

**GCSE  
COMBINED SCIENCE: TRILOGY  
8464/P/2F**

Physics Paper 2F

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**Mark scheme**

June 2022

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Version: 1.0 Final Mark Scheme



Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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## Information to Examiners

### 1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the examiner make their judgement
- the Assessment Objectives and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent (for example, a scientifically correct answer that could not reasonably be expected from a student's knowledge of the specification).

### 2. Emboldening and underlining

- 2.1** In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.
- 2.2** A bold **and** is used to indicate that both parts of the answer are required to award the mark.
- 2.3** Alternative answers acceptable for a mark are indicated by the use of **or**.  
Alternative words in the mark scheme are shown by a solidus eg allow smooth / free movement.
- 2.4** Any wording that is underlined is essential for the marking point to be awarded.

### 3. Marking points

#### 3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of errors / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as \* in example 1) are not penalised.

Example 1: What is the pH of an acidic solution?

[1 mark]

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

Example 2: Name **two** magnetic materials.

[2 marks]

Student	Response	Marks awarded
1	iron, steel, tin	1
2	cobalt, nickel, nail*	2

#### 3.2 Use of symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, or uses symbols to denote quantities in a physics equation, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

#### 3.3 Marking procedure for calculations

Marks should be awarded for each stage of the calculation completed correctly, as students are instructed to show their working. At any point in a calculation students may omit steps from their working. If a subsequent step is given correctly, the relevant marks may be awarded.

Full marks are **not** awarded for a correct final answer from incorrect working.

#### 3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

### 3.5 Errors carried forward

An error can be carried forward from one question part to the next and is shown by the abbreviation 'ecf'.

Within an individual question part, an incorrect value in one step of a calculation does not prevent all of the subsequent marks being awarded.

### 3.6 Phonetic spelling

Marks should be awarded if spelling is not correct but the intention is clear, **unless** there is a possible confusion with another technical term.

### 3.7 Brackets

(.....) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

### 3.8 Allow

In the mark scheme additional information, 'allow' is used to indicate creditworthy alternative answers.

### 3.9 Ignore

Ignore is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

### 3.10 Do **not** accept

Do **not** accept means that this is a wrong answer which, even if the correct answer is given as well, will still mean that the mark is not awarded.

### 3.11 Numbered answer lines

Numbered lines on the question paper are intended to support the student to give the correct number of responses. The answer should still be marked as a whole.

## 4. Level of response marking instructions

Extended response questions are marked on level of response mark schemes.

- Level of response mark schemes are broken down into levels, each of which has a descriptor.
- The descriptor for the level shows the average performance for the level.
- There are two marks in each level.

Before you apply the mark scheme to a student's answer, read through the answer and, if necessary, annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

### **Step 1: Determine a level**

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level.

The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer. With practice and familiarity you will find that for better answers you will be able to quickly skip through the lower levels of the mark scheme.

When assigning a level you should look at the overall quality of the answer. Do **not** look to penalise small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level.

Use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 2 with a small amount of level 3 material it would be placed in level 2 but be awarded a mark near the top of the level because of the level 3 content.

### **Step 2: Determine a mark**

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this. The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do not have to cover all of the points mentioned in the indicative content to reach the highest level of the mark scheme.

You should ignore any irrelevant points made. However, full marks can be awarded only if there are no incorrect statements that contradict a correct response.

An answer which contains nothing of relevance to the question must be awarded no marks.

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	energy		1	AO1 6.6.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	frequency	either order	1	AO1 6.6.2.1
	wavelength		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	A = visible light	allow visible allow light	1	AO1 6.6.2.1
	B = gamma (rays / waves / radiation)		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	<p style="text-align: center;"><b>Type of electromagnetic wave</b></p> <div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="border: 1px solid black; padding: 5px; width: 100px; text-align: center;">Microwaves</div> <div style="border: 1px solid black; padding: 5px; width: 100px; text-align: center;">Ultraviolet</div> <div style="border: 1px solid black; padding: 5px; width: 100px; text-align: center;">X-rays</div> </div>	<p style="text-align: center;"><b>Use</b></p> <div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="border: 1px solid black; padding: 5px; width: 150px; text-align: center;">Electrical heaters</div> <div style="border: 1px solid black; padding: 5px; width: 150px; text-align: center;">Energy efficient lamps</div> <div style="border: 1px solid black; padding: 5px; width: 150px; text-align: center;">Imaging bones</div> <div style="border: 1px solid black; padding: 5px; width: 150px; text-align: center;">Satellite communications</div> </div> <p style="margin-top: 20px;">additional line from a box on the left negates the mark for that box</p>	<p>1</p> <p>1</p> <p>1</p>	<p>AO1 6.6.2.4</p>

<b>Total Question 1</b>		<b>8</b>
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**Question 2**

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	any <b>one</b> from: <ul style="list-style-type: none"> <li>• stand up</li> <li>• use a funnel</li> <li>• pour water slowly</li> <li>• pour at arms-length</li> <li>• wear heat-proof gloves</li> </ul>	gloves on its own is insufficient allow do not touch hot objects (with bare hands)	1	AO3 6.6.2

Question	Answers	Mark	AO / Spec. Ref.
02.2	<b>Level 2:</b> The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	3–4	AO1 6.6.2.2
	<b>Level 1:</b> The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	
	No relevant content	0	
	<b>Indicative content</b> <ul style="list-style-type: none"> <li>• use the kettle to heat the water</li> <li>• use measuring cylinder to measure volume of water</li> <li>• same volume of water in each flask</li> <li>• use the thermometer to measure temperature of the water</li> <li>• ensure temperature is the same in each flask</li> <li>• infrared detector the same distance from each flask</li> <li>• use the infrared detector to measure the power of infrared radiation from each flask and compare results</li> </ul>		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	as time increases the power decreases		1	AO3 6.2.2
	the change (in power) each 60s decreases as the time increases	allow rate of decrease of power decreases	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	4.4 W		1	AO3 6.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	any <b>one</b> from: <ul style="list-style-type: none"> <li>• all surfaces will be at the same temperature</li> <li>• temperature of the water does not need to be measured</li> <li>• more surfaces can be tested</li> <li>• the procedure only needs to be done once</li> <li>• volume of water does not need to be measured</li> </ul>	allow different surfaces can be tested at the same time	1	AO3 6.2.2

<b>Question</b>	<b>Answers</b>	<b>Extra information</b>	<b>Mark</b>	<b>AO / Spec. Ref.</b>
<b>02.6</b>	measurements can be taken at the same time	allow no need to move the detectors / cube	1	AO3 6.2.2
	results will be more accurate		1	

<b>Total Question 2</b>		<b>11</b>
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**Question 3**

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	vertical arrow from <b>X</b> pointing downwards	ignore any labels	1	AO2 6.5.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	$W = 0.150 \times 9.8$	allow 1.5 (N)	1	AO2 6.5.1.3
	$W = 1.47$ (N)		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	the resultant force on the apple is zero		1	AO1 6.5.4.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	the resultant force on the apple is downwards		1	AO1 6.5.4.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	$t = \frac{4.9}{9.8}$	allow 0.50 (s)	1	AO2 6.5.4.1.2
	$t = 0.5$ (s)		1	

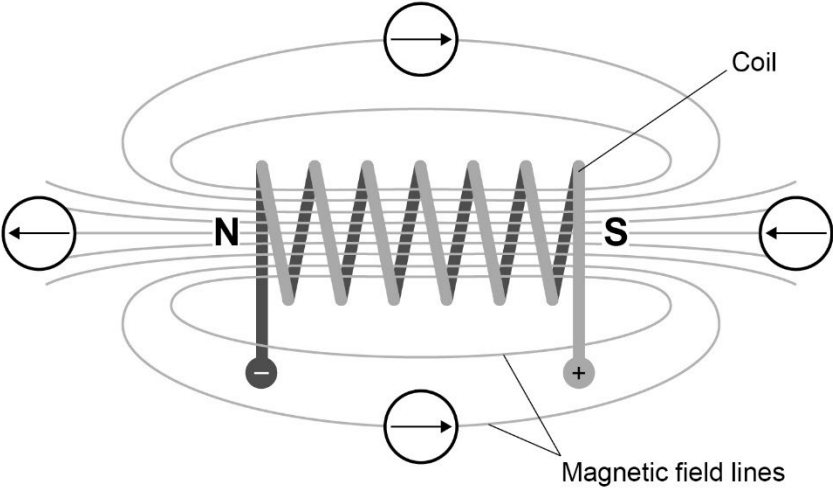
<b>Total Question 3</b>		<b>7</b>
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**Question 4**

<b>Question</b>	<b>Answers</b>	<b>Extra information</b>	<b>Mark</b>	<b>AO / Spec. Ref.</b>
<b>04.1</b>	the Earth has a magnetic field		1	AO2 6.7.1.2

<b>Question</b>	<b>Answers</b>	<b>Extra information</b>	<b>Mark</b>	<b>AO / Spec. Ref.</b>
<b>04.2</b>	steel		1	AO1 6.7.1.2

<b>Question</b>	<b>Answers</b>	<b>Extra information</b>	<b>Mark</b>	<b>AO / Spec. Ref.</b>
<b>04.3</b>	the field is strongest at the ends of the coil		1	AO1 6.7.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	<p>all arrows in the correct direction</p>  <p>The diagram shows a solenoid (coil) with current entering from the bottom left (marked with a minus sign) and exiting from the bottom right (marked with a plus sign). The current flows clockwise when viewed from the left. Magnetic field lines are shown as loops around the coil, with an arrow pointing from the North (N) pole on the left to the South (S) pole on the right. Four circular arrows are placed around the field lines: one at the top pointing right, one at the bottom pointing right, one on the left pointing left, and one on the right pointing left. Labels include 'Coil', 'N', 'S', and 'Magnetic field lines'.</p> <p>allow 1 mark for 2 or 3 arrows in the correct direction</p>		2	AO2 6.7.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	<p>any <b>two</b> from:</p> <ul style="list-style-type: none"> <li>• increase the current</li> <li>• insert an iron core</li> <li>• increase the number of turns</li> </ul>	<p>allow increase potential difference</p> <p>allow turns closer together</p>	2	AO1 6.7.2.1

Total Question 4		7
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**Question 5**

Question	Answers	Extra information	Mark	AO / Spec. Ref.
<b>05.1</b>	tiredness of the driver		1	AO1 6.5.4.3.2
	using a mobile phone		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
<b>05.2</b>	increases reaction time		1	AO1
	so increases the thinking distance		1	AO1
	so more likely to have a collision	allow travels a greater distance before stopping (in an emergency)	1	AO3 6.5.4.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
<b>05.3</b>	23 m/s		1	AO2 6.5.4.3.2



Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	directly proportional	allow 1 mark for as speed increases thinking distance increases	2	AO3 6.5.4.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	straight line from the origin with a greater gradient	allow a line that passes within half a small square of (15,21)  dependent on MP1	1	AO2 6.5.4.3.2
	through (15,21)		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	$v^2 - 0^2 = 2 \times 5.0 \times 45$	allow a correctly rounded value of v calculated using the correct equation	1	AO2 6.5.4.1.5
	$v^2 = 450$ or $v = \sqrt{450}$		1	
	$v = 21.21320343$		1	
	$v = 21$ (m/s)		1	

<b>Total Question 5</b>	<b>14</b>
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**Question 6**

Question	Answers	Extra information	Mark	AO / Spec. Ref.
<b>06.1</b>	<b>A</b> = rarefaction		1	AO1 6.6.1.1
	<b>B</b> = wavelength		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
<b>06.2</b>	$f = 4000 \text{ Hz}$		1	AO2
	$T = \frac{1}{4000}$	allow a correct substitution using an incorrectly / not converted value of $f$	1	AO2
	$T = 0.00025$	allow a correct calculation using an incorrectly / not converted value of $f$	1	AO2
	seconds <b>or</b> s		1	AO1 6.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
<b>06.3</b>	wave speed = frequency × wavelength  <b>or</b> $v = f\lambda$		1	AO1 6.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
<b>06.4</b>	$v = 348$	allow a value in the range 347 to 348	1	AO2 6.6.1.2
	$348 = 300 \times \lambda$	subsequent marks may only be awarded if value for $v$ is in the range 343 to 349	1	
	$\lambda = \frac{348}{300}$	allow a correct substitution using an incorrect value of $v$ read from graph	1	
	1.16 (m)	allow a correct rearrangement using an incorrect value of $v$ read from graph  allow 1.2 (m) allow a correct calculation using an incorrect value of $v$ read from graph  allow a maximum of <b>2</b> marks for use of $v = 330$ m/s	1	

<b>Total Question 6</b>		<b>11</b>
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**Question 7**

Question	Answers	Extra information	Mark	AO / Spec. Ref.
<b>07.1</b>	work done = force × distance (along the line of action of the force)  or  $W = F s$		1	AO1 6.5.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
<b>07.2</b>	$3\,360\,000 = F \times 42\,000$  $F = \frac{3\,360\,000}{42\,000}$  $F = 80 \text{ (N)}$		1  1  1	AO2 6.5.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
<b>07.3</b>	distance travelled = speed × time		1	AO1 6.5.4.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	$42\,000 = v \times 5600$ $v = \frac{42\,000}{5600}$ $v = 7.5 \text{ (m/s)}$		1 1 1	AO2 6.5.4.1.2

Question	Answers	Mark	AO / Spec. Ref.
07.5	<b>Level 2:</b> Relevant points (reasons/causes) are identified, given in detail and logically linked to form a clear account.	3–4	AO3 6.5.4.1.2
	<b>Level 1:</b> Relevant points (reasons/causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	1–2	
	No relevant content	0	
	<b>Indicative content</b>  the effect on speed must be consistent with the cause of the change  <ul style="list-style-type: none"> <li>• competitors accelerate at the start</li> <li>• so speed increases</li>   <li>• the road is not flat</li> <li>• so speed increases going downhill and / or speed decreases going uphill</li>   <li>• the competitor goes round a bend</li> <li>• so speed decreases</li>   <li>• competitors may tire towards the end (so the force they exert decreases)</li> <li>• so they slow down</li>   <li>• competitors may sprint during the race</li> <li>• causing speed to increase</li>   <li>• may get a puncture</li> <li>• so speed would decrease or they would stop</li>   <li>• resistive forces on competitors may increase/decrease</li> <li>• so speed would decrease/increase</li> </ul>		

Total Question 7		12
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