OXFORD
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PHYSICS

9203/2

Paper 2

Mark scheme

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226Y9203/2/MS

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, i.e. if the response is predominantly level 3 with a small amount of level 4 material it would be placed in level 3 but be awarded a mark near the top of the level because of the level 4 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 /; e.g. 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	protractor		1	AO4 3.3.4c L1–3

Question	Answers	Extra information	Mark	AO/Spec. Ref.
01.2	equal to		1	AO1 3.3.4a L1–3

Question	Answers	Extra information	Mark	AO/Spec. Ref.
01.3	the normal		1	AO1 3.3.4b L1–3

Question	Answers	Extra information	Mark	AO/Spec. Ref.
01.4	10°– 80°		1	AO4 3.3.4 L1–3

Question	Answers	Extra information	Mark	AO/Spec. Ref.
01.5	8		1	AO4 3.3.4c L1–3

Question	Answers	Extra information	Mark	AO/Spec. Ref.
01.6	an image that cannot be displayed on a screen		1	AO1 3.3.4c L1–3

Question	Answers	Extra information	Mark	AO/Spec. Ref.
01.7	laterally inverted upright		1 1	AO1 3.3.4c L1–3

Question	Answers	Extra information	Mark	AO/Spec. Ref.
01.8	flat		1	AO1 3.3.4a,c L4–5

Total			**9**

Question 2

Question	Answers	Extra information	Mark	AO/Spec. Ref.
02.1	electron		1	AO1 3.7.2e L1–3

Question	Answers	Extra information	Mark	AO/Spec. Ref.
02.2	22 (years)		1	AO2 3.7.2h L4–5

Question	Answers	Extra information	Mark	AO/Spec. Ref.
02.3	the gas will leak from the crack therefore (beta) radiation emitted by the gas will be detected (near the crack)	 allow beta radiation cannot penetrate the pipe	1 1	AO3 3.7.2g L4–5

Question	Answers	Extra information	Mark	AO/Spec. Ref.
02.4	can be breathed in so (more risk of) internal ionisation / damage	allow is easily ingested allow spreads inside the body MP2 dependent on MP1	1 1	2 × AO3 3.7.2i L4–5

Total			6

Question 3

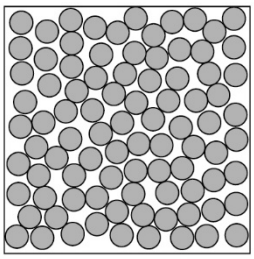
Question	Answers	Extra information	Mark	AO/Spec. Ref.
03.1	chemical energy (in the fuel) decreases		1	AO2 3.2.3a,b L4–5
	kinetic energy of the car increases		1	
	thermal energy of the car / surroundings increases	allow named part of car	1	

Question	Answers	Extra information	Mark	AO/Spec. Ref.
03.2	180 000 = 1200 × *v*		1	AO2 3.1.4a L4–5
	$v = \frac{180\,000}{1200}$		1	
	v = 150 (m/s)		1	

Question	Answers	Extra information	Mark	AO/Spec. Ref.
03.3	$F = \frac{180\,000}{6.0}$	allow *F* = 1200 × 25	1	AO2 3.1.4c L4–5 view with 03.2
	F = 30 000 (N)	allow ecf using *F* = *ma* and value from Question **03.2**	1	

Total			8

Question 4

Question	Answers	Extra information	Mark	AO/Spec. Ref.
04.1			1	3.4.1a AO1 L1–3

Question	Answers	Extra information	Mark	AO/Spec. Ref.
04.2	convection		1	3.4.2a AO1 L1–3

Question	Answers	Extra information	Mark	AO/Spec. Ref.
04.3	evaporation		1	3.4.2b AO1 L1–3

Question	Answers	Extra information	Mark	AO/Spec. Ref.
04.4	any **two** from: • starting temp of coffee • the lid being put on • temperature of the air • mass of coffee • material / colour of cup	allow volume of coffee allow humidity allow surface area of coffee exposed to air	2	3.4.2d AO2 L1–3

Question	Answers	Extra information	Mark	AO/Spec. Ref.
04.5	$E = 0.15 \times 4000 \times 20$ $E = 12\,000$ (J)		1 1	3.4.1b AO2 L1–3

Question	Answers	Extra information	Mark	AO/Spec. Ref.
04.6	density (of coffee) increases because the particles become closer together	 max **1** mark if denser particles is seen	1 1	3.4.2a AO3 L6–7

Total			**9**

Question 5

Question	Answers	Extra information	Mark	AO/Spec. Ref.
05.1	$2.0 \times 0.40 = 5.0 \times d$ $d = \frac{(2.0 \times 0.40)}{5.0}$ $d = 0.16$ m		1 1 1	AO2 3.1.8ab L4–5

Question	Answers	Extra information	Mark	AO/Spec. Ref.
05.2	add/remove slotted masses change the distance between either of the slotted mass holder and the pivot	 allow move the pivot	1 1	AO4 3.1.8ab L1–3

Question	Answers	Extra information	Mark	AO/Spec. Ref.
05.3	 the moment of the force exerted by the man is equal to the moment of the weight of the rock as distance increases force decreases (for a given moment) therefore force exerted on the rock is greater than force exerted by the man	allow effort and load throughout allow the moment of the force exerted by the man is greater than the moment of the weight of the rock allow the force exerted by the man is further from pivot than the force exerted by the rock allow reduces the force the man needs to exert (to lift the rock)	 1 1 1	AO2 3.1.8d L6–7

Total			8

Question 6

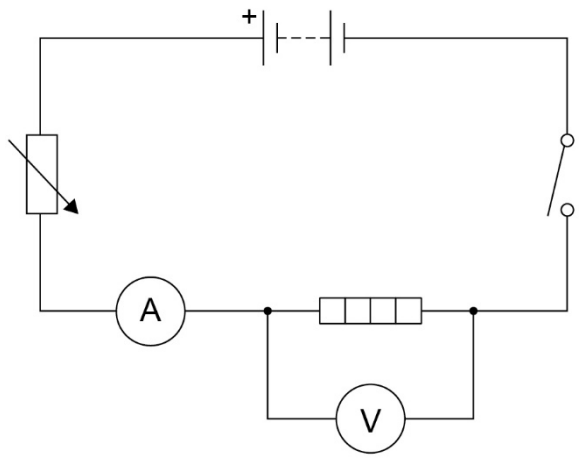
Question	Answers	Extra information	Mark	AO/Spec. Ref.
06.1	$4.0 = \frac{E}{2160}$		1	AO2 3.5.1g L4–5
	$E = 4.0 \times 2160$		1	
	$E = 8640$ (J)	allow 8600 (J)	1	

Question	Answers	Extra information	Mark	AO/Spec. Ref.
06.2	$5.0 \times 10^{-3} = \frac{2160}{t}$		1	AO2 3.5.1c L6–7
	$t = \frac{2160}{5.0 \times 10^{-3}}$		1	
	$t = 432\,000$		1	
	$t = 120$ hours	allow a correct conversion of their value of time in seconds if a correct equation has been used allow use of E = IVt allow ecf from Question **06.1** if E = IVt	1	

Question	Answers	Extra information	Mark	AO/Spec. Ref.
06.3	(current changes) depending on what the watch is being used for	allow it will not always use minimum current allow any use that would increase the current	1	AO3 3.5.1f 3.5.1c L4–5
	amount of energy stored in the battery may change	allow the idea that over time the maximum charge the battery can store decreases	1	

Total			9

Question 7

Question	Answers	Extra information	Mark	AO/Spec. Ref.
07.1	**Level 3:** The design / plan would lead to the production of a valid outcome. All key steps are identified and logically sequenced.		5–6	AO4 3.5.1n 4 × L4–5 2 × L6–7
	Level 2: The design / plan would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.		3–4	
	Level 1: The design / plan would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.		1–2	
	No relevant content		0	
	Indicative content **Circuit Diagram**  **Plan** • close the switch • variable resistor in series • ammeter in series • voltmeter in parallel across the heating element • variable resistor in series • vary the resistance using the variable resistor • record the potential difference reading on the voltmeter • record the current reading on the ammeter • repeat for different values of resistance • reverse the polarity of the battery and repeat • plot graph of I against V to access level 3 there must be a correct circuit diagram and a statement that current is measured with an ammeter and potential difference is measured with a voltmeter			

Question	Answers	Extra information	Mark	AO/Spec. Ref.
07.2	any **one** from: • wear insulating gloves • do not touch the heating element • use a heat proof mat because the heating element would get hot enough to burn	 element gets hot is insufficient allow to prevent burns	1 1	3.5.1n AO4 L4–5

Question	Answers	Extra information	Mark	AO/Spec. Ref.
07.3	as the current increases the temperature of the heating element increases this increases the resistance of the heating element due to an increase in the frequency of electron-ion collisions	ignore references to potential difference allow due to increased vibrations of ions	1 1 1	3.5.1m AO3 L6–7

Total			**11**

Question 8

Question	Answers	Extra information	Mark	AO/Spec. Ref.
08.1	power output = $\frac{11\ 400\ 000}{5}$ **or** = 2 280 000	allow substitution of $\frac{11\ 400\ 000}{5}$ throughout	1	AO2 3.2.2f L6–7
	$60 = \left(\frac{2\ 280\ 000}{\text{power input}}\right) \times 100$	allow a correct substitution using an incorrectly / not converted value of *P* and / or *P* for all 5 turbines used	1	
	power input = $\frac{(2\ 280\ 000 \times 100)}{60}$	allow a correct rearrangement using an incorrectly / not converted value of *P* and / or *P* for all 5 turbines used	1	
	power input = 3 800 000 (W)	allow a correct calculation using an incorrectly / not converted value of *P* and / or *P* for all 5 turbines used	1	

Question	Answers	Extra information	Mark	AO/Spec. Ref.
08.2	less energy / electricity is needed at night	allow demand is lower at night	1	AO3 3.2.3d 1 × L4–5 2 × L6–7
	energy generated by wind turbines would be wasted	allow would not be used allow excess electricity is generated	1	
	so energy (from wind) is stored in upper reservoir		1	

Question	Answers	Extra information	Mark	AO/Spec. Ref.
08.3	(to generate electricity) when there is no wind **or** when all the energy stored in the high reservoir has been used to be used when the electricity generated by the renewables doesn't meet demand	 allow because neither can meet the maximum demand on their own if no other mark awarded allow as a backup for **1** mark	1 1	AO3 3.2.3d L6–7

Total			**9**

Question 9

Question	Answers	Extra information	Mark	AO/Spec. Ref.
09.1	hydrogen helium	 any order	1 1	AO1 3.8.1 a L4–5

Question	Answers	Extra information	Mark	AO/Spec. Ref.
09.2	(nuclear) fusion		1	AO1 3.8.1d L4–5

Question	Answers	Extra information	Mark	AO/Spec. Ref.
09.3	mass	allow size	1	AO1 3.8.1e L4–5

Question	Answers	Extra information	Mark	AO/Spec. Ref.
09.4	 (sun leaves the main sequence) becomes a red giant (surface) temperature decreases (to < 3500 °C) then becomes a white dwarf (surface) temperature increases (to 6000 °C–30 000 °C) then becomes a black dwarf cools to much less than 3500 °C	ignore references to yellow / orange MP2 dependent on MP1 MP4 dependent on MP3 MP6 dependent on MP5	 1 1 1 1 1 1	3 × AO1 3 × AO3 3.8.1j 3 × L6–7 3 × L8–9

Total			10

Question 10

Question	Answers	Extra information	Mark	AO/Spec. Ref.
10.1	weight is equal to the air resistance (in magnitude) therefore the resultant force is zero	allow gravitational force is equal to the air resistance allow drag	1 1	AO1 3.1.3c L6–7

Question	Answers	Extra information	Mark	AO/Spec. Ref.
10.2	$0.0441 = F \times 150$		1	AO2 3.1.1e
	$F = \frac{0.0441}{150}$		1	3.2.1a L8–9
	$F = 0.000294$		1	
	$W = F$ (at constant speed)			
	$0.000294 = m \times 9.8$	allow a correct substitution using an incorrectly calculated value of F	1	
	$m = \frac{0.000294}{9.8}$	allow a correct rearrangement using an incorrectly calculated value of F	1	
	$m = 3.0 \times 10^{-5}$ (kg)	allow 0.00003 allow a correct calculation using an incorrectly calculated value of F	1	

Question	Answers	Extra information	Mark	AO/Spec. Ref.
10.3	air resistance increases with speed rain drops have different weights (because of different masses) therefore rain drops with greater weight must fall faster for air resistance to be equal to weight	allow drag for air resistance	1 1 1	AO3 3.1.6a,b L8–9

Total			**11**