



# Mark Scheme (Results)

January 2021

Pearson BTEC Nationals

In Applied Science (31617H1P)

Unit 1: Principles and Applications of Science I -  
Physics

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# Unit 1: Principles and Applications of Science I

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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.

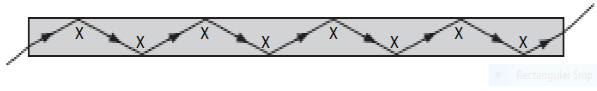
- Examiners should first make a holistic judgement on which band most closely matches the learner's response and place it within that band. Learners will be placed in the band that best describes their answer.
- The mark awarded within the band will be decided based on the quality of the answer, in response 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

Question Number	Answer	Additional Guidance	Mark
1 (a)(i)	A PQ		1
1 (a)(ii)	rarefaction(s)	Accept rarefraction  do not accept reflection, rarefaction or refraction	1
1 (b)(i)	6.8 (minutes) /6:48/ 6 mins 48 s(econds)	accept any time between 6.6 (minutes) and 7.0 (minute) Do not accept 6.48	1
1 (b)(ii)	substitution (1)  $(v) = \frac{6000}{1010}$  evaluation (1)  5.9 (km s <sup>-1</sup> )	Answer 5.9 for 2 marks without working    accept 6.(0 )/ 5.9405/5.94(km s <sup>-1</sup> ) power of ten error gains 1 mark	2
<b>Total</b>			<b>5 marks</b>

Question Number	Answer	Additional Guidance	Mark
2 (a)	<p>A description that includes <b>three</b> of the following in a logical order:</p> <p>the wire/it is fixed between two points / one end of wire is fixed (1)</p> <p>the wire/it is {tight/taut} (1)</p> <p>the wire/it is {displaced/plucked/moved upwards/ moved sideways /vibrated / oscillated} (1)</p> <p>the wave is reflected/bounces back (from fixed end) (1)</p>	<p>accept any movement from rest position for wire</p> <p>accept any relevant reference to interference or superposition</p>	3
2 (b)	D 5		1
2 (c)	<p>substitution (1)</p> $60.1 = \sqrt{\frac{T}{0.0056}}$ <p>squaring (1)</p> $60.1^2 = \frac{T}{0.0056}$ <p>rearrangement (1)</p> $60.1 \times \sqrt{0.0056} = \sqrt{T}$ <p>Or</p> $60.1^2 \times 0.0056 = T$ <p>evaluation (1)</p> <p>20.2 (N)</p>	<p>Answer 20.2 (N) with no working for 4 marks</p> <p>values must be seen in an equation</p> <p>substitution and rearrangement can be in any order</p> <p>accept rearrangement giving <math>v \times \mu</math> with square or square root for both or either symbol</p> <p>accept 20/20.16(N)</p> <p>power of 10 error and values of 0.58/0.337/0.43/0.34/0.11/ and 4.5 gain 3 marks power of 10 error on these values gains 2 marks.</p> <p>award 2 marks for <math>60.1 \times 0.0056</math> seen with square or square root for both or either value</p>	4
<b>Total</b>			<b>8 marks</b>

Question Number	Answer	Additional Guidance	Mark
3 (a)	C Microwaves have a higher frequency than radio waves.		1
3 (b)	Any <b>two</b> from:  only works over short distances/short range/about 10m (1)  (Bluetooth®) signals can pass through walls/ (Bluetooth® ) does not need 'line of sight' (1)  uses multiplexing (1)  uses frequency hopping (1)	accept any other relevant response  accept transfers /transmits/carries data  accept avoids interference  ignore use of multiple devices	2
3 (c)	Award <b>one</b> mark for identification and <b>one</b> additional mark for an appropriate expansion.  <b>identification</b> (1) high orbit (satellite) is above the ionosphere OR radio waves do not travel to 36000km/ high orbit(satellites) (1)  <b>expansion</b> (1) radio waves/they are reflected by the <u>ionosphere</u> or radio waves/ they cannot pass through the <u>ionosphere</u> (1)	ORA  accept are absorbed	2
<b>Total</b>			<b>5 marks</b>

Question Number	Answer	Additional Guidance	Mark
4 (a)		<p>X can be inside or outside the optical fibre</p> <p>One correctly positioned X is sufficient to gain the mark The list principle applies</p>	1
4 (b)	<p>Award <b>one</b> mark for identification and <b>two</b> additional marks for an appropriate expansion.</p> <p><b>identification</b> the energy/light loss is reduced/less attenuation (1)</p> <p><b>expansion</b> (because) there are fewer reflections (1) the critical angle is larger (1) less distance travelled by the signal (1) travels through the cable in less time (1)</p>	<p>Do not allow travels quicker or faster</p>	3
4 (c)	<p>Award <b>one</b> mark for identification and <b>one</b> additional mark for an appropriate expansion.</p> <p><b>identification (1)</b> (the optical fibre cable) carries many signals/frequencies/channels/bands (at the same time)</p> <p><b>expansion (1)</b> more data travels/ can be sent/received (in the same time) OR gives faster broadband/ internet/ connection speeds</p>		2
<b>Total</b>			<b>6 marks</b>

Question number	Indicative content	
5	<p><b>Diffraction grating</b></p> <ul style="list-style-type: none"> <li>• Light waves pass through slits in the grating</li> <li>• Light from sodium lamp is made up of light of different colours/frequencies/wavelengths</li> <li>• Slits same size as wavelength of light</li> <li>• Light disperses/spreads out, semi-circular diffraction pattern at one or more slits (may be seen on the diagram)</li> <li>• Light from slits/gaps in grating is coherent</li> <li>• The smaller the slits the more the light spreads out (ORA)</li> <li>• The light waves from the slits interfere/overlap</li> <li>• The light waves change direction</li> <li>• The longer the wavelength (shorter the frequency) the bigger the change in direction</li> <li>• Red lines are furthest away from the central maximum</li> </ul> <p><b>Screen</b></p> <ul style="list-style-type: none"> <li>• Bright band of (yellow) light at the centre</li> <li>• All waves reaching the centre of the screen are in phase</li> <li>• Constructive superposition/interference between waves</li> <li>• Each spectral/bright line is due to constructive superposition for a particular wavelength/frequency of light At bright lines, the waves for that frequency of light, from all the gaps in the diffraction grating, are in phase/have whole wavelength path difference/peak on peak</li> <li>• Dark regions between spectral/bright lines is due to destructive superposition/interference for all the wavelengths of light</li> <li>• At dark regions, there is half a wavelength path difference or a trough and peak meet or 180° out of phase or <math>\pi</math> radians</li> </ul>	
<p><b>Mark scheme (award up to 6 marks)</b> refer to the guidance on the cover of this document for how to apply levels-based mark schemes*.</p>		
Level	Mark	Descriptor
Level 0	0	No rewardable material
<b>Level 1</b>	<b>1-2</b>	<ul style="list-style-type: none"> <li>• Demonstrates adequate knowledge of scientific facts/concepts with generalised comments made</li> <li>• Generic statements may be presented rather than linkages being made so that lines of reasoning are unsupported or partially supported</li> <li>• The discussion shows some structure and coherence</li> </ul>



<b>Level 2</b>	<b>3-4</b>	<ul style="list-style-type: none"> <li>• Demonstrates good knowledge and understanding by selecting and applying some relevant scientific facts/concepts to provide the discussion being presented</li> <li>• Lines of argument mostly supported through the application of relevant evidence</li> <li>• The discussion shows a structure which is mostly clear, coherent and logical</li> </ul>
<b>Level 3</b>	<b>5-6</b>	<ul style="list-style-type: none"> <li>• Demonstrates comprehensive knowledge and understanding by selecting and applying relevant scientific facts/concepts to provide the discussion being presented.</li> <li>• Line(s) of argument consistently supported throughout by sustained application of relevant evidence</li> <li>• The discussion shows a well-developed structure which is clear, coherent and logical</li> </ul>



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