OCR
Oxford Cambridge and RSA

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GCSE (9–1)

Physics B (Twenty First Century Science)

J259/01: Breadth in physics (Foundation Tier)

General Certificate of Secondary Education

Mark Scheme for November 2020

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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

Annotation	Meaning
	Correct response
	Incorrect response
	Omission mark
BOD	Benefit of doubt given
CON	Contradiction
RE	Rounding error
SF	Error in number of significant figures
ECF	Error carried forward
L1	Level 1
L2	Level 2
L3	Level 3
NBOD	Benefit of doubt not given
SEEN	Noted but no credit given
I	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)	(i)	balance ✓	1	1.2	First box clearly indicated
		(ii)	measuring cylinder ✓	1	1.2	Second box clearly indicated
	(b)		ruler ✓ multiply ✓	2	1.2	
	(c)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 925 award 2 marks** 2.22 ÷ 0.0024 ✓ 925 ✓	2	2.1	
	(d)		Any **two** from: use measuring cylinder / Eureka can / AW ✓ put the cheese under water / AW ✓ measure volume of displaced water / rise in water level ✓	2	2.2	**ALLOW** any other method which would produce a reasonable estimate e.g. triangular prism calculation, melting cheese and using measuring cylinder

Question			Answer	Marks	AO element	Guidance
2	(a)	(i)	split ✓	1	1.1	**ALLOW** other types of clear indication of the correct response.
		(ii)	unstable ✓	1	1.1	**ALLOW** other types of clear indication of the correct response
	(b)		Gamma radiation ✓ Kinetic energy of the new particles ✓	2	1.1	Second and fourth boxes clearly indicated.
	(c)	(i)	Any **two** from: hydrogen / small(er) nuclei ✓ fuse / stick together / combine AW ✓ (to make) helium / large(r) nuclei✓ energy released ✓	2	1.1	 **ALLOW** gamma radiation emitted
		(ii)	energy / (electromagnetic) radiation ✓	1	1.1	**ALLOW** gamma radiation

Question			Answer	Marks	AO element	Guidance
3	(a)		transverse: vibrations are at right angles to direction of travel OR have crests and troughs ✓ longitudinal: vibrations are in the same direction as the direction of travel OR have compressions and rarefactions ✓	2	1.1	**ALLOW** oscillate/particle movement for vibrate, but not just movement
	(b)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 0.05 award 2 marks** 0.30 ÷ 6 ✓ 0.05 (m) ✓	2	1.2	
		(ii)	Count the number of waves passing a given point in a given time (and divide by the time) ✓ **OR** time for a number of waves to pass a point (and then calculate reciprocal) ✓	1	3.3a	
	(c)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 0.24 award 2 marks** 3.0 × 0.08 ✓ 0.24 (m/s) ✓	2	2.2	
	(d)		(observe that) it moves up and down and/or to and fro (in the wave direction) ✓ stays in the same place (on average/once the wave has passed)/ is not pushed along the tank by the waves / no net movement in the direction of the wave ✓	2	2.2	

Question			Answer	Marks	AO element	Guidance
4	(a)	(i)	kinetic ✓	1	1.1	
		(ii)	chemical ✓	1	1.1	
	(b)		(energy is) transferred ✓ **AND** any **one** from: to thermal store (in the surroundings) ✓ to kinetic store (in the motor/movement) ✓ by sound ✓ by heating ✓ by electricity ✓	2	2.1	**DO NOT ALLOW** used up **ALLOW** heat instead of thermal
	(c)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 5.91 award 3 marks** 65 ÷ 11 ✓ = 5.9090… / 5.9 / 5.90 ✓ = 5.91 (A) ✓	3	**2.1 x2** **1.2**	**ALLOW** for 2 marks any answer that rounds to 5.91 **ALLOW** 2 marks for 3.04 (correct answer calculated for vacuum cleaner A) **ALLOW** 1 mark for 3.0 or for any answer that rounds to 3.04 (correct answer calculated for vacuum cleaner A, not rounded)
	(d)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 420 000 award 3 marks** recall energy = power × time ✓ = 700 × 600 ✓ = 420 000 (J) ✓	3	**1.2** **2.1 x2**	**ALLOW** 1 mark for 65 × 600 (Vacuum cleaner B) **ALLOW** 2 marks 39 000
		(ii)	(Vacuum cleaner A transfers more energy **ORA)** It has a higher power ✓ They are used for the same time OR power is the rate at which energy is used ✓	2	2.1	**ALLOW** calculation of energy used by each vacuum cleaner

Question			Answer	Marks	AO element	Guidance
5	(a)		the force of gravity (on an object) ✓ **OR** mass × acceleration of gravity ✓	1	1.1	
	(b)	(i)	use a spring balance / newton meter / force meter ✓ **OR** use a (top-pan) balance / scales ✓	1	1.2	
		(ii)	attach/hang the object (on the (spring) balance/force meter/newton meter) ✓ **OR** measure mass and multiply by g / 10 / 9.8 (N/kg) ✓	1	1.2	
	(c)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 24 award 3 marks** recall /rearrange mass = weight ÷ g ✓ 240 ÷ 10 ✓ 24 (kg) ✓	3	1.2 2.1 x2	

Question			Answer	Marks	AO element	Guidance
6	(a)		28 (J) ✓	1	2.1	
	(b)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 30 award 3 marks** Identifying correct number to use (12, 40) ✓ (12 ÷ 40) = 0.30 ✓ 30 (%) ✓	3	 **2.1 x2** **1.2**	

Question			Answer	Marks	AO element	Guidance
7	(a)		gravitational force / weight ✓ tension (in string) / string pulling down / contact force (from string) ✓	2	2.1	**ALLOW** gravity **ALLOW** upthrust from the air
	(b)		Any **two** from: (force) acts from the paperclip on the magnet ✓ equal in size (to force on paper clip) ✓ acts downwards / in opposite direction ✓	2	1.1	**ALLOW** paperclip attracts/pulls the magnet to cover m.p.1 & m.p.3 getting two marks
	(c)	(i)	moves upwards ✓	1	3.2b	**ALLOW** gets stuck to the magnet
		(ii)	net force will be upwards / magnetic force greater than weight / forces are unbalanced ✓	1	3.2b	

Question			Answer	Marks	AO element	Guidance
8	(a)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 0.42 award 3 marks** 4.6 cm = 0.046 m ✓ $0.5 \times 400 \times 0.046^2$ ✓ 0.42 (J) ✓	3	**1.2** **2.1 × 2**	**ALLOW** 2 marks for 4232 (unit conversion omitted) **ALLOW** 3 marks for 0.423 / 0.4232 (3 or 4 s.f. answers)
	(b)	**(i)**	Any **two** from: less energy in elastic store (of spring) ✓ more energy in kinetic store of ball ✓ more energy in thermal store of metal tube / air / surroundings ✓	**2**	**2.1**	**ALLOW** Elastic energy transferred to kinetic energy and/or heat/thermal energy for 1 mark (energy needed at least once) If the location of the energy is included for at least either the kinetic energy or the heat energy then a second mark can be awarded. E.g. elastic energy = kinetic energy in ball + heat energy would gain 2 marks
		(ii)	Total energy stays the same ✓	**1**	**2.1**	

Question			Answer	Marks	AO element	Guidance
9	(a)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 75 award 2 marks** 30 ÷ 0.40 ✓ 75 (m/s) ✓	**2**	**1.2**	
	(b)	**(i)**	results are very different from the true value / AW ✓	**1**	**3.2a**	
		(ii)	because results are scattered / results are inconsistent / result is different each time / there is a big range of results ✓	**1**	**3.2a**	
	(c)	**(i)**	Use a longer distance, ✓ **OR** use of electronic timing system ✓	**1**	**3.3b**	
		(ii)	to reduce the effect of reaction time ✓ **OR** to reduce uncertainty/error ✓	**1**	**3.3b**	

Question			Answer	Marks	AO element	Guidance
10	(a)		Any **three** from use ruler (to measure length / extension) ✓ measure (original) length ✓ suspend /attach mass (hanger) on spring ✓ measure new length / extension ✓ add more masses to mass hanger (and repeat) ✓ calculate weight of masses using W = mg / measure weight of masses using spring balance ✓	**3**	**1.2**	
	(b)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 40 award 3 marks** recall / rearrange spring constant = force / extension ✓ 8.0 ÷ 0.20 ✓ 40 (N/m) ✓	**3**	**1.2** **2.1 × 2**	
	(c)	**(i)**	28 ✓	**1**	**1.2**	
		(i)	27.2 ✓	**1**	**1.2**	**ALLOW** 27 (2sf)

Question			Answer	Marks	AO element	Guidance
11	(a)		(D) bubble wrap reduces conduction / has low thermal conductivity ✓ thicker insulation / more layers reduces heat loss (so slower than C) ✓ **OR** (E) bubble wrap reduces conduction / has low thermal conductivity ✓ metal foil reduces heat loss by radiation ✓	**2**	**3.2a**	**ALLOW** one mark for C <u>and</u> bubble wrap reduces conduction / has low thermal conductivity **ALLOW** bubble wrap doesn't conduct instead of low conductivity **IGNORE** convection **ALLOW** foil reflects thermal radiation
	(b)	**(i)**	experiment gives the same results / same data ✓ if performed by another person / with similar equipment / in a different lab ✓	**2**	**1.1**	
		(ii)	Any **one** from: size / shape / thickness / material of tin ✓ volume / mass of water ✓ temperature of surroundings ✓	**1**	**2.1**	 **ALLOW** amount of water

Question			Answer	Marks	AO element	Guidance
12	(a)	(i)	(use of biofuels has) increased ✓	1	3.1a	Increase could be shown by use of data.
		(ii)	Any **one** from: use of biofuels has been encouraged/government incentives ✓ more cost effective ✓ to reduce carbon (dioxide) emissions ✓ to make use of by-products/waste materials ✓	1	3.1a	**IGNORE** renewable **ALLOW** cheap/not expensive **ALLOW** to reduce/prevent climate change
	(b)	(i)	Any **one** from: trend shows (large) increase in wind ✓ trend shows nuclear staying the same/ (slight) increase ✓ **AND** any **one** from: (supports statement because) if trends continue we will use more wind than nuclear ✓ (does not support statement because) we do not know if the trends will continue in the future ✓	2	3.1b	**ALLOW** evaluation based on both trends e.g. the evidence / it support this statement because wind is increasing and nuclear is not [2]
		(ii)	data includes nuclear which is not renewable ✓	1	3.2b	**DO NOT ALLOW** biofuel is not renewable
		(iii)	any value from 9(%) to 10(%) ✓	1	2.2	

Question			Answer	Marks	AO element	Guidance
13	(a)		electrons (in atoms) ✓ lose energy ✓	2	1.1	**ALLOW** electrons change energy levels (2 marks) **DO NOT ALLOW** beta decay or emission of particles
	(b)	(i)	(ultraviolet radiation is) ionising ✓ damages / mutates DNA or cells OR causes cancer/tumours ✓	2	1.1	 **ALLOW** kills cells
		(ii)	(ultraviolet radiation) cannot penetrate the steel casing ✓	1	3.2b	**ALLOW** radiation absorbed by steel casing **ALLOW** steel casing reflects (ultraviolet radiation inside the container).
	(c)		Any **two** from: (alpha radiation) not penetrating enough (to disinfect all of the water) ✓ alpha-emitting isotope could contaminate water supply ✓ activity of alpha source will fall with time ✓ risk of handling alpha <u>source</u> ✓	2	1.1	 **ALLOW** alpha radiation cannot penetrate water **DO NOT ALLOW** alpha particles remain in the water **IGNORE** alpha cannot penetrate the steel case **ALLOW** alpha source may have a short half-life

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