OCR
Oxford Cambridge and RSA

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GCSE (9–1)

Physics B (Twenty First Century Science)

J259/02: Depth in physics (Foundation Tier)

General Certificate of Secondary Education

Mark Scheme for June 2019

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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.

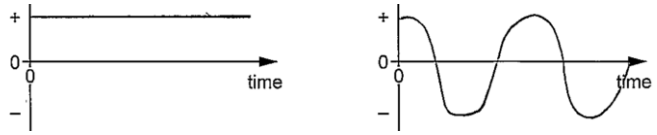
You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New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

	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.

Question			Answer	Marks	AO element	Guidance
1	(a)		electric ✓	1	1.1	
	(b)		Opposite charges ✓	2	2.1	**ALLOW** 'positive and negative charges' OR 'electrons and positive ions' **DO NOT ALLOW** poles/magnetically **IGNORE** 'opposites' on its own OR + and – on their own
			Attract (AW) ✓		2.1	**ALLOW** attract if e.g. positive electrons attract negative electrons OR positive ions attract negative ions
	(c)		(NO) Only electrons move/are transferred OR atoms/protons don't move/are not transferred ✓ The balloon picks up electrons (from the cloth) OR the cloth loses electrons (to the balloon) ✓	2	 1.1 1.1	**ALLOW** alternative wording

Question			Answer	Marks	AO element	Guidance
2	(a)	(i)	Frequency = 50 Hz and Potential difference = 230 V ✓	1	1.1	The units must also be stated for 1 mark **ALLOW** hertz and volt
		(ii)	Direct: horizontal line in either + or – region ✓ Alternating: A sine or cosine shape curve ✓ that oscillates in both + and – regions ✓	3	1.1 1.1 1.1	**ALLOW** voltage that is always positive **ALLOW** a varying voltage Example: 
		(iii)	2000 (J) ✓	1	2.1	
	(b)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 600 (kW h) award 3 marks** Conversion: 1500 (W) = 1.5(kW) ✓ = 1.5 × 400 ✓ = 600 (kW h) ✓	3	 1.2 2.1 2.1	IF NO ANSWER ON ANSWER LINE CHECK TABLE **ALLOW** 2 marks if power of ten error e.g. for 1500 × 400 = 600 000 (no conversion) OR 150 × 400 = 6000 (incorrect conversion)
		(ii)	Kettle **A** ✓ **A** has the lowest power rating/transfers the least energy in the same time (AW) ✓	2	3.2b 3.2a	 **ALLOW** Kettle **A** has lowest power
	(c)		Transformer ✓	1	1.1	

Question			Answer	Marks	AO element	Guidance
3	(a)	(i)	absorbs ✓ scatters ✓	2	2.1 2.1	 **ALLOW** reflects
		(ii)	blue ✓	1	2.1	
	(b)		(Sarah is incorrect because) **Any two from:** Not a straight line /gradient is not constant ✓ Graph does not pass through origin ✓ The graph levels off / is a curve ✓	2	3.1b × 2	
	(c)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 3.0 × 10^8 (m/s) award 3 marks** =5.6 × 10^{-7} × 5.4 × 10^{14} ✓ = 3.024 × 10^8 or 302 400 000 (m/s) ✓ = 3.0 × 10^8 (m/s) ✓	3	 2.1 2.1 1.2	 **ALLOW** substitution of decimals with power of ten error e.g. 0.000056 × 540000000000 **ALLOW** any correct rounding including 300 000 000 or 3 × 10^8 and any correct power of 10 e.g 30 × 10^7 **ALLOW** their answer correctly written in standard form to 2sf

Question			Answer	Marks	AO element	Guidance
4	(a)	(i)	**Any one from:** Planet / Earth is smaller ORA ✓ Planet / Earth orbits the star / Sun ✓ Planet / Earth does not produce energy (by fusion) / there is no nuclear fusion ORA ✓ Planet / Earth is cooler than the Sun ORA ✓ Planet / Earth is made of rock and Sun from gas ✓ Planet / Earth can support life ORA ✓	1	1.1	**ALLOW** Planet/Earth is made of rock and Sun is not **ALLOW** Sun is made from gas and planet/Earth is not

Question			Answer	Marks	AO element	Guidance
		(ii)*	*Please refer to the marking instructions on page 5 of this mark scheme for guidance on how to mark this question.* **Level 3 (5–6 marks)** Clear and labelled diagram of the planetary system including star and 2 or more planets in separate orbits. **AND** Detailed description of the processes in the formation of a star and planets. *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)** Clear and labelled diagram of the planetary system including star and 2 or more planets in separate orbits. **AND** Partial description of the processes in the formation of a star and planets. **OR** Detailed description of the processes in the formation of a star and planets. *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)** Clear and labelled diagram of the planetary system. **OR** An attempt to describe a process in the formation of a star or the planets. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.*	**6**	**1.1 × 4** **2.1 × 2**	**AO1.1 Knowledge and understanding of star formation and planets** For example • Dust / gas cloud/nebula • Gravitational collapse of the dust /gas cloud/nebula • Temperature of dust / cloud /nebula increases • Energy produced through fusion (of nuclei) • A stable star is formed when outward forces/pressure equal to the inward forces/pressure • Dust/gas cloud join up to produce planets • Gravity causes dust/gas/rock to orbit star or form planets • The planets orbit around the star **AO2.1 Application of knowledge and understanding of planetary systems** For example • Planets shown in circular/elliptical orbits around the star • Star and planet(s) labelled

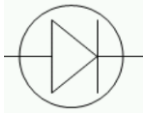
Question			Answer	Marks	AO element	Guidance
			0 marks *No response or no response worthy of credit.*			
	(b)	**(i)**	More distant (galaxy) moves faster ORA ✓	**1**	**3.2b**	**DO NOT ALLOW** example of one galaxy e.g. the tadpole galaxy is moving faster
		(ii)	Cigar galaxy, Tadpole galaxy ✓ Higher red-shift = Last entry is GN-z11 ✓	**2**	**3.2a** **3.2a**	

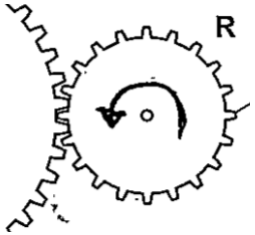
Question			Answer	Marks	AO element	Guidance
5	(a)		(Alpha radiation) is stopped by plastic / cannot pass through plastic ✓	1	1.1	**ALLOW** cannot travel /penetrate far **ALLOW** cannot travel through (materials/case) **ALLOW** alarm/plastic absorbs all the radiation
	(b)		Place radiation measuring device / Geiger counter close to the source/fire alarm ✓ No change in radiation / counts / count-rate detected (so smoke alarm is safe) OR no increase in count rate is detected OR only background radiation detected ✓	2	3.3a 3.2b	 **ALLOW** no radiation detected **ALLOW** beeps/clicks for counts **ALLOW** reverse arguments e.g. increase in count rate shows radiation is leaking (so alarm not safe) **ALLOW** device can detect whether radiation is passing through the case OR use it to see if any radiation comes through the case 1 mark max
	(c)		Gamma radiation will pass through plastic/case /alarm ORA ✓ Gamma radiation can damage/mutate cells ✓	2	2.1 1.1	 **ALLOW** may cause cancer / kill cells
	(d)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer lies with 380 to 420 (years) award 2 marks** Evidence of horizontal line at 20000 counts per second ✓ Half-life = in range 380 to 420 (years) ✓	2	 1.2 3.1a	 **ALLOW** two horizontal lines and corresponding vertical lines one at half the activity of the other.
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 10000 (counts per second) award 3 marks** = 40000 ÷ 2 or 20000 (counts per second) after first half-life ✓ = 20000 ÷ 2 ✓ = 10000 (counts per second) (after 2nd half-life) ✓	3	 2.1 2.1 2.1	

Question			Answer	Marks	AO element	Guidance
		(iii)	Graph starts at 30 000 (counts per second) ✓	3	2.1	
			A curve of decreasing gradient ✓		2.1	
			Curve showing half-life to be the same ✓		2.1	**ALLOW** Curve passes through (400, 15 000) and (800, 7 500) ± 2 small squares. **ALLOW ECF** from **d(i)** if 400 years not used

Question			Answer	Marks	AO element	Guidance
6	(a)		(stationary) Section **C** ✓ (constant speed) Section **B** ✓ (accelerating) Section **A** ✓	3	2.1 2.1 2.1	
	(b)	(i)	Section **Y** ✓ Velocity increases (as time increases) OR It is accelerating ✓	2	3.1a 3.1a	 **ALLOW** the gradient is positive **IGNORE** gradient is increasing/steeper **IGNORE** the line is going up
		(ii)	Section **X** ✓ Velocity decreases (as time increases) OR It is decelerating ✓	2	3.1a 3.1a	 **ALLOW** the gradient is negative **IGNORE** gradient is decreasing **IGNORE** the line is going down
	(c)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 5.6 m / s^2 or m s^{-2} or metres per seconds squared award 3 marks for the calculation** = [36.5 – 8.5] ÷ 5.0 = 28 ÷ 5 ✓ = 5.6 ✓ = 5.6 m / s^2 or 5.6ms^{-2} or 5.6 metres per seconds squared ✓	3	 2.1 2.1 1.2	
	(d)	(i)	500 to 7500 kg ✓	1	2.1	

Question			Answer	Marks	AO element	Guidance
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = (d)(i) × (c) (N) award 3 marks for the calculation**	**3**		
			Recall and apply: force = mass × acceleration ✓		**1.2**	
			(force =) **(d)(i) × (c)** ✓		**2.1**	**ALLOW ECF** from **(c)** and **(d)(i)**
			= value of **(d)(i) × (c)** stated ✓		**2.1**	

Question			Answer	Marks	AO element	Guidance
7	(a)	(i)	Ring around the last/right *I-V* characteristic (curve with decreasing gradient) ✓	1	1.1	
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 30 (C) award 3 marks** Conversion: 500 m A = 0.5(00) A ✓ = 0.5 × 60 ✓ = 30 (C) ✓	3	1.2 2.1 2.1	**ALLOW** 2 marks for power of ten error e.g. 500 × 60 = 30000 (no conversion) OR 5 × 60 = 300 (incorrect conversion)
		(iii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 1.2 (W) award 3 marks** Recall and apply: power = potential difference × current ✓ = 2.4 × 0.5 ✓ = 1.2 (W) ✓	3	1.2 2.1 2.1	**ALLOW ECF** from **(a)(ii)**, 3 marks for 1200 if (2.4 × 500)(no conversion) **OR** e.g. for 12 if (2.4 × 5) (incorrect conversion) is used in **(a)(ii)** **ALLOW** 2 marks for 1200 if (2.4 × 500)(no conversion) **OR** e.g. for 12 if (2.4 × 5) (incorrect conversion) is used
	(b)		The ammeter reading increases ✓ The (total) resistance (of the circuit) decreases / both lamps have (same) current ✓	2	2.1 2.2	**DO NOT ALLOW** the ammeter will (start to) show a reading **DO NOT ALLOW** the circuit is complete
	(c)	(i)	Diode ✓	1	1.1	
		(ii)	Correct symbol for diode ✓	1	1.1	**ALLOW ECF** correct symbol for lamp, LDR or thermistor to match response to **(c)(i)** **ALLOW** missing circle in diode **ALLOW** light emitting diode Example: 

Question			Answer	Marks	AO element	Guidance
8	(a)	(i)	Anticlockwise arrow ✓  	1	2.1	**ALLOW** word anticlockwise
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 12 (per minute) award 2 marks** 40 / 20 = 2 ✓ 6 x 2 = 12 (per minute) ✓	2	 **2.2** **2.2**	
	(b)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 6.4 (N m) award 3 marks for the calculation** Recall and apply: moment of a force = force × distance ✓ (moment =) 32 × 0.20 ✓ (moment =) 6.4 (N m) ✓	3	 **1.2** **2.1 x 2**	

Question			Answer	Marks	AO element	Guidance
9*			*Please refer to the marking instructions on page 5 of this mark scheme for guidance on how to mark this question.* **Level 3 (5–6 marks)** Correct density of both liquids determined **AND** Qualitative comparison of graphs of which at least one idea is interpretation and one is evaluation *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)** A valid attempt made to determine density of both liquids **AND** Some comparison of graphs at least one idea of which must be an interpretation or an evaluation *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)** A valid attempt made to determine density of one liquid **OR** Limited comparisons of graphs and densities *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 or no response worthy of credit.*	**6**	**1.1** **2.1 × 2** **3.1a x 2** **3.1b**	**AO3.1a Interpreting information from the graph** For example: • Straight-line graphs • Linear relationship between mass and volume • Graph does not go through origin because of the mass of the beaker • Gradient of line for **E** is greater • Gradient is density • Intercept is mass of beaker **AO3.1b Evaluation of information from the graph** For example: • Mass of cylinder = 60 g (allow ± 5 g) • Density of **E** is greater than that of **F** **AO1.1 – Demonstration of ideas about density** For example: • Correct use of density equation for any point taken from the graph **AO2.1 Apply knowledge and understanding of scientific ideas** • Line(s) extended to determine *y*-intercept • Density of **E** is about 1.4 (g/cm^3) or 1400kg/m^3 • Density of **F** is about 1.0 (g/cm^3) or 1000kg/m^3

Question			Answer	Marks	AO element	Guidance
10	(a)		More sheets means less light / intensity (for LDR) ORA ✓ Resistance of LDR increases with less light / intensity ORA ✓	2	3.2a 3.2b	 **ALLOW** more light (intensity) less resistance **ALLOW** more resistance with more sheets 1 mark max
	(b)		Ammeter connected in series ✓ Voltmeter connected across the cell / LDR ✓	2	1.2 1.2	Candidates must have correct symbols for each device and complete circuit **IGNORE** other extra symbols / minor gaps **DO NOT ALLOW** continuous line through ammeter or voltmeter **IGNORE** continuous line through second meter in a correct circuit
	(c)	(i)	**Any one from:** Use the same light source ✓ Keep the distance between the LDR and light source the same ✓ Keep the same background light ✓	1	3.3a	 **ALLOW** any suggestions that keep the ambient light the same
		(ii)	**Any one from:** Work in a darkroom ✓ Keep the same background light ✓ Put a box around the LDR (and light source) ✓ Use the same light source ✓ Keep the distance between the LDR and light source the same ✓	1	3.3b	 **ALLOW** any suggestions that keep the ambient light the same

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