



GCSE MARKING SCHEME

SCIENCE - PHYSICS (LEGACY)

JANUARY 2013

INTRODUCTION

The marking schemes which follow were those used by WJEC for the January 2013 examination in GCSE SCIENCE - PHYSICS (LEGACY). They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.

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GCSE Science - Physics (Legacy) - P1

Mark Scheme

FOUNDATION TIER

Question			Marking details	Marks Available
1.			230[V 50 Hz], 2450[MHz], 0.8 kW/800 W, 800 Question total	4 [4]
2.	(a)		250 (1) 100 (1)	2
	(b)		2400/150 = 16 years substitution (1), answer (1) Question total	2 [4]
3.			D A B E 3 or 4 correct = 3 marks 2 correct = 2 marks 1 correct = 1 mark Question total	3 [3]
4.		(i) (ii)	100/4 = 25 [p] 4/1.6 = 2.5 [h] substitution (1) answer (1) Question total	1 2 [3]
5.	(a)	(i) (ii)	X rays / microwaves UV / X rays / gamma	1 1
	(b)		smaller / lower change in energy [of the charged particle] Question total	1 [3]

Question			Marking details	Marks Available
6.	(a)	(i)	radiation	1
		(ii)	convection	1
	(b)		$\frac{2.5}{5} = 50$ [%] substitution (1) answer (1)	2
			Question total	[4]
7.	(a)		No fuel costs / limited pollution / generated immediately Don't accept renewable	1
	(b)	(i)	An environmental decision	1
		(ii)	Step-up / change voltage (1) so that energy loss in the cables is minimised. (1)	2
			Question total	[4]
8.	(a)	(i)	Box 2	1
		(ii)	Box 3	1
		(iii)	Box 1	1
(b)		Any 2 x (1): More signals per cable / less interference / faster /more secure	2	
			Question total	[5]
9.	(a)		Any 2 x (1): Lagging roof space / double glazing / draught excluding on doors etc	2
	(b)	(i)	Bad conductor / traps heat (1) because of air gaps (1)	2
		(ii)	Prevents movement of air pockets in the cavity	1
			Question total	[5]

Question			Marking details	Marks Available
10.	(a)	(i) (ii)	6325-5100 = 1225 (1) 7335-6325 = 1010 (1)	2
	(b)		Units saved = 1225-1010 = 215 units (1) ecf Money saved = 215 ecf x 43 = 9245 [p] / [£]92.45 (1) Both answers to (a) x 43 award 1 mark only	2
	(c)		No account taken of different conditions re: weather and gas charges Question total	1 [5]
11.	(a)	(i)	$\frac{(1.7 - 1.3)(1)}{2} = \frac{0.4}{2} = 0.2[\text{m}]$ (1)	2
		(ii) (iii)	4 10/4 = 2.5 [m]	1 1
	(b)		Reduced [when speed is constant] Question total	1 [5]
12.	(a)		A group of rocks of various sizes orbiting the Sun / between Mars and Jupiter	1
	(b)	(i) (ii)	Between 350-650 [million km] -50 and -100 [°C]	2
	(c)	(i) (ii)	Inner rocky / outer gaseous Sun's radiant energy easily pushed the gases to the outer reaches Question total	1 1 [6]
			Total Foundation paper	50

HIGHER TIER

Question			Marking details	Marks Available
1.	(a)	(i)	6325-5100 = 1225 (1)	2
		(ii)	7335-6325 = 1010 (1)	
	(b)	Units saved = 1225-1010 = 215 units (1) ecf Money saved = 215 ecf x 43 = 9245 [p] / [£]92.45 (1) Both answers to (a) x 43 award 1 mark only	2	
(c)	No account taken of different conditions re: weather and gas charges	1		
Question total				[5]
2.	(a)	(i)	$\frac{(1.7-1.3)(1)}{2} = \frac{0.4}{2} = 0.2[\text{m}]$ (1)	2
		(ii)	4	1
		(iii)	10/4 = 2.5 [m]	1
	(b)	Reduced [when speed is constant]	1	
Question total				[5]
3.	(a)	A group of rocks of various sizes orbiting the Sun / between Mars and Jupiter	1	
	(b)	(i)	Between 350-650 [million km]	2
		(ii)	-50 and -100 [°C]	
	(c)	(i)	Inner rocky / outer gaseous	1
		(ii)	Sun's radiant energy easily pushed the gases to the outer reaches	1
Question total				[5]

Question		Marking details	Marks Available
4.		<p>Kettle: 2000 (1) 2(1) ecf on power (W) conversion</p> <p>Food mixer: $\frac{5}{60} \times 0.72 = 0.06$ (1) correct power (1), conversion (1)</p> <p>Answer of 3.6 with no working shown award 1 mark Answer of 3.6 with working shown award 2 marks</p> <p>Question total</p>	<p>5</p> <p>[5]</p>
5.	<p>(a)</p> <p>(b)</p>	<p>(i) Award (1) x 3: By conduction through the metal (1), radiates heat to people directly in front of the radiation (1), air in contact becomes heated and rises – circulating the room / forming convection currents to heat the room (1) mechanism of convection (1).</p> <p>(ii) Dark colours are best <u>radiators / emitters</u> of heat</p> <p>(i) Conduction [through ceiling] (1) and mainly convection [through the roof space] (1)</p> <p>(ii) Air gaps in fibre glass reduces conduction through the ceiling (1) and [as a consequence] reduces convection since little heat conducted (1)</p> <p>Question total</p>	<p>3</p> <p>1</p> <p>2</p> <p>2</p> <p>[8]</p>

Question		Marking details	Marks Available
6.	(a)	Any 3 x (1): Localised heating effects e.g. rivers Inefficient (can be implied) Carbon dioxide / CO ₂ leads to global warming Sulphur dioxide / SO ₂ leads to acid rain	3
	(b)	(i) % efficiency = $\frac{\text{useful power transfer}}{\text{total power input}} \times 100$ $\frac{82 \times 400}{100} = 328$ [MW] substitution (1) answer (1)	1 2
		(ii) 328-118=210 [MW]	1
		(iii) To minimise heat losses / ease of access to the energy / benefit to more people	1
		Question total	[8]
7.	(a)	(i) Forces unbalanced, radiation pressure greater than gravity (ii) Correct sequence red giant to white dwarf (1) Any 2 points from the graph relevant to the red giant or white dwarf (1) (don't accept reference to colour)	1 2
	(b)	(i) More energy produced by fusion / more hydrogen to fuse (ii) Any 3 x (1): Expand to a red supergiant (1) and cools (1) and eventually becomes a supernova (1) leaving behind a black hole / neutron star (1)	1 3
		Question total	[7]
8.	(a)	Satellite takes the same <u>time</u> to orbit / 24 hours (1) as it takes for the Earth to spin once on its axis (1)	2
	(b)	(i) $\frac{3 \times 10^8}{5 \times 10^9} = 0.06$ [m] substitution (1) answer (1)	
		(ii) $\frac{2(1) \times 3.6 \times 10^7}{3 \times 10^8} = 0.24$ [s] substitution (1) answer (1)	5
		Question total	[7]
		Total Higher Tier	50

GCSE Science - Physics (Legacy) - P2

Mark Scheme

FOUNDATION TIER

Question			Marking details	Marks Available
1.	(a)	(i)	H and A	1
		(ii)	G and B	1
	(b)		Good insulator / poor conductor or implied Question total	2 [4]
2.	(a)		150 x 2 = 300 [J] substitution (1) answer (1)	2
	(b)		Energy required to operate lifting gear	1
			Question total	[3]
3.	(a)		Statement (ii) (1) Low level radiation from surroundings (1)	2
	(b)	(i)	$\frac{108}{5}$ (1) = 21 / 22 [cpm] (1)	2
		(ii)	Statement 2 Question total	1 [5]
4.	(a)		6 400 [W]	1
	(b)		$\frac{6400}{230} = 27.8$ [A] Substitution (1) answer (1)	2
	(c)		m.c.b. needs a value above 28 A / too much current for the m.c.b. Question total	1 [4]
5.		Any 2 x (1) from: Containment / safe transport / long activity / highly radioactive Question total	2 [2]	

Question			Marking details	Marks Available
6.	(a)	(i)	8 [m]	1
		(ii)	2 [s]	1
	(b)	$\frac{8}{2}$ (1) ecf = 4 [m/s] (1)	2	
			Question total	[4]
7.	(a)	(i)	Measure voltage (1)	3
		(ii)	Measure current (1)	
		(iii)	Change resistance / change meter readings / change current / change voltage across the coil (1)	
(b)	$\frac{6}{1.5} = 4$ [Ω] Substitution (1) answer (1)	2		
			Question total	[5]
8.	(a)		Computer generated from readings picked up by gamma camera	1
	(b)		<u>Low energy</u> gamma [emitter] / easily escapes the body	1
	(c)	(i)	640	1
		(ii)	24 [hours]	1
			Question total	[4]
9.	(a)		Straight line to (50,25) (1)	2
			Straight line from (50,25) to (60,0) (1) ecf	
	(b)		Accelerates / <u>uniform</u> increase in speed / increase speed to 25 m/s	1
	(c)		$\frac{25-0}{10}$ ecf from graph = 2.5 [m/s ²] Substitution (1) answer (1)	2
			Question total	[5]

Question			Marking details	Marks Available
10.	(a)	(i)	120 [cpm] (1)	2
		(ii)	300-250 = 50 [cpm] (1)	
	(b)		This was amount absorbed by the aluminium plate (1) and beta are absorbed by aluminium (1)	2
			Question total	[4]
11.	(a)		2 000 [N]	1
	(b)	(i)	3 200 – 2 000 = 1 200 [N]	1
		(ii)	Acceleration = $\frac{\text{Resultant force}}{\text{Mass}}$	1
			$\frac{1200}{800} \text{ ecf} = 1.5 \text{ [m/s}^2\text{]}$	2
			Question total	[5]
12.	(a)		B is <u>connected</u> to the fuse (not goes through the fuse box)	1
	(b)	(i)	S ₁ and S ₂ in position to control lamp X and lamps Y and Z (2 x (1))	3
	(ii)	Both S ₁ and S ₂ on live side (B) (1)		
	(c)		Currents in excess of <u>5 A</u> (1) melts / breaks the fuse (1)	2
			Question total	[6]
			Total Foundation paper	50

HIGHER TIER

Question			Marking details	Marks Available
1.	(a)	(i)	120 [cpm] (1)	2
		(ii)	300-250 = 50 [cpm] (1)	
	(b)	This was amount absorbed by the aluminium plate (1) and beta are absorbed by aluminium (1)		2
			Question total	[4]
2.	(a)	2 000 [N]		1
	(b)	(i)	3 200 – 2 000 = 1 200 [N]	1
		(ii)	acceleration = $\frac{\text{resultant force}}{\text{mass}}$ $\frac{1200}{800} \text{ ecf} = 1.5 \text{ [m/s}^2\text{]}$	1 2
(c)	Drag increases as speed increases (1) until it equals the new driving force (1) Or drag becomes equal to the <u>new</u> driving force (2)		2	
			Question total	[7]
3.	(a)	B is connected to the fuse		1
	(b)	(i)	S ₁ and S ₂ in position to control lamp X and lamps Y and Z (2 x (1))	3
		(ii)	Both S ₁ and S ₂ on live side (B) (1)	
(c)	Currents in excess of <u>5 A</u> (1) melts / breaks the fuse (1)		2	
			Question total	[6]

Question		Marking details	Marks Available
4.	(a)	(i) C-14 atoms / their nuclei (1) decay emitting an electron (1)	2
		(ii) In 5 700 years (1) the activity / number of C-14 atoms halves (1)	2
	(b)	(i) Dead wood decays, therefore decreasing the activity (1) not taking in C-14 (1) or living wood maintains its activity level (2)	2
		(ii) 7 000 [years] Accept: 6 800 – 7 200	1
c)	Any 3 x (1) from: <ul style="list-style-type: none"> • Dangerous to humans • Costly because of containment • Site / transport • Length of time it is active 	3	
(d)	X activity = 80 (1) and Y activity = 40 (1) [120 cps] Question total	2 [12]	
5.	(a)	(i) Doubles	1
		(ii) Quadruples [increase / increase earns 1 mark only]	1
(b)	$24(1) + 160(1) = [184 \text{ m}]$ Question total	2 [4]	

Question			Marking details	Marks Available
6.	(a)	(i)	Z (1)	2
		(ii)	Y (1)	
	(b)	(i)	$2.3 \times 1000 = I \times 230$ Substitution (1) manipulation (1) $I = 10$ [A] (1)	3
		(ii)	$R = \frac{230}{10}$ (1) ecf = 23 [Ω](1)	2
(c)	Faster acting (1) More sensitive / detects small changes in current (1)		2	
			Question total	[9]
7.	(i)	Work done by engines: $2 \times 10^5 \times 60 = 1.2 \times 10^7$ [J](1)		3
		Work done by catapult: $10.8 \times 10^5 \times 60 = 6.48 \times 10^7$ [J](1) Total work done = 7.68×10^7 [J](1) ecf		
	(ii)	$\frac{1}{2} \times 24000 \times v^2 = 7.68 \times 10^7$ (1) ecf $v^2 = \frac{2 \times 7.68 \times 10^7}{24000}$ (1) $v^2 = 6400$ $v = 80$ [m/s] (1)		3
(iii)	$\frac{60}{80}$ (1) ecf = 0.75 [s](1)		2	
			Question total	[8]
			Total Higher Tier	50

GCSE Science - Physics (Legacy) - P3

Mark Scheme

FOUNDATION TIER

Question			Marking details	Marks Available
1.			A transverse wave (1) Can travel through solids (1) Travel slower than P waves (1) Question total	3 [3]
2.			Diagram with defined nucleus (1) containing 3 protons and 4 neutrons (1) 2 orbits (1) with 2, 1 electrons (1) Question total	4 [4]
3.		(i) (ii)	1 200 x 20 = 24 000 [kg m/s] Greater mass / more momentum Question total	1 1 [2]
4.		(i) (ii)	B (1) empty space (1) A / C (1) nucleus (1) Question total	4 [4]
5.	(a)	(i) (ii) (iii)	BC Largest gradient / steepest line Speed changes (1) from low to high value (1)	1 1 2
	(b)		$\frac{50}{3.5} (1) = 14.28 \text{ [km/h]} (1)$ Question total	2 [6]

Question			Marking details	Marks Available
6.	(a)		Any (1) x 2: <ul style="list-style-type: none"> • Fusion is joining together of two atoms • Releases more energy • Produces no radioactive waste • Readily available source of atoms Fission statements acceptable alternatives	2
	(b)		Any (1) x 2: <ul style="list-style-type: none"> • The extremely high temperatures required. • Safe containment for the reaction. Question total	1 [3]
7.	(a)		3 waves drawn (1) perpendicular to wave direction (1)	2
	(b)		Refraction	1
	(c)	(i) (ii)	Decreases (1) Decreases (1)	2
			Question total	[5]
8.	(a)	(i) (ii) (iii)	1, 2 and 5 (1) Faster than S waves (1) Nearest to the earthquake (1)	3
	(b)		Change of medium / solid → liquid	1
			Question total	[4]
9.	(a)		E A D C 3 or 4 correct = 3 marks 2 correct = 2 marks 1 correct = 1 mark	3
	(b)		Less turns on secondary / more turns on primary	1
			Question total	[4]

Question		Marking details	Marks Available
10.	(a)	$\frac{25}{10}$ (1) = 2.5 [m/s ²] (1)	2
	(b)	$\frac{1}{2} \times 20 \times 25 = 250$ [m] (1) (substitution (1))	2
	(c)	Larger area for the last 30 s	1
		Question total	[5]
11.	(a)	(i) Capture (1) of slow neutrons (1) (ii) Graphite slows (1) up neutrons to enable fission (1) Award a maximum of 3 marks in total for (a).	3
	(b)	Reduces output (1) since more neutrons are absorbed / so less fission (1)	2
		Question total	[5]
12.	(a)	0.4 [s]	1
	(b)	B → A	1
	(c)	Decreased (1) Increased (1) Decreased (1)	3
		Question total	[5]
Total Foundation paper			50

HIGHER TIER

Question		Marking details	Marks Available
1.	(a)	$\frac{25}{10}$ (1) = 2.5 [m/s ²] (1)	2
	(b)	$\frac{1}{2} \times 20 \times 25 = 250$ [m] (1) (substitution (1))	2
	(c)	Larger area for the last 30 s	1
	Question total		[5]
2.	(a)	(i) Capture (1) of slow neutrons (1) (ii) Graphite slows (1) up neutrons to enable fission (1) Award a maximum of 3 marks in total for (a).	3
	(b)	Reduces output (1) since more neutrons are absorbed / so less fission (1)	2
	(c)	To prevent escape of radiation – stray neutrons (1) Protection for workers / community / environment (1)	2
	(d)	$a = 92 - 36 = 56$ (1) $b = 236 - 146 = 90$ (1)	2
	Question total		[9]
3.	(a)	0.4 [s]	1
	(b)	B → A	1
	(c)	Decreased (1) Increased (1) Decreased (1)	3
	(d)	Any 2 x (1): <ul style="list-style-type: none"> • Radial fields • Multi-coils • Electromagnets rotate • Rotor & stator 	2
	Question total		[7]

Question			Marking details	Marks Available
4.	(a)		Transverse <u>vibrations</u> (1) at right angles to direction (1) / longitudinal <u>vibrations</u> (1) along direction (1)	2
	(b)		Any (1) x 5: Speed increases with depth in the mantle (1) Speed increases with depth in the core (1) No S waves in the core (1) Core must be a liquid (1) Abrupt change of speed shows boundary (1) Size of mantle (1) Size of core (1) P wave speed constant through solid inner core (1)	5
			Question total	[7]
5.	(a)	(i)	Alpha (1)	2
		(ii)	Beta (1)	
	(b)		$230 - 90 = 140$	1
	(c)		A	1
			Question total	[4]

Question			Marking details	Marks Available
6.	(a)	(i)	Core has a changing field (1) which links with secondary coil (1)	3
		(ii)	Fewer turns (1)	
	(b)	No changing field with d.c.	1	
	(c)	$\frac{V_1}{V_2} = \frac{N_1}{N_2}$ $\frac{230}{V_2} = \frac{4600}{40}$ (1 for substitution) (1 for manipulation)	1	
			$V_2 = \frac{230}{115} = 2 \text{ [V]} \text{ (1)}$	3
			Question total	[8]
7.	(a)	(i)	$v^2 = u^2 + 2ax$ $240^2 = 2 \times a \times 0.6 \text{ (1)}$ $a = 48000 \text{ [m/s}^2\text{]} \text{ (1)}$	2
		(ii)	$x = \frac{1}{2}(u + v)t$ $0.6 = \frac{240}{2}t \text{ (1)}$ $t = 0.005 \text{ [s]} \text{ (1)}$	
	(b)	Momentum before = Momentum after $0.02 \times 240 = 2v \text{ (1)}$ $v = \frac{0.02 \times 240}{2}$ $v = 2.4 \text{ [m/s]} \text{ (1)}$	2	
	(c)	(i)	$KE = \frac{mv^2}{2} \text{ (1)}$ $\frac{0.02 \times 240^2}{2} = 576 \text{ [J]} \text{ (1)}$	2
		(ii)	Some lost as heat (1) Some lost doing work against bullet's penetration of target (1) Accept: change in shape of target	2
			Question total	[10]
				Total Higher Tier



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