



Pearson  
Edexcel

# **Mark Scheme (Results)**

Summer 2018

Pearson Edexcel GCSE

In Physics (1PH0) Paper 1F

## **Edexcel and BTEC Qualifications**

Edexcel and BTEC qualifications are awarded by Pearson, the UK's largest awarding body. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers. For further information visit our qualifications websites at [www.edexcel.com](http://www.edexcel.com) or [www.btec.co.uk](http://www.btec.co.uk). Alternatively, you can get in touch with us using the details on our contact us page at [www.edexcel.com/contactus](http://www.edexcel.com/contactus).

## **Pearson: helping people progress, everywhere**

Pearson aspires to be the world's leading learning company. Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at: [www.pearson.com/uk](http://www.pearson.com/uk)

Summer 2018

Publications Code 1PH0\_1F\_1806\_MS

All the material in this publication is copyright

© Pearson Education Ltd 2018

## General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Mark schemes have been developed so that the rubrics of each mark scheme reflects the characteristics of the skills within the AO being targeted and the requirements of the command word. So for example the command word 'Explain' requires an identification of a point and then reasoning/justification of the point.

Explain questions can be asked across all AOs. The distinction comes whether the identification is via a judgment made to reach a conclusion, or, making a point through application of knowledge to reason/justify the point made through application of understanding. It is the combination and linkage of the marking points that is needed to gain full marks.

When marking questions with a 'describe' or 'explain' command word, the detailed marking guidance below should be consulted to ensure consistency of marking.

Assessment Objective		Command Word	
Strand	Element	Describe	Explain
AO1*		An answer that combines the marking points to provide a logical description	An explanation that links identification of a point with reasoning/justification(s) as required
AO2		An answer that combines the marking points to provide a logical description, showing application of knowledge and understanding	An explanation that links identification of a point (by applying knowledge) with reasoning/justification (application of understanding)
AO3	1a and 1b	An answer that combines points of interpretation/evaluation to provide a logical description	
AO3	2a and 2b		An explanation that combines identification via a judgment to reach a conclusion via justification/reasoning
AO3	3a	An answer that combines the marking points to provide a logical description of the plan/method/experiment	
AO3	3b		An explanation that combines identifying an improvement of the experimental procedure with a linked justification/reasoning

\*there will be situations where an AO1 question will include elements of recall of knowledge directly from the specification (up to a maximum of 15%). These will be identified by an asterisk in the mark scheme.

Question Number	Answer	Mark
1(a)	<p><b>B</b> 1.0 m/s      <b>The only correct answer is B</b></p> <p><i>A 0.1 m/s is incorrect, being 1 metre every 10s, insect crawling pace</i></p> <p><i>C 10 m/s is incorrect, being an Olympic sprinter's pace, much too fast for 'walking'</i></p> <p><i>D 100 m/s is incorrect, being a very fast sport's car's pace</i></p>	<p><b>(1)</b></p> <p>AO 1 1</p>

Question Number	Answer	Mark
1(b)	<p>weight / force</p> <p>(accept circle around weight if not contradicted on answer line)</p>	<p><b>(1)</b></p> <p>AO 1 2</p>

Question Number	Answer	Additional guidance	Mark
<b>1(c)</b>	substitution (1) $(F =) 0.10 \times 2.0$  evaluation (1) $0.2(0)$  unit (1) N	$100 \times 2$ (using $0.10\text{kg} = 100\text{g}$ )  reject $0.10 \times 2.0^2$ and the follow up evaluation (equation given should be used)  correct answer without working gets 2 marks  allow 1 mark total for 2 with any other power of ten, so that includes 200 for example  separate unit mark  newtons / Newtons accept lowercase 'n'  for the abbreviated unit  accept $\text{kg ms}^{-2}$  accept $200 \text{ g ms}^{-2}$ for 3 marks	<b>(3)</b> AO 2 1

Question Number	Answer	Additional guidance	Mark
<b>1(d)</b>	<ul style="list-style-type: none"> <li>• direction (1)</li> <li>• size (1)</li> </ul>	answers only acceptable in given order  or magnitude	<b>(2)</b> AO 2 1

**(Total for Question 1 = 7 marks)**

Question Number	Answer	Additional guidance	Mark
2(a)(i)	recall speed = $\frac{\text{distance}}{\text{time}}$	accept any correct rearrangement or use of s, d and t may use v for speed and x for distance ignore use of triangles	<b>(1)</b> AO 1 1

Question Number	Answer	Additional guidance	Mark
2(a)(ii)	substitution (1) (speed) = $\frac{220}{0.7(0)}$  evaluation (1) 310 (m/s)	allow ecf from part (i) for this mark only  allow any numbers that round to 310 e.g. 314 award full marks for the correct answer without working	<b>(2)</b> AO 2 1

Question Number	Answer	Additional guidance	Mark
2(b)	<p>an explanation linking:</p> <ul style="list-style-type: none"> <li>• measure across more than one (wavelength) (1)</li> <li>• divide by the number of wavelengths (1)</li> </ul>	<p>use a more accurate device (finer divisions)</p> <p>use a camera / picture/strobe(light) (so the waves are not moving)</p> <p>count the number of wavelengths</p> <p>must be talking about <b>measuring</b>, NOT changing the wavelength etc.</p>	<p><b>(2)</b></p> <p>AO 3 3b</p>

Question Number	Answer	Additional guidance	Mark
2(c)	<p>a description to include:</p> <ul style="list-style-type: none"> <li>• longitudinal – (vibrations) parallel to (direction of travel) (1)</li> <li>• transverse – (vibrations) at right angles to (direction of travel) (1)</li> <li>• (connection between) direction of travel with (direction of) vibrations (1)</li> </ul>	<p>back and forth (oscillations)/ compressions or rarefactions</p> <p>up and down (oscillations)</p>	<p><b>(3)</b></p> <p>AO 1 1</p>

**(Total for Question 2 = 8 marks)**



Question Number	Answer	Additional guidance	Mark
3(a)(i)	points plotted to within $\pm 1$ small square (10, 60) (1) (20, 37) (1)		(2) AO 2 1

Question Number	Answer	Additional guidance	Mark
3(a)(ii)	point at 15,55 circled (1)		(1) AO 2 1

Question Number	Answer	Additional guidance	Mark
3(a)(iii)	best fit curve passing through most of the points seen, apart from 15,55 (1)	reject tramlining (multiple lines/curves) ignore slight shakiness in drawing	(1) AO 3 2a

Question Number	Answer	Additional guidance	Mark
3(a)(iv)	the curve will be above the first one (starting at the same point) / it will take longer to cool down / cools more slowly (1)	less steep  ignore all comments about heat / the process; <b>the question is about the curve</b>	(1) AO 2 1

Question Number	Answer	Additional guidance	Mark
3(b)(i)	wavelength for object L = 84.(0) to 85.(0) ( $\mu\text{m}$ ) (1)  wavelength for object M = 93.(0) to 95.(0)( $\mu\text{m}$ ) (1)	estimates, so we are being generous with this	(2) AO 3 2a

Question Number	Answer	Additional guidance	Mark
<b>3(b)(ii)</b>	object L and shorter wavelength (1)		<b>(1)</b> AO 3 1a

---

**(Total for Question 3 = 8 marks)**

Question Number	Answer	Additional guidance	Mark
4(a)(i)	kinetic (1)	<b>only</b> (adding another incorrect alternative negates)	<b>(1)</b> AO 2 1

Question Number	Answer	Additional guidance	Mark
4(a)(ii)	any one of increase the speed (of spinning) (1)  increase the mass / weight (of the flywheel) (1)	accept (idea of) faster  ignore make it bigger	<b>(1)</b> AO 2 1

Question Number	Answer	Additional guidance	Mark
4(b)(i)	substitution (1) ( $\Delta GPE =$ ) $65 \times 10 \times 200$  evaluation (1) $1.3 \times 10^5 / 130\,000$ (J)	allow substitution mark with 65000 (g)  allow 1 mark for answers that round to 1.3 with any other power of ten  do not allow 13000  award full marks for the correct answer without working	<b>(2)</b> AO 2 1

Question Number	Answer	Additional guidance	Mark
4(b)(ii)	substitution (1) (KE) $\frac{1}{2} \times 65 \times 36^2$  squaring (1) $36^2$ (=1296)  (completing) evaluation (1) $42\,120 / 4.2(1) \times 10^4$ (J)	using 36 → 1170 (J) OR $36 \times 2 \rightarrow 2340$ (J) scores 2 marks (apply power of ten error as well if occurring e.g. 117000 (J) gets 1 mark)  award full marks for the correct answer without working  allow 2 marks for answers that round to 4.2 with any other power of ten  omitting $\frac{1}{2}$ gives 84240(J) scores 2 marks	<b>(3)</b> AO 2 1

Question Number	Answer	Additional guidance	Mark
4(c)	<p>a description to include 3 points from:</p> <ul style="list-style-type: none"> <li>• measure a distance (at the bottom) / use mark(er)s (certain distance apart) (1)</li>   <li>• starting timer (at first mark(er)) (1)</li>   <li>• stopping timer (at 2<sup>nd</sup> mark(er)) OR measures a time (interval) (1)</li>   <li>• (use speed) = distance/time (1)</li> </ul>	<p>use a light gate (or equivalent sensors idea) not over whole slope for this mark point</p> <p>use of video / (speed) camera /interrupts the light beam</p> <p>accept any time measured for this mp including data logger OR timer / stopwatch</p>	<p><b>(3)</b> AO 2 2</p>

**(Total for Question 4 = 10 marks)**

Question Number	Answer	Mark
5(a)	proton(s)	(1) AO 1 1

Question Number	Answer	Additional guidance	Mark
5(b)(i)	<p>a description referring to:</p> <p>fusion involves coming together / joining of particles / nuclei / atoms (1)</p> <p>fission involves (larger) particle(s) / nuclei /atoms breaking up (1)</p>	<p>not just 'fuse together' that's just restating – more explanation needed</p> <p>particles etc. coming apart / separating</p> <p>no marks if just objects / things joining / coming apart</p>	(2) AO 1 1

Question Number	Answer	Mark
5(b)(ii)	<p><b>D</b> protons <b>The only correct answer is D</b></p> <p><i>A 'beta particles' is incorrect, they are not found in nuclei to facilitate that repulsion</i></p> <p><i>B 'electrons' is incorrect, for the same reason as A</i></p> <p><i>C 'neutrons' is incorrect as they don't repel each other</i></p>	(1) AO 1 1

Question Number	Answer	Additional guidance	Mark
5(c)(i)	substitution (1) $\frac{845\,000}{0.0394}$ evaluation (1) 21 000 000	answers that round to 21 000 000 $2.1(45) \times 10^7$ etc. award full marks for the correct answer without working	(2) AO 2 1

Question Number	Answer	Additional guidance	Mark
5(c)(ii)	any two from: <ul style="list-style-type: none"> <li>fusion power gives (many) more times the energy output (for the same mass used)</li> <li>no greenhouse gases / CO<sub>2</sub> emissions (produced with the fusion alternative)</li> <li>does not lead to global warming</li> <li>no (radioactive) waste</li> <li>does not deplete / use up a finite resource (e.g. oil)</li> </ul>	may quote numbers here accept no or less pollution / no or less harmful gases etc.  sustainable reference oil is running out ignore references to costs	(2) AO 1 1

<b>Question Number</b>	<b>Answer</b>	<b>Additional guidance</b>	<b>Mark</b>
<b>5(c)(iii)</b>	any two from: <ul style="list-style-type: none"><li>• problem of containment (the fusion gases / isotopes at high temperatures)</li><li>• (maintaining) high temperature</li><li>• (maintaining) high pressure</li></ul>		<b>(2)</b> AO 2 1

---

**(Total for Question 5 = 10 marks)**



Question Number	Answer	Additional guidance	Mark
6(a)	any two sources from: <ul style="list-style-type: none"> <li>oil</li> <li>(natural) gas</li> <li>coal</li> <li>nuclear/uranium</li> </ul>	accept petrol /diesel for oil  accept fossil fuel(s) for any of the first three i.e. fossil fuel and oil or coal or gas scores 1 mark but fossil fuel and nuclear scores 2 marks	<b>(2)</b> AO 1 1

Question Number	Answer	Additional guidance	Mark
6(b)(i)	bioenergy	biofuel / biomass	<b>(1)</b> AO 3 1b

Question Number	Answer	Additional guidance	Mark
6(b)(ii)	largest area / fraction / percentage (idea)	<b>must be referring to the chart</b> , not just repeating 4bi stem- can't have greatest/ largest amount by itself	<b>(1)</b> AO 3 1b

Question Number	Answer	Additional guidance	Mark
6(b)(iii)	wind		<b>(1)</b> AO 3 1b

Question Number	Answer	Additional guidance	Mark
<b>6(c)</b>	<p>discussion to involve two points each giving change and effect (max 4 marks)</p> <p>some examples:</p> <p>change: biomass-solar-geothermal (fraction) increases (1) effect: e.g. reduces greenhouse gas / CO<sub>2</sub> emissions (1)</p> <p>change: 'wind' (fraction) increases (1) effect: e.g. visual/noise pollution arguments (1)</p> <p>change: 'natural gas' (fraction) increases (1) effect: e.g. contributes to global warming (1)</p> <p>change: 'uranium' (fraction) decreases (1) effect: e.g. less radioactive waste (1)</p>	<p>ignore vague responses such as 'environmentally friendly', less pollution etc.</p> <p>candidates may give positive or negative effects</p> <p>for this change (and for oil) allow decreases (with a correct accompanying effect for 2 marks)</p> <p>accept conserves non-renewables but not just 'more renewable'</p>	<p><b>(4)</b></p> <p>AO 3 2a</p> <p>AO 3 2b</p>

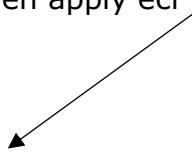
Question Number	Answer	Additional guidance	Mark
6(d)	an explanation linking use of lubrication / oil (1) to reduce friction (between parts) (1)		<b>(2)</b> AO 2 1

---

**(Total for Question 6 = 11 marks)**

Question Number	Answer	Mark
7(a)(i)	<p>A converging lens forming a real image  <b>The only correct answer is A</b></p> <p><i>B 'diverging lens forming a real image' is incorrect since the lens drawn in the diagram is not diverging</i></p> <p><i>C 'converging lens forming a virtual image' is incorrect, since the diagram shows rays coming to a focus (on a screen if placed there)</i></p> <p><i>D 'diverging lens forming a virtual image' is incorrect, since the diagram shows neither a diverging image or the formation of a virtual image</i></p>	<p><b>(1)</b>  AO 3 1a</p>

Question Number	Answer	Mark
7(a)(ii)	<p>C 'R' <b>The only correct answer is 'R'</b></p> <p><i>'P' is incorrect, being a distractor, showing a width of rays</i></p> <p><i>'Q' is incorrect, being a distractor showing an arbitrary distance to the lens distance</i></p> <p><i>'S' is incorrect, being a distractor showing an overall distance</i></p>	<p><b>(1)</b>  AO 3 1b</p>

Question Number	Answer	Additional guidance	Mark
7(b)	<p>substitution (1)</p> <p><u>1</u></p> <p>17 or 0.17</p> <p>evaluation (1)</p> <p>5.882...</p> <p>evaluation to 2sf (1)</p> <p>5.9 (any answer to 2 sf for this mark, but not if wrong rounding is seen)</p>	<p>lose this mark if there is <b>any other power of 10 error</b> but then apply ecf (e.g. 1/1.7)</p> <p></p> <p>so 0.588 then = 1 mark for that ecf</p> <p>independent mark</p> <p>award full marks for the correct answer without working</p>	<p><b>(3)</b>  AO 2 1</p>

Question Number	Answer	Mark
7(c)	<p>Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme.</p> <p>The indicative content below is not prescriptive, and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant.</p> <p style="text-align: center;"><b>AO1 strand 1 (6)</b></p> <ul style="list-style-type: none"> <li>• idea that telescopic evidence supported the heliocentric model e.g. observing the moons of Jupiter supported a sun-centred solar system</li> <li>• detail e.g. it was Galileo's observations of the moons of Jupiter</li> <li>• the moons rotate around Jupiter i.e. not everything rotates about the earth</li> <li>• other observations by telescope – discoveries of the planets Uranus and Neptune + the asteroid belt</li> </ul> <ul style="list-style-type: none"> <li>• (detailed) photographic evidence</li> <li>• use of computer modelling</li> <li>• satellite observations</li> <li>• heliocentric model verified by Voyager missions (space probes)</li> </ul>	<p><b>(6)</b></p> <p>AO 1 1</p>

<b>Level</b>	<b>Mark</b>	<b>Descriptor</b>
	0	<ul style="list-style-type: none"> <li>• No rewardable material.</li> </ul>
Level 1	1-2	<ul style="list-style-type: none"> <li>• Demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1)</li> <li>• Presents an explanation with some structure and coherence. (AO1)</li> </ul>
Level 2	3-4	<ul style="list-style-type: none"> <li>• Demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1)</li> <li>• Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)</li> </ul>
Level 3	5-6	<ul style="list-style-type: none"> <li>• Demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1)</li> <li>• Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)</li> </ul>

**(Total for Question 7 = 11 marks)**

---

Question Number	Answer	Mark
8(a)(i)	<p><b>D</b> refraction <b>The only correct answer is D</b></p> <p>A 'deflection' is an incorrect distracting description</p> <p>B 'incidence' is incorrect, that would be angle X</p> <p>C 'reflection' is incorrect, no reflection being shown in the diagram</p>	<p><b>(1)</b></p> <p>AO 1 1</p>

Question Number	Answer	Additional guidance	Mark
8(a)(ii)	<p>any pair of coordinates selected from the line (1)</p> <p>in range → 0.6(0) to 0.7(0) (1)</p>	<p>e.g. 20 and (13 or 14)</p> <p>or 10 and (6 or 7)</p> <p>ignore any units given</p> <p>award full marks for a correct answer without working</p>	<p><b>(2)</b></p> <p>AO 2 1</p>

Question Number	Answer	Additional guidance	Mark
8(a)(iii)	<p>an explanation linking:</p> <p>repeat (1)</p> <p>different angles / more values of X (1)</p> <p>for larger angles / values of X (1)</p>	<p>allow 'more measurements' / 'repeat experiment' / collect more data</p> <p>&gt; 20°</p>	<p><b>(3)</b></p> <p>AO 3 3a</p>

Question Number	Answer	Additional guidance	Mark
<b>8(b)</b>	substitution (1) $\frac{3.0 (\times 10^8)}{5.8 (\times 10^{-7})}$  evaluation (1) $5.2 \times 10^{14}$  unit (1)  Hz	   answers that round to $5.2 \times 10^{14}$  award 2 marks for a correct answer without working  allow 1 mark for answers that round to 5.2 to any power of ten   independent mark   accept hz or s <sup>-1</sup> or per sec(ond) or hertz   accept kHz, MHz etc with correct power (10 <sup>11</sup> kHz, 10 <sup>8</sup> MHz)	<b>(3)</b> AO 2 1

Question Number	Answer	Mark
<b>8(c)(i)</b>	red <b>or</b> orange	<b>(1)</b> AO 1 1

Question Number	Answer	Additional guidance	Mark
<b>8(c)(ii)</b>	green <b>or</b> blue <b>or</b> indigo <b>or</b> violet		<b>(1)</b> AO 1 1

**(Total for Question 8 = 11 marks)**



Question Number	Answer	Additional guidance	Mark
<b>9(a)</b>	a description to include: 1. put rock(s) in front of/near tube (1) 2. measure (count rate) separately for the two different rocks (1) 3. measure each count for the same time period (1) 4. keep source-detector distance the same for both rocks (1) 5. take (into account)/measure background count (1) 6. repeat readings and take average(s) (1)	not 'in' tube  keep rocks apart	<b>(4)</b> AO 2 2

Question Number	Answer	Additional guidance	Mark
9(b)	<ul style="list-style-type: none"> <li>• point after first half-life - 6, 40 (1)</li> <li>• point after second half-life - 12, 20 (1)</li> <li>• point after third half-life - 18, 10 (1)</li> </ul>	<p>within 1 small square by eye</p> <p>smooth curve starting at 80, with a decreasing gradient passing through one correct half-life point scores 2 marks</p> <p>smooth curve starting at 80, with a decreasing gradient passing through two correct half-life points scores 3 marks</p> <p><b>if no other mark scored</b></p> <p>smooth curve showing decreasing gradient but not going through any correct points scores 1 mark</p>	<p><b>(3)</b></p> <p>AO 3 1a</p>

Question Number	Answer	Mark
9(c)	<p>Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme.</p> <p>The indicative content below is not prescriptive, and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant.</p> <p style="text-align: center;"><b>A03 Strand 2a and 2b (6 marks)</b></p> <ul style="list-style-type: none"> <li>• shows some idea that the data can support arguments about alpha, beta and gamma radiation being present</li> <li>• argues that there is some evidence that alpha might be emitted (count rate going down with paper interposed)</li> <li>• argues that there is a lot of evidence that beta particles are emitted (count rate goes down a lot when the aluminium is inserted)</li> <li>• argues that there might be some gamma getting through (lead stopping everything apart from gamma) OR that with the lead present the count rate has gone down to a level consistent with background, so no gamma was present</li> </ul> <p>a level 3 answer will use data effectively</p>	<p><b>(6)</b> AO 1 1</p>

Level	Mark	Descriptor
	0	<ul style="list-style-type: none"> <li>No rewardable material.</li> </ul>
Level 1	1-2	<ul style="list-style-type: none"> <li>Deconstructs scientific information but understanding and connections are flawed. An unbalanced or incomplete argument that provides limited synthesis of understanding.</li> <li>Judgements are supported by limited evidence. (AO3)</li> </ul>
Level 2	3-4	<ul style="list-style-type: none"> <li>Deconstructs scientific information and provides some logical connections between scientific concepts. An imbalanced argument that synthesises mostly relevant understanding, but not entirely coherently.</li> <li>Judgements are supported by evidence occasionally. (AO3)</li> </ul>
Level 3	5-6	<ul style="list-style-type: none"> <li>Deconstructs scientific information and provide logical connections between scientific concepts throughout. A balanced, well-developed argument that synthesises relevant understanding coherently.</li> <li>Judgements are supported by evidence throughout. (AO3)</li> </ul>

**(Total for Question 9 = 13 marks)**

---

Question Number	Answer	Mark			
10(a)	<table border="1"> <tr> <td>D</td> <td>vector</td> <td>vector</td> </tr> </table> <p><b>The only correct answer is D</b></p> <p><b>A</b> 'scalar scalar' is incorrect, both force and velocity are vectors</p> <p><b>B</b> 'scalar vector' is incorrect, with force being described incorrectly as a scalar</p> <p><b>C</b> 'vector scalar' is incorrect, with velocity being described incorrectly as a scalar</p>	D	vector	vector	(1) AO 1 1
D	vector	vector			

Question Number	Answer	Additional guidance	Mark
10(b)(i)	gravitational / centripetal (1)	accept gravity / weight / gravitational field strength	(1) AO 2 1

Question Number	Answer	Additional guidance	Mark
10(b)(ii)	arrow from the satellite towards the centre of Earth – by eye (1)	direction must be clear	(1) AO 2 1

Question Number	Answer	Additional guidance	Mark
10(c)(i)	<p>a description to include:</p> <p>wavelength (of e.m. radiation) increased / frequency decreased (1)</p> <p>as the (star) moves away (from us) (1)</p>	<p>don't penalise planet instead of object</p> <p>stretched/moves to(wards) red end of spectrum</p> <p>spectral lines move towards the red end of the spectrum</p>	(2) AO 1 1

Question Number	Answer	Additional guidance	Mark
10(c)(ii)	<ul style="list-style-type: none"> <li>• an explanation linking:</li> <li>• big bang has expanding universe (1)</li> <li>• with galaxies moving away (from each other) (1)</li> </ul>	<p>from (original) explosion started at a point</p> <p>accept stars moving away (not objects or planets here)</p> <p>the further away they are the greater is their (recessional) speed idea</p>	<p><b>(2)</b></p> <p>AO 1 1</p>

Question Number	Answer	Additional guidance	Mark
10(c)(iii)	microwave		<p><b>(1)</b></p> <p>AO 1 1</p>

Question Number	Answer	Additional guidance	Mark
10(c)(iv)	(radiation) that comes from all over the sky / space / the universe	from the big bang / explosion	<p><b>(1)</b></p> <p>AO 1 1</p>

Question Number	Answer	Additional guidance	Mark
10(c)(v)	<p>an explanation linking:</p> <ul style="list-style-type: none"> <li>• the Big Bang theory has a beginning / initial explosion (1)</li> <li>• that releases / gives out radiation (1)</li> </ul>	<p>explosion from a point</p> <p>radiation still present</p>	<p><b>(2)</b></p> <p>AO 1 1</p>

**(Total for Question 10 = 11 marks)**

