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PHYSICS

9203/2

Paper 2

Mark scheme

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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.

Further copies of this mark scheme are available from oxfordaqaexams.org.uk

Level of response marking instructions

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 marks in each level.

Before you apply the mark scheme to a student's answer read through the answer and 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 and not look to pick holes in 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 and then 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.

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

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 his or her judgement
- the Assessment Objectives, level of demand 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.

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**. Different terms in the mark scheme are shown by a / ; 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 planets in the solar system.

[2 marks]

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols/formulae

If a student writes a chemical symbol/formula instead of a required chemical name, 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. Full marks can, however, be given for a correct numerical answer, without any working shown.

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

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward is kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation ecf in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **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 <u>not</u> 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.

Question 1

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.1	electrons		1	AO1 3.5.1a L1–3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.2	$I = \frac{24}{60}$ I = 0.4 (A)	 allow 0.40 (A)	1 1	AO2 3.5.1c L1–3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.3	ammeter		1	AO1 3.5.1g L1–3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.4	the current in the wire becomes too high		1	AO1 3.6.3e L1–3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.5	circuit breakers can reset circuit breakers operate much faster		1 1	AO1 3.6.3e L1–3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.6	earth wire		1	AO1 3.6.3d,f L1–3

Total Question 1		**8**

Question 2

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.1	any **two** from: • thermometer • kettle • stopclock • measuring cylinder • top pan balance	allow stopwatch / timer	2	AO4 3.4.2c L1–3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.2	thickness would affect the (rate of) temperature change	allow thickness affects the time it takes to cool allow thickness is a control variable ignore to make it a fair test unqualified	1	AO4 3.4.2c L4–5

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.3	**Level 2:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.		3–4	AO4 3.4.2c 2 × L1–3 2 × L4–5
	Level 1: The method would not necessarily lead to a valid outcome. Some steps are identified, but the method is not fully logically sequenced.		1–2	
	No relevant content		0	
	Indicative content • boil the water using the kettle • all cups the same size, so fill to the same level with boiling water • measure out a/same volume of water using the measuring cylinder • measure out a/same mass of water using top pan balance • place the lid on cup • place thermometer/probe in the cup (through the hole in the lid) • measure starting temperature • start stop clock • observe thermometer until temperature drops to 60 °C • stop stopclock and record time • repeat for other cups • use same starting temperature To access level 2 there must be a description of measuring both time and temperature and one control variable			

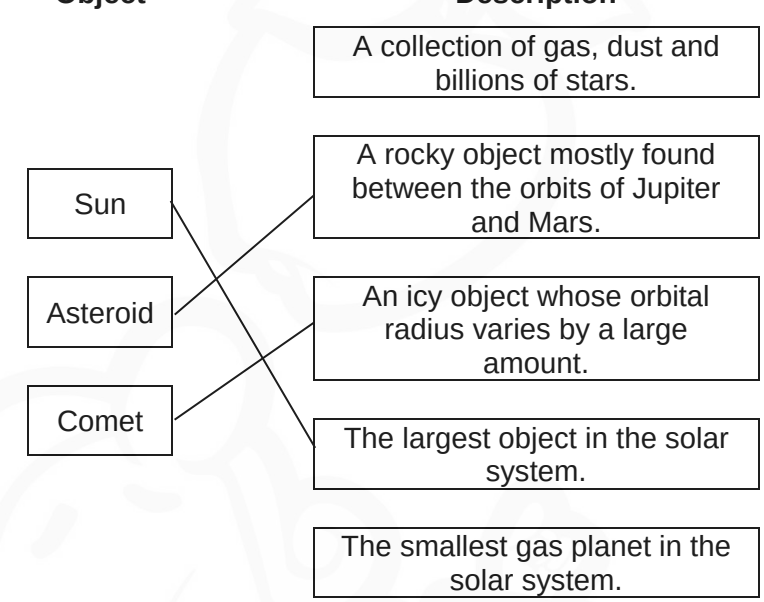
Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.4	**<u>y-axis label</u>** time taken to cool in seconds		1	AO2 3.4.2c 2 × L1–3 2 × L4–5
	<u>scale</u> major grid lines 100 seconds	all values must be correct	1	
	<u>plotting</u> all bars correct	allow 1 plotting mark for **2** correct bars	2	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.5	evaporation convection		1 1	AO1 3.4.2a,b L1–3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.6	$\Delta\theta$ = 25 (°C) E = 0.30 × 4000 × 25 E = 30 000 J **or** joule	 allow a correct substitution of an incorrectly calculated value of $\Delta\theta$ allow a correct calculation of an incorrectly calculated value of $\Delta\theta$	1 1 1 1	3 × AO2 1 × AO1 3.4.1b L4–5

Total Question 2		**17**

Question 3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.1	 Do not accept more than one line from a box on the left		3	AO1 3.8.2a L1–3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.2	moon(s)		1	AO1 3.8.2a L1−3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.3	6		1	AO3 3.8.2a L4−5

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.4	orbital speed decreases as height increases because the gravitational force decreases		1 1	AO3 3.8.2f,g L4–5 L6–7

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.5	$s = 2 \times \pi \times 42\,000\,000$ m $s = 263\,893\,783$ m $v = \frac{263\,893\,783}{24 \times 60 \times 60}$ $v = 3054.32619099008$ $v = 3100$ m/s	allow use of 3.14… allow a correct calculation using an incorrectly/not converted value of *r* allow a correct substitution of an incorrectly calculated value of distance allow any correct answer to at least 2 significant figures this mark can only be awarded if the correct equations have been used	1 1 1 1 1	AO2 3.1.2c,d L6–7

Total Question 3		**12**

Question 4

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.1	normal		1	AO1 3.3.5a L4–5

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.2	i = 40 r = 25 $n = \frac{\sin 40}{\sin 25}$ n = 1.5…	allow ± 1° allow any correct answer to 2 or more significant figures	1 1 1	AO2 3.3.5e L4–5

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.3	$1.61 = \frac{1}{\sin c}$ $c = \sin^{-1}\left(\frac{1}{1.61}\right)$ *c* = 38… (°)	 allow a correct answer to 2 or more significant figures	1 1 1	AO2 3.3.5f,h L6–7

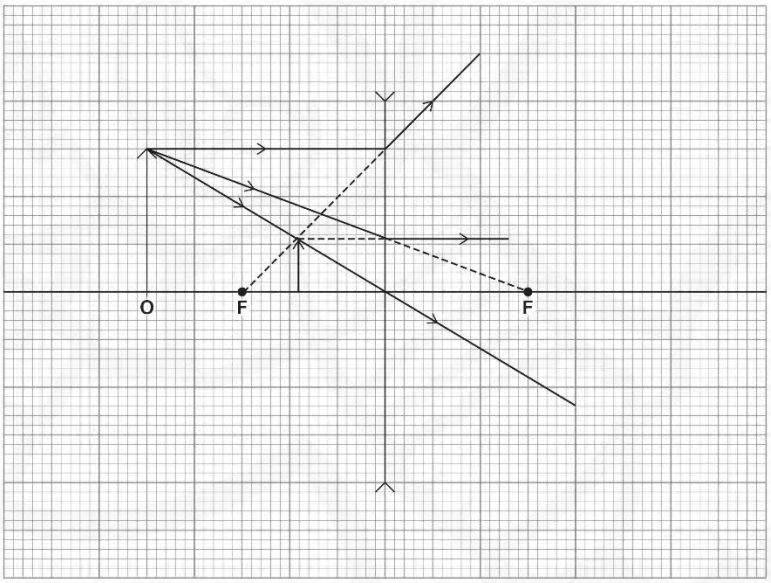
Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.4	light is reflected off the inside of the engine the image / light / information / is transferred to the phone through the fibre optic cable by total internal reflection		1 1 1	1 × AO1 2 × AO3 3.3.5h L4–5

Total Question 4		**10**

Question 5

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.1	ciliary muscle relaxes makes lens thinner so focal length increases	 allow less powerful lens allow less refraction	1 1 1	AO3 3.3.6h 1 × L4–5 2 × L6–7

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.2	$0.0020 = \frac{\text{height of image}}{1.5}$ height of image = 0.0020 × 1.5 height of image = 0.003 (m)	 allow 0.0030 (m)	1 1 1	AO2 3.3.6g L4–5

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.3	any **two** from: • ray drawn parallel to principal axis from top of object to lens virtual ray drawn through (–)F • ray drawn from top of object through the centre of the lens undeviated • a ray directed towards the focal point on the opposite side of the lens to the object, which emerges parallel to the principle axis. image drawn as an arrow from the principal axis to the point where two correct rays cross	allow **1** mark for any correct ray	2 1	AO2 3.3.6f L6–7 2 × L8–9
	an answer of  scores **3** marks			

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.4	rays diverge on leaving the diverging lens		1	AO2 3.3.6j L6–7
	approximately the same amount of refraction by the eye lens as shown in Figure 10	dependent on MP1	1	
	rays focused on the retina	dependent on MP1	1	

Total Question 5		**12**

Question 6

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.1	a conductor is in a magnetic field a current in a conductor produces a magnetic field so there is a force on the conductor	allow wire for conductor if no other mark awarded, allow **1** mark for two magnetic fields interacting	1 1 1	AO1 3.6.4a 1 × L4–5 2 × L6–7

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.2	(increasing the potential difference) increases the current in the fan and hence the strength of the magnetic field produced which increases the force on the fan **OR (2nd and 3rd marks)** increases the power of the fan (1) increases the kinetic energy of the fan (1)		1 1 1	AO3 3.6.4b 1 × L4–5 2 × L6–7

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.3	any **two** pairs from; • test a greater range of potential difference • because 4 data points is insufficient to spot a pattern / trend **OR** • test more fans • to see if other fans have the same relationship **OR** • repeat the measurement at 4 volts (1) • because it is an anomalous point (1)	 allow there is not enough data to draw a conclusion allow not all fans may behave in the same way	 1 1 1 1	AO4 3.6.4a 2 × L4–5 2 × L6–7

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.4	the fan can run more slowly (when less cooling is required) so any **one** from: • less power / energy transferred • quieter • last longer	 allow it is more efficient	1 1	2 × AO3 3.6.4a 1 × L4–5 1 × L6–7

Total Question 6		12

Question 7

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
07.1	**difference** caesium-134 has 3 fewer neutrons **similarity** (both have the same) number of protons		1 1	AO1 AO2 3.7.1f 1 × L4–5 1 × L6–7

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
07.2	(5 half-lives) activity = $1.35 \times 10^{16} \times \left(\frac{1}{2}\right)^5$ activity = 4.2… × 10^{14} Bq	 allow any correct answer to 2 or more significant figures	 1 1	AO2 3.7.2h L6–7

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
07.3	5 half-lives of caesium-137 is 150 years (2011 + 150 =) 2161	 allow use of their number of half-lives from **07.2**	1 1	AO3 3.7.2h L6–7

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
07.4	137 , 0 (top line) 56 , -1 (bottom line)	 if no other mark awarded allow **1** mark for correct numbers on the beta particle	1 1	AO2 3.7.2f L6–7

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
07.5	**Level 2:** Scientifically relevant features are identified; the way(s) in which they are similar / different is made clear and (where appropriate) the magnitude of the similarity / difference is noted.		3–4	2 × AO1 2 × AO3 3.7.2g,i 2 × L4–5 2 × L6–7
	Level 1: Relevant features are identified and differences noted.		1–2	
	No relevant content		0	
	Indicative content • gamma is the most penetrating • alpha is the least penetrating • gamma is the least ionising • alpha is the most ionising • correct order of range • correct order of ionisation • ionisation causes cancer / genetic mutations • risk to humans linked to penetration, range and ionising ability for each type of radiation • risk to humans linked to ingestion / contamination of radioactive material To access level 2 the risk to humans must be linked to a property of the radiation or ingestion / contamination			

Total Question 7		**12**

Question 8

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
08.1	$E_p = 74 \times 9.8 \times 10$ $E_p = 7252$ (J) ($E_p = E_k$) $7252 = 0.5 \times 74 \times v^2$ $v = \sqrt{\left(\frac{7252}{0.5 \times 74}\right)}$ $v = 14$ (m/s)	for subsequent marks to be awarded the correct equation for E_p must have been used allow $v^2 = \left(\frac{7252}{0.5 \times 74}\right)$	1 1 1 1 1	AO2 3.2.1d,e L8–9

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
08.2	distance is small so air resistance can be ignored so both have the same acceleration **OR** $mgh = ½ mv^2$ (1) (so v does not depend on m because) $v = \sqrt{(2gh)}$ (1) **OR** (E_p lost = E_k gained) E_k gained $\propto m$ (1) so final v does not change (1)	allow force $\propto$ mass allow acceleration = g	1 1	AO3 3.2.1d,e L8–9

Total Question 8		**7**