OXFORD
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PHYSICS

9203/1

Paper 1

Mark scheme

November 2021

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.

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	stopclock	allow stopwatch	1	AO4 3.1.6 a 1−3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.2	dependent		1	AO4 3.1.6 a 1−3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.3	any **two** from: • the distance the ball falls • size / mass of the ball • diameter of the tube • temperature of the liquid / room	allow volume of liquid	2	AO4 3.1.6 a 1−3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.4	3.4 × 3 = 10.2 10.2 – 3.2 – 3.7 = 3.3		1 1	AO2 3.1.6 a 4−5

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.5	bar chart type of liquid is a categoric variable		1 1	AO3 3.1.6 a 1 × 1−3 1 × 4−5

Total Question 1		**8**

Question 2

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.1	moment = 15 × 0.050 0.75 (Nm)		1 1	AO2 3.1.8 a 1–3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.2	less force is needed (to produce the same moment) because greater (perpendicular) distance from the pivot		1 1	AO1 3.1.8 d 4–5

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.3	$340 \times \frac{40}{100}$ 136 (litres)	allow 1 mark for daily use = 204 (litres)	1 1	AO3 3.1.8 d 1–3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.4	any **one** from: • more hygienic • more accessible to those with mobility problems • saves money on water bills • less energy used for water treatment		1	AO3 3.1.8 d 1–3

Total Question 2		**7**

Question 3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.1	the distance travelled from when the driver sees a hazard until the brakes are applied		1	AO1 3.1.5 c 1–3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.2	any **two** from • the speed of the car • reaction time of driver • if the driver has taken alcohol / drugs • if the driver is tired • distractions	 allow a named drug allow a named distraction	2	AO1 3.1.5 c 1–3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.3	32 (m)	allow 32 to 32.5 (m)	1	AO2 3.1.5 e 1–3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.4	the larger the depth of tread the shorter the stopping distance		1	AO3 3.1.5 e 1–3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.5	90 000 = 2500 × d $d = \frac{90\,000}{2500}$ d = 36 (m)		1 1 1	AO2 3.2.1 a 4–5

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.6	friction between brakes and the wheels (so the) kinetic energy of car is reduced (and the) thermal energy of brakes increases	 if no other mark awarded allow one mark for kinetic energy (of the car) decreases and thermal store of energy (of the brakes) increases	1 1 1	AO1 3.1.5 d 4–5

Total Question 3		**11**

Question 4

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.1	600 (J)		1	AO2 3.2.2 a 1–3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.2	$\frac{600}{800}$ 0.75 **OR** $\frac{600}{800}$ × 100 (1) 75% (1)	allow ecf from Question **04.1**	1 1	AO2 3.2.2 f 1–3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.3	dissipated to the surroundings		1	AO1 3.2.2 d 1–3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.4	60 Ω		1	AO2 3.5.1 r 1–3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.5	3.0 = I × 60 $I = \frac{3.0}{60}$ I = 0.05 (A)	allow their value for R from Question **04.4** I = 0.050 (A)	1 1 1	AO2 3.5.1 h 4–5

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.6	as the temperature increases the resistance (of the thermistor) decreases therefore, the current increases so, the motor spins faster	 allow the potential difference across the motor increases dependent on gaining marking point 1 or 2	1 1 1	1 × AO1 2 × AO3 3.5.1 g 6–7

Total Question 4		11

Question 5

Question	Answers	Mark	AO/ Spec. Ref.
05.1	**Level 3:** The design would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5–6	AO1 3.3.5 e 4−5
	Level 2: The design 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 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 • draw around the glass block (when placed on a piece of paper) • use a protractor to measure an angle of 90° to the side of the glass block • draw the normal line • use a ray box to produce a ray of light • use a protractor to measure angle of incidence • draw the ray of light entering the glass block • draw the ray of light emerging from the glass block • draw the path of the light through the glass block • use a protractor to measure the angle of refraction • repeat for different angles (20, 30, 40, etc) some indicative content can be gained by a correctly labelled diagram		

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.2	$n = \frac{0.64 - 0}{0.44 - 0}$	allow any correct pair of readings taken from the line	1	AO2 3.3.5 e 4−5
	n = 1.45	allow a correct answer consistent with their readings	1	
	n = 1.5	allow a calculated value correctly rounded to 2 significant figures	1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.3	light slows down as it enters the glass	speed / velocity changes is insufficient allow the refractive index of glass is higher than that of air allow glass has a higher optical density than air	1	1 × AO1 2 × AO2 3.3.5 a b 6–7
	so each end of the wavefront travels at a different speed		1	
	so the wavefront changes direction	allow for **2** marks in the same time, the waves in air travel a larger distance so have a longer wavelength than the waves in glass, which travel a shorter distance	1	

Total Question 5		**12**

Question 6

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.1	a uranium nucleus absorbs a (slow moving) neutron the large nucleus splits into two smaller nuclei and (2/3) neutrons and energy		1 1 1	AO1 3.7.3 c 6–7

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.2	a neutron decays into a proton and a (high speed) electron the (high speed) electron is emitted from the nucleus		1 1	AO1 3.7.2 e 6–7

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.3	$^{147}_{61}Pm \rightarrow \underline{\mathbf{147}}_{\mathbf{62}}Sm + \underline{\mathbf{0}}_{\mathbf{-1}}\beta$ one mark for 147 and 0 and one mark for 62 and -1		1 1	AO2 3.7.2 f 6–7

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.4	3 half-lives have passed $360 \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2}$ 45 (counts per second)	 allow $\frac{360}{2^3}$ allow 360 ⇒ 180 ⇒ 90 ⇒ 45 for **3** marks	1 1 1	AO2 3.7.2 h 6–7

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.5	**advantage** no need to use electricity / batteries **disadvantage** risk of contamination / exposure	 allow batteries will not run out allow named risk associated with exposure	 1 1	AO3 3.7.2 j 1 × 4−5 1 × 6−7

Total Question 6		**12**

Question 7

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
07.1	there is a magnetic field (due to the permanent magnet) **and** current in a wire causes a magnetic field		1	AO1 3.6.4 a d 2 × 6−7 2 × 8−9
	current is in opposite directions in each side of the coil		1	
	so forces act in opposite directions on either side of the coil		1	
	(the split ring ensures that) the current in the left / right side of the coil is always in the same direction	allow (the split ring ensures that) the force in the left / right side of the coil is always in the same direction	1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
07.2	increase the current		1	AO2 3.6.4 b 1 × 4−5 1 × 6−7
	which will increase the force **or** will increase the magnetic field in the motor		1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
07.3	time to wall = $\frac{1.5 \times 10^{-9}}{2}$ $= 7.5 \times 10^{-10}$ s		1	AO2 3.1.2 c 3.3.3 f 6–7
	$3.0 \times 10^{8} = \frac{\text{distance}}{7.5 \times 10^{-10}}$	allow subsequent marks if time has not been halved	1	
	distance = $3.0 \times 10^{8} \times 7.5 \times 10^{-10}$ (= 0.225)		1	
	distance = 225 (mm)	allow 230 (mm)	1	
	OR			
	$3.0 \times 10^{8} = \frac{\text{distance}}{1.5 \times 10^{-9}}$ (1)			
	distance = $3.0 \times 10^{8} \times 1.5 \times 10^{-9}$ (= 0.45) (1)			
	distance to wall = $\frac{0.45}{2}$ (= 0.225) (1)			
	distance = 225 (mm) (1)	allow 230 (mm) allow correct conversion if distance is not halved		

Total Question 7		10

Question 8

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
08.1	if a fault causes a large current	allow if the current exceeds the fuse rating	1	AO1 3.6.3 e 4–5
	fuse wire gets hotter and melts		1	
	fuse wire breaks and disconnects the circuit	allow which stops the current in the circuit in the kettle	1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
08.2	operates faster than a fuse		1	AO1 3.6.3 e 4–5
	can be reset		1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
08.3	plastic is an insulator	allow the kettle is double insulated	1	AO1 3.6.3 f 1 × 4–5
	so the case cannot become live	allow touching the plastic case will not result in the user receiving an electric shock	1	1 × 6–7

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
08.4	water surrounding heating element is heated and particles become further apart		1	AO3 3.4.2 a 6–7
	heated water is less dense and rises to the surface, cooler water is denser and falls		1	
	a convection current is set up which heats all the water in the kettle		1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
08.5	calculation of energy transferred to the kettle			AO2 3.6.5 c b 3.4.1 b
	P = 230 × 11		1	8–9
	P = 2530 (W)		1	
	E = 2530 × 180	allow E = 455 400 (J)	1	
	calculation of energy transferred to the water			
	E = 1.2 × 4200 × 80	allow subsequent marks for incorrectly / not calculated value of temperature	1	
	E = 403 200 (J)		1	
	wasted energy = 455 400 – 403 200 = 52 200 (J)	allow correct calculation using their calculated values of energy	1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
08.6	particles at the surface of the liquid		1	AO1 3.4.2 b 1 × 6–7
	with the most kinetic energy escape		1	2 × 8–9
	mean kinetic energy of particles in the liquid is less (so the temperature is less)		1	
		allow **1** mark for kinetic energy of the particles depends on temperature of the liquid if no other marks scored		

Total Question 8		**19**