OXFORD

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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	35		1	AO2 1−3 3.7.1f

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.2	35		1	AO2 1−3 3.7.1d

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.3	neutrons		1	AO1 1−3 3.7.1f

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.4	neutron **and** proton electron **and** proton	in any order in any order	1 1	AO1 1−3 3.7.1c

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.5	liquid melting point is lower (than 20 °C) boiling point is higher (than 20 °C)	 allow 20 °C is higher than the melting point allow 20 °C is lower than the boiling point	1 1 1	AO3 1−3 3.4.1a

Total Question 1		**8**

Question 2

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.1	E = 4.0 × 1.5 E = 6 (kWh)	 allow 6.0 (kWh)	1 1	AO2 1−3 3.6.5e f

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.2	cost / saving for 1 charge = 24 × 0.15 = \$3.60 number of charges = $\left(\frac{14\,400}{3.60}\right) = 4000$	 allow max 2 marks if kWh is converted to Wh	1 1 1	2 × AO2 1 × AO3 2 × 1−3 1 × 4−5 3.6.5e f

Question	Answers	Mark	AO/ Spec. Ref.
02.3	**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	AO3 3.2.3a 3.2.3d 2 × L1−3 2 × L4−5
	Level 1: Relevant features are identified and differences noted.	1–2	
	No relevant content	0	
	Indicative content • both cars use a renewable energy source • car **A** needs no fuel • car **A** produces no CO_2 • electricity that charges car **A** is generated in a way that does not produce CO_2 • car **B** produces CO_2 • the CO_2 produced by car **B** only comes from the carbon that was captured • car B produces exhaust gasses that cause local air pollution • growth of fuel crops takes up a lot of space/resources • neither car contributes to global warming • neither requires mining / drilling	

Total Question 2		**9**

Question 3

Question	Answers	Mark	AO/ Spec. Ref.
03.1	**Level 2:** The design / plan would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	3-4	AO4 3.1.1h 2 × 1−3 2 × 4−5
	Level 1: The design / plan would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.	1–2	
	No relevant content	0	
	Indicative content • note original position of the marker • add a slotted mass • measure the distance between the original position and the new position using the ruler • record the extension • readings taken at eye level • repeat with more masses • range 0–10 100 g masses • suggests repeat readings • determine the weight of the masses • mean values calculated for each force / weight • plot graph (of force on the y-axis and extension on the x-axis) • draw line of best fit • gradient = Δy/Δx		

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.2	9.3 (N/kg) to 10.2 (N/kg)		1	AO4 4−5 3.1.1e

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.3	the value 9.3 is a lot lower than the other consistent values		1 1	AO4 4−5 3.1.1e

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.4	$\frac{(10.1 + 10.2 + 10.0 + 10.1)}{4}$ 10.1 (N/kg)	 allow **1** mark for 9.94 (N/kg) if 9.3 is included in mean calculation	1 1	AO4 4−5 3.1.1e

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.5	zero the balance		1	AO4 1−3 3.1.1e

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.6	mass = 0.158 kg weight = 0.158 × 9.8 weight = 1.5484 weight = 1.5 (N)	 allow a correct substitution using an incorrectly/not converted value of mass allow a correct calculation using an incorrectly/not converted value of mass allow max 3 marks if 165g is used	1 1 1 1	AO2 4−5 3.1.1e

Total Question 3		**14**

Question 4

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.1	**differences** any **two** from: • sound is a longitudinal wave, electromagnetic waves are transverse waves • electromagnetic waves travel much faster than sound waves • electromagnetic waves have a much larger range of frequencies / wavelengths • electromagnetic waves can travel through a vacuum and sound waves need a medium to travel through **similarities** any **two** from: • both transfer energy/information • both can be diffracted • both can be refracted • both can be reflected	allow a description of longitudinal and transverse. allow both used in communications	2 2	AO1 2 × 4−5 2 × 6−7 3.3.1d

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.2	300 000 000 = 750 000 000 × λ $\lambda = \frac{300\,000\,000}{750\,000\,000}$ λ = 0.4 m	 allow correct rearrangement using an incorrectly / not converted value of f allow 0.40 allow correct calculation using an incorrectly / not converted value of f	 1 1 1 1	1 × AO1 3 × AO2 1 × 4−5 3 × 6−7 3.3.1h

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.3	(24 000 – 20 000 =) 4000 Hz		 1	AO2 4−5 3.3.3a

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.4	any **two** from: • measuring distances • medical imaging • removing kidney stones • cleaning delicate items	allow prenatal scanning allow any sensible suggestion	2	AO1 4−5 3.3.3f,h

Total Question 4		**11**

Question 5

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.1	the force on the ball is the same size as the force on the racket		1	AO1 1−3 3.1.3a

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.2	e = 0.0025		1	AO2 4−5 3.2.1c
	$E_e = ½ \times 4.0 \times 10^5 \times 0.0025^2$	allow correct substitution using an incorrectly / not converted value of e	1	
	$E_e = 1.25$ (J)	allow correct calculation using an incorrectly / not converted value of e	1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.3	magnitude of the velocity increases **or** the velocity increases by 10 m/s		1	AO2 6−7 3.1.1c
	direction is opposite		1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.4	Δv = (−20 − 10) = (−)30 m/s		1	AO2 8−9 3.1.4c
	$15 = \frac{(0.025 \times 30)}{t}$	this mark may be awarded if Δv = 10 (m/s)	1	
	$t = \frac{(0.025 \times 30)}{15}$	this mark may be awarded if Δv = 10 (m/s)	1	
	t = 0.05 s	allow 0.050 s this mark can only be awarded if Δv = 30 (m/s)	1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.5	compression increases elastic potential store		1	AO3 6−7 3.2.1c
	kinetic store decreases	allow becomes zero	1	3.2.2c 3.2.2d
	thermal store increases		1	

Total Question 5		**13**

Question 6

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.1	all points plotted correctly curved line of best fit	allow **1** mark for 3 or 4 points plotted correctly	2 1	2 × AO2 1 × AO3 2 × 4−5 1 × 6−7 3.5.1l

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.2	as light intensity increases the current increases because the resistance of the LDR decreases at high light intensities there is a smaller decrease in resistance so gradient decreases	 allow total resistance in the circuit decreases 	1 1 1	AO3 2 × 6−7 1 × 8−9 3.5.1l

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.3	to prevent the current from becoming too high so that the LDR wasn't damaged	 allow melt / overheat	1 1	AO4 6−7 3.5.1l

Total Question 6		**8**

Question 7

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
07.1	thousands of millions	allow billions allow any number between 10^8 and 10^{13}	1	AO1 4–5 3.8.2b

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
07.2	(Andromeda is) not moving away from Earth	allow it is moving towards our galaxy	1	AO3 6–7 3.8.3b

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
07.3	the further away a galaxy is the greater the red shift the furthest galaxies are moving the fastest (in every direction) so the universe is expanding therefore must have been smaller in the past and started from a very small point	allow the further away a galaxy is the bigger the increase in observed wavelength dependent on MP1 or MP2	1 1 1 1	AO1 6–7 3.8.3b

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
07.4	13.7×10^9 years		1	AO3 6–7 3.8.3d

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
07.5	cosmic microwave background radiation		1	AO1 4–5 3.8.3c

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
07.6	cloud of dust and gas pulled together by gravity until temperature and density of core is great enough for (nuclear) fusion to start (releasing energy)		1 1 1 1	AO1 2 × 4–5 1 × 6–7 1 × 8–9 3.8.1a,c 3.7.4d

Total Question 7		**12**

Question 8

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
08.1	electric current in fixed resistors in circuits causes heating		1	AO3 2 × 6−7 8−9 3.5.1r
	so the temperature of the fixed resistors in circuits would increase		1	
	nichrome is suitable because its resistance changes very little over a large range of temperatures		1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
08.2	R of 1.0 m = 1001.2 (Ω)		1	AO3 4−5 3.5.1r
	$\left(\frac{1.0}{0.25} = 4\right)$			
	R of 0.25 m = $\frac{1001.2}{4}$		1	
	R = 250.3 (Ω)	allow 250 (Ω)	1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
08.3	as temperature increases the ions in tungsten vibrate more		1	AO2 6−7 3.5.1m
	this increases frequency of collisions of electrons with ions		1	
	so resistance increases	dependent on MP1 or MP2	1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
08.4	$I = \frac{1200}{240}$		1	AO2 8–9 3.5.1c,f,h
	I = 5.0 (A)	allow a correct calculation of an incorrectly / not converted value of t	1	
	$V = \frac{15\,000}{1200}$		1	
	V = 12.5 (V)	allow a correct calculation of an incorrectly / not converted value of E	1	
	$R = \frac{12.5}{5.0}$	for this mark, and the subsequent mark, the correct equations must have been used to calculate V and I	1	
	R = 2.5 (Ω)		1	

Total Question 8		**15**