	B microwaves travel at the speed of light in a vacuum		1
2 (b)	<p>An explanation that makes reference to one <b><u>linked pair</u></b>:</p> <p>(microwaves/they) can travel long distance (to the satellite) (1)</p> <p>(because) they are not absorbed by the (Earth's) atmosphere (1)</p> <p>OR</p> <p>(microwaves/they) carry large amounts of information/data (1)</p> <p>(because) the frequency is high(er)/short(er) wavelength/ bandwidth large (1)</p> <p>OR</p> <p>loss of energy is less(1)</p> <p>(because) (microwaves/they) do not spread (diffract) very much/they are not absorbed by the atmosphere (1)</p> <p>OR</p> <p>small wavelength allows (antennas/dishes to direct them in) narrow beams (1)</p> <p>(dish to dish) for improved security (1)</p>	<p>accept can reach/ travel up to satellite</p> <p>accept not reflected by the ionosphere</p> <p>accept 'pass through'</p> <p>allow low for short</p>	2

2 (c)(i)	(different frequency) to prevent interference (of signals) (1)  OR  down load needs less power (so lower frequency) (1)	idea of not mixing signals	1
2 (c)(ii)	(received upload) signal is weak/has less power (so needs amplifying) (1)  OR  download signal needs to be made stronger/have more power (for transmission) (1)		1
Total			5 marks

Question Number	Answer	Additional Guidance	Mark
3 (a)	any value between 14.8 (mV) and 15.2 (mV) inclusive		1
3 (b)	<p><b>First Space</b> voltage(s)/amplitude/frequency/wavelength/mV/ (microphone)output (1)</p> <p><b>Second Space</b> continuously/consistently/constantly/always/along/ regularly(1)</p>	<p>the responses must be in the correct spaces</p> <p>do not accept MV or Mv</p>	2
3 (c)	<p>Award 1 mark for each logically ordered point up to a maximum of 3 marks.</p> <p>(voltages of the analogue signal are) sampled (1)</p> <p>at (discrete/set time) intervals (1)</p> <p>(sampled voltages) are converted to a binary(code)(1)</p> <p>transmitted as a digital signal (1)</p>	<p>allow a sample is taken</p> <p>accept rate as an alternative to set time intervals</p> <p>data is quantised</p> <p>allow 0/1 or on/off or high/low voltage</p> <p>accept electrical impulses for digital signal</p> <p>if no other mark awarded allow use 'analogue to digital converter/ADC' for one mark</p>	3
Total			6 marks

Question Number	Answer	Additional guidance	Mark
4 (a)	C 		1
4 (b)	substitution (1) $1.55 = \frac{3 \times 10^8}{v}$ rearrangement (1) $v = \frac{3 \times 10^8}{1.55}$ OR $v = \frac{c}{n}$ evaluation (1) $1.9 \times 10^8 \text{ (ms}^{-1}\text{)}$	answer $1.9 \times 10^8$ (ms <sup>-1</sup> ) gains full marks  allow substitution and rearrangement in either order          accept 193548387.1  accept any answer that rounds to 200 000 000 OR $2 \times 10^8$  award max. of 2 marks if POT error.  award full marks for correct answer without working	3



4 (c)

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.

#### Use of Total Internal Reflection (TIR)

- light travels through the fibres by total internal reflection
- TIR only occurs when light in an (optically) more dense medium is incident on the boundary with an (optically) less dense medium at greater than the critical angle
- TIR only occurs when light in a medium of higher refractive index is incident on the boundary with a medium of lower refractive index at greater than the critical angle
- incident light on the wall of the fibre at greater than the critical angle is reflected
- diagram to show total internal reflection/critical angle with mediums labelled

#### Optical Fibres

- two (bundles of) optical fibres
- one (incoherent bundle - randomly arranged fibres) connected to light source to take light to the point inside the body to be observed
- reflection occurs (at internal body part)
- second (coherent bundle - fibres in the same order at each end) takes the image from inside the body to the viewer/camera

#### General

- the fibres are very fine and made of glass
- each fibre (in bundle) gives one piece of the image (pixel), which can be converted to give an image on a screen
- each fibre has a (glass) cladding that has a slightly lower refractive index than the glass in the fibre
- cladding increases the critical angle
- only rays close to the axis of the fibre pass through
- giving fewer reflections down the fibre
- less energy loss
- all the light signals arrive at the same time and give a clearer image
- the light signal is analogue

**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\*.

<b>Level</b>	<b>Mark</b>	<b>Descriptor</b>
Level 0	0	No rewardable material.
Level 1	1–2	<ul style="list-style-type: none"> <li>• Demonstrates adequate knowledge and understanding of scientific facts/concepts to the given context with generalised comments made.</li> <li>• Generic statements may be presented rather than linkages to the context being made so that lines of reasoning are unsupported or partially supported.</li> <li>• The explanation shows some structure and coherence.</li> </ul>
Level 2	3–4	<ul style="list-style-type: none"> <li>• Demonstrates good knowledge and understanding by selecting and applying some relevant scientific facts/concepts to provide the explanation being presented.</li> <li>• Lines of argument mostly supported through the application of relevant evidence.</li> <li>• The explanation shows a structure which is mostly clear coherent and logical.</li> </ul>
Level 3	5–6	<ul style="list-style-type: none"> <li>• Demonstrates comprehensive knowledge and understanding by selecting and applying relevant knowledge of scientific facts/concepts to provide the explanation being presented.</li> <li>• Line(s) of argument consistently supported throughout by sustained application of relevant evidence drawn.</li> <li>• The explanation shows a well-developed structure which is clear, coherent and logical.</li> </ul>

Ofqual



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