OCR
Oxford Cambridge and RSA

GCSE (9-1)

Physics A (Gateway)

Unit **J249H/04**: Higher Tier – Paper 4

General Certificate of Secondary Education

Mark Scheme for June 2018

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

Annotations available in RM Assessor

Annotation	Meaning
	Correct response
	Incorrect response
	Omission mark
	Benefit of doubt given
	Contradiction
	Rounding error
	Error in number of significant figures
	Error carried forward
	Level 1
	Level 2
	Level 3
	Benefit of doubt not given
	Noted but no credit given
	Ignore

Abbreviations, annotations and conventions used in the detailed Mark Scheme (to include abbreviations and subject-specific conventions).

Annotation	Meaning
/	alternative and acceptable answers for the same marking point
✓	Separates marking points
DO NOT ALLOW	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
( )	Words which are not essential to gain credit
__	Underlined words must be present in answer to score a mark
ECF	Error carried forward
AW	Alternative wording
ORA	Or reverse argument

Subject-specific Marking Instructions

INTRODUCTION

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

The breakdown of Assessment Objectives for GCSE (9-1) in Physics:

	Assessment Objective
AO1	**Demonstrate knowledge and understanding of scientific ideas and scientific techniques and procedures.**
AO1.1	Demonstrate knowledge and understanding of scientific ideas.
AO1.2	Demonstrate knowledge and understanding of scientific techniques and procedures.
AO2	**Apply knowledge and understanding of scientific ideas and scientific enquiry, techniques and procedures.**
AO2.1	Apply knowledge and understanding of scientific ideas.
AO2.2	Apply knowledge and understanding of scientific enquiry, techniques and procedures.
AO3	**Analyse information and ideas to interpret and evaluate, make judgements and draw conclusions and develop and improve experimental procedures.**
AO3.1	Analyse information and ideas to interpret and evaluate.
AO3.1a	Analyse information and ideas to interpret.
AO3.1b	Analyse information and ideas to evaluate.
AO3.2	Analyse information and ideas to make judgements and draw conclusions.
AO3.2a	Analyse information and ideas to make judgements.
AO3.2b	Analyse information and ideas to draw conclusions.
AO3.3	Analyse information and ideas to develop and improve experimental procedures.
AO3.3a	Analyse information and ideas to develop experimental procedures.
AO3.3b	Analyse information and ideas to improve experimental procedures.

For answers to Section A if an answer box is blank ALLOW correct indication of answer e.g. circled or underlined.

Question			Answer	Marks	AO element	Guidance
1			**A** ✓	1	1.1	
2			**C** ✓	1	1.2	
3			**B** ✓	1	2.2	
4			**C** ✓	1	2.1	
5			**B** ✓	1	1.2	
6			**B** ✓	1	1.1	
7			**B**✓	1	1.1	
8			**D** ✓	1	1.1	
9			**D** ✓	1	1.2	
10			**D** ✓	1	2.2	
11			**B** ✓	1	2.2	
12			**C** ✓	1	2.1	
13			**C** ✓	1	1.1	
14			**C** ✓	1	2.2	
15			**B** ✓	1	1.2	

Question			Answer	Marks	AO element	Guidance
16	a	i	5.2 (billion tonnes oil equivalent) ✓	**1**	3.1a	**ALLOW** answers between 5.0 and 5.5 **IGNORE** wrong units
		ii	Oil ✓	**1**	3.1a	
		iii	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 78 (%) award 2 marks** 8.3 / 10.6 (x 100) ✓ =78 (%) ✓	**2**	2 x 3.1a	**ALLOW** answers that round between 77(%) and 80(%) ✓✓ **ALLOW** 8.2 / 10.6 (x 100) OR 8.4 / 10.6 (x 100) OR 8.5 / 10.6 (x 100) OR answers that round between 0.77 and 0.80
	b	i	Fossil fuel may run out / is non-renewable / be in short supply / become very costly ✓ **Named** damage to environment: Eg (increased) greenhouse gases / global warming / sea levels rise / carbon dioxide / climate change / acid rain ✓	**2**	3.1b 3.1b	**ALLOW** being used faster than being produced / finite resource **ALLOW** ice caps melting / droughts and storms / more polluting gases / other named polluting gases e.g. SO_2 / carbon emissions **IGNORE** just pollution or bad for the environment / more CFCs
		ii	To meet demand for electricity / not enough energy from renewable resources ✓ Less **named** damage to environment: (decreased) greenhouse gases / global warming / sea levels may fall / carbon dioxide / climate change / acid rain / ORA for coal ✓	**2**	1.2 1.2	**ALLOW** will not run out as fast (as coal) / to preserve fossil fuels / produces more energy (per kg than coal) **ALLOW** less polluting gases / carbon emissions / ice caps melting / droughts and storms **IGNORE** just less pollution or just better for the environment / less CFCs
	c	i	Step-up transformer ✓	**1**	1.1	

Question			Answer	Marks	AO element	Guidance
		ii	**Reduce** energy wastage / loss ✓	**1**	1.1	**ALLOW** less heat loss / reduce current / reduce power loss / more useful power out / more efficient / less heating of wires **DO NOT ALLOW** no energy losses / prevent energy loss / AW
		iii	d.c – (current / voltage / charge flow / it) has one direction or polarity ✓ a.c.- (current / voltage / charge flow / it) (continually) changes direction or polarity ✓	**2**	1.1 1.1	**ALLOW** dc only positive / only negative **IGNORE** electricity **ALLOW** current / voltage alternates OR positive **and** negative
	d	i	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 2.8 (kW) award 4 marks** (P =) I^2 x R ✓ 11 x 11 x 23 or 11^2 x 23 or 121 x 23 ✓ = 2783 ✓ Conversion to kW = 2.8 ✓	**4**	 1.2 2.1 2.1 2.1	**ALLOW** 2.78 kW or 2.783 kW ✓✓✓✓ **ALLOW** equation in any form **ALLOW** ECF candidates answer to 3rd marking point converted to kW
		ii	Wind speed varies / AW ✓	**1**	2.1	**ALLOW** it depends on the strength of the wind / how windy it is / AW **IGNORE** there might not be any wind / wind changes direction / AW
		iii	(Idea of) not always enough wind / demand may exceed supply / AW ✓	**1**	2.1	**ALLOW** (it) may not generate enough power / energy / AW

Question			Answer	Marks	AO element	Guidance
17	a	i	2 ½ or 2.5 ✓	1	1.2	
		ii	**Speed** is unchanged / stays the same ✓ **Wavelength** reduces ✓	2	2.1 2.1	Answer **must** indicate idea of speed Answer **must** indicate idea of wavelength **IGNORE** answers that merely state 'no change and reduces'
		iii	Any two from: Water / particles move up and down / oscillate vertically ✓ Water / particles move at 90° / perpendicular to the direction of wave (travel) / AW ✓ Energy moves in direction of the wave (travel) / AW ✓	2	2 x 1.2	**IGNORE** any statements that are just repeated from the question. **IGNORE** water waves move up and down **ALLOW** energy moves at 90° to wave vibrations / movement ✓✓
	b		(Idea of) action to produce sound and seen by observer / received by receiver ✓ Measure an appropriate distance eg between source and observer or between microphone(s) / speaker ✓ Measure an appropriate time eg between seeing action and hearing sound or on CRO / or frequency from signal generator ✓ (Idea of) calculating speed = distance / time or velocity = frequency x wavelength ✓ (Idea of) improvements to experiment eg repeat **and** average readings / retake readings if they are anomalous / use a different method / use different equipment / use longer distances ✓	5	1.1 2.2 2.2 3.2b 3.3b	**ALLOW** marks to be awarded from a clear diagram **ALLOW** higher level methods eg using standing waves **ALLOW** equation in any form

Question			Answer	Marks	AO element	Guidance
	c		**Any 3 from:** Outer ear (pinna) / auditory canal transfers sound to ear drum ✓ Ear drum vibrates ✓ Ossicles / small bones / anvil, hammer or stirrup vibrate ✓ Ossicles / small bones / anvil, hammer or stirrup amplify vibration ✓ Liquid in cochlea transmits movement (to small hairs) ✓ Small hairs / cilia vibrate ✓	**3**	1.1 2 x 2.1	**ALLOW** ear drum moves in and out
18	**a**	**i**	(Wave speed =) frequency x wavelength ✓ $30 \times 10^9 \times 0.01$ or $30 \times 10^9 \times 1 \times 10^{-2}$ ✓	**2**	1.1 3.2b	**ALLOW** correct symbol equation eg (v =) f x λ **ALLOW** equation in any form **ALLOW** any frequency and corresponding wavelength from the table substituted into this equation **IGNORE** units for this marking point only **ALLOW** 30 000 000 000 x 0.01 or 30 000 000 000 x 1×10^{-2} **ALLOW** reverse arguments using speed and wavelength or speed and frequency

Question			Answer	Marks	AO element	Guidance
		ii	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 100 (nm) award 3 marks** (Wavelength =) velocity ÷ frequency ✓ $\frac{3 \times 10^8}{3000 \times 10^{12}}$ or 1×10^{-7} ✓ = 100 (nm) ✓	**3**	1.2 2.1 2.1	**ALLOW** (λ =) v ÷ f **IGNORE** v = f x λ and f = v / λ or words **ALLOW** 3×10^8 divided by any frequency from the table **IGNORE** units for this marking point only
	b		(skin) cancer / (skin) aging ✓	**1**	1.1	**ALLOW** sunburn / blisters / wrinkles / mutates cells / ionises cells **IGNORE** kills cells / damages cells / just burns
	c	**i**	120 (minutes) ✓	**1**	2.2	
	c	**ii**	Any two from: children have (more) sensitive skins ✓ children have cells / skins that are more at risk from skin cancers ✓ children lack awareness of the time they spend in the sunshine ✓ the idea that they advise a higher SPF than they (really) need just to be sure they are safe ✓	**2**	1.1 2.1	**IGNORE** just to reduce risk of burning **ALLOW** skin is vulnerable / more easily damaged / more affected by UV / delicate / has less melanin / AW **ALLOW** idea that damage to cells builds up over time **ALLOW** children are outside for longer / spend more time in the sun

Question			Answer	Marks	AO element	Guidance
	d*		Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. **Level 3 (5–6 marks)** **A detailed explanation of how ultrasound and X-rays are used.** **AND** **A detailed evaluation of the risks / benefits of using the two different waves to scan patients in hospital, which may include use of information from the table.** *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** **An explanation of how ultrasound and X-rays are used.** **AND** **An evaluation of the risks / benefits of using the two different waves to scan patients in hospital.** *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** **EITHER** **An explanation of how ultrasound and X-rays are used.** **OR** **An evaluation of the risks / benefits of using the two different waves to scan patients in hospital.** **OR** **An explanation of ultrasound or X-rays AND an evaluation of the risks / benefits of ultrasound or X-rays.** *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks -** *No response worthy of credit.*	**6**	2 x 1.2 1 x 2.2 1 x 3.1b 2 x 3.2a	**AO1.2 Demonstrate knowledge and understanding of X-rays and ultrasound** X-rays show bone Ultrasound shows eg soft tissue / kidneys/ blood flow / prenatal scan **AO2.2 Applies knowledge and understanding of X-rays and ultrasounds** X-rays damage / ionise living cells / causes cancer / damage foetus Ultrasound is harmless **AO3.1b Analyses information to evaluate the differences in X-rays and ultrasound** X-rays are absorbed by bone but do not show up soft tissues Ultrasound is (partially) reflected for soft tissues only **AO3.2a Analyses information to make judgements about the risks and benefits:** Ultrasound always safe **and** useful for soft tissue scanning X-rays can cause cancer **but** save lives with identifying bone problems X-rays have a frequency greater than 3×10^{16} Hz / (very small) wavelengths less than 10 nm to penetrate the body

Question			Answer	Marks	AO element	Guidance
19	a		Contamination occurs when radioactive **source** / **material** is on or in the body / object ✓ Irradiation occurs when object is exposed to radiation (from outside of the body / object) ✓	**2**	1.1 1.1	**ALLOW m**aterial becomes radioactive / becomes a source of radiation
	b		Bacteria is killed / AW ✓ Slows food decay / AW ✓	**2**	2.2 2.2	**ALLOW** idea that food does not go mouldy / off / rot (so quickly) **IGNORE** just that food lasts longer / food does not go stale / food stays fresh
	c		May cause food to become radioactive ✓ May allow food (to be sold) which is old but looks fresh / AW ✓	**2**	2.2 2.2	**ALLOW** food becomes contaminated / risk of cancer / they are taking in radiation **ALLOW** food might taste different / strange / out of date food might be eaten **IGNORE** food is poisonous / just unsafe
	d	i	(Radioactive nuclei) are unstable ✓	**1**	1.1	**ALLOW** (nuclei have) too many neutrons
		ii	Different numbers of neutrons ✓	**1**	1.1	
	e	i	**226** ✓ Th **90** ✓	**2**	2.2 2.2	
		ii	**0** ✓ β **-1** ✓	**2**	2.2 2.2	
		iii	**235** ✓ U ➔ γ = U **92** ✓	**2**	2.2 2.2	

Question			Answer	Marks	AO element	Guidance
20	a		F ✓	1	3.3a	
	b		E ✓ **FIRST CHECK THE ANSWER ON THE ANSWER LINE** **If answer = 0.6 (s) award 2 marks** 5 ÷ 8 ✓ =0.6 (s) ✓	3	3.1a 1.2 2.2	**ALLOW** 0.625 or 0.63 (s)
	c		Any two from**:** A, C or D ✓ Thinking distance / reaction time is proportional to speed / AW ✓	2	3.2b 3.2b	**ALLOW** as speed doubles, thinking distance doubles / ratio of speed:distance or distance:speed is the same / both have reaction time of 0.75 (s)
	d	i	AWARD **ALL** CANDIDATES 2 MARKS	2	1 x 2.1 1 x 1.2	
		ii	KE transferred to thermal energy / heat in brakes / surroundings / AW ✓✓ **OR** (KE of car) is reduced / transferred ✓ Brakes gain / absorb thermal energy / heat ✓	2	1.1 1.2	**ALLOW** surroundings gain thermal energy / heat dissipated to surroundings **IGNORE** just brakes get hot

Question			Answer	Marks	AO element	Guidance
		iii	AWARD **ALL** CANDIDATES 3 MARKS	**3**	2 x 2.1 1.2	
	e		(The **thinking** distance will) **stay the same** (The **braking** distance will) **decrease** (The **stopping** distance will) **decrease** **All three** correct ✓✓ **Two** correct ✓	**2**	 3.2a 3.2a	

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