GCSE MARKING SCHEME

SCIENCE – PHYSICS (LEGACY)

JANUARY 2012

INTRODUCTION

The marking schemes which follow were those used by WJEC for the January 2012 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.

PHYSICS 1 (LEGACY)

FOUNDATION TIER

Question			Answer / Explanatory Notes	Marks Available
1.			Line from 1 to Radiation Line from 2 to Conduction Line from 3 to Convection Line from 4 to Radiation	1 1 1 1 **4**
2.	(a)		400 – 215 – 105 = 80 (1)	1
	(b)		$\frac{320}{400} \times 100 = 80(\%)$ Subs (1) Ans (1) allow e.c.f. (0.8 award 1 mark)	2 **3**
3.	(a)	(i)	4865 – 2515 = 2350 (1)	1
		(ii)	Cost = 2350 × 40 Subs / Ans (1) allow e.c.f. = 94000 p = (£)940 Conversion to £ (1)	2
	(b)		$\frac{25}{100} \times 940$ (94000) = (£)235/ (23500) Subs (1) Ans (1) allow e.c.f	2 **5**
4.	(a)	(i)	8 (m/s) (1)	1
		(ii)	$f = \frac{v}{\lambda} = \frac{8}{40} = \frac{1}{5}$ or 0.2 (Hz) Subs (1) Ans (1) allow e.c.f.	2
	(b)		Speed – 4 m/s / slower (1) Freq – 0.4 Hz / greater (1) **Or** speed different (1) Frequency different (1)	2 **5**
5.			Disposal of waste Contamination of the water used for cooling Decommissioning time Meltdown / explosion Safety – needs to be qualified Transport of fuel to and from for reprocessing Risk of terrorist attack Pollution – needs to be qualified e.g. risk of leaks Any (3 × 1)	3 **3**

Question			Answer / Explanatory Notes	Marks Available
6.	*(a)*		Fusion (1) Hydrogen **<u>to</u>** Helium / light elements to heavier elements (1)	2
	(b)	(i) (ii)	Explosion of a star (1) Stars of a high mass / big enough star (1)	2 **4**
7.	*(a)*	(i) (ii)	Electricity Has best value for cost per MJ / gets more energy for 50 p	1 1
	(b)	(i) (ii) (iii)	Cost of gas = £4 /400(p) (1) Number of MJ = 800 (MJ) (1) Cost using coal = £8/800 (p) (1) allow e.c.f.	3 **5**
8.	*(a)*		Venus	1
	(b)		Highest temperature (1) even though further from the Sun than Mercury / even though not the nearest planet to the Sun(1)	2
	(c)		12 × 413 Subs (1) 4956 million km [Answer (1) **Unit** (1)] Unit must match answer	3 **6**
9.	*(a)*		Radio waves in 1st LH box or X-rays in RH box (1) Correct sequence for remaining parts (1)	2
	(b)		Remote (controls) , thermal imaging, optical fibres, radiant heaters, burgular alarms, grilling/toasting, mobile phones Night lights, Heat treatment Any (2×1)	2
	(c)		X-rays ionises [molecules in] cells / damages DNA / mutates cells (1)	1 **5**

Question			Answer / Explanatory Notes	Marks Available
10.	*(a)*		To maintain supply to customers when a breakdown occurs / changes in demand	1
	(b)	(i)	[Low resistance] to keep heat loss to minimum	1
		(ii)	High voltages are dangerous / stop people being eletrocuted / people can't touch them / can't get damaged	1
	(c)		'Step- up' to raise voltage (to a suitable level) (1) (for transmission) with minimum loss of energy (1) 'Step-down' to lower voltage to safe value for domestic use (1) Statement of value correctly used in transmission or domestic use, e.g. 132 000 V, 400 000 V 230[accept 240] V (1) **Award a maximum of 5 marks only for (b) and (c)**	3 **6**
11.	*(a)*	(i)	800 (W)	1
		(ii)	800 × 60 = 48000 (J) Or = 0.8 x 60 = 48 kJ Subs (1) Ans (1) allow e.c.f.	2
	(b)		This is the frequency of the radiation used / or correct definition of frequency	1 **4**

HIGHER TIER

Question			Answer / Explanatory Notes	Marks Available
1.	*(a)*		Radio waves in 1st LH box or X-rays in RH box (1) Correct sequence for remaining parts (1)	2
	(b)		Remote (controls) , thermal imaging, optical fibres, radiant heaters, burgular alarms, grilling/toasting, mobile phones Night lights, Heat treatment Any (2×1)	2
	(c)		X-rays ionises [molecules in] cells / damages DNA /mutates cells (1)	1
				5
2.	*(a)*		To maintain supply to customers when a breakdown occurs / changes in demand	1
	(b)	(i)	[Low resistance] to keep heat loss to minimum	1
		(ii)	High voltages are dangerous / stop people being eletrocuted / people can't touch them / can't get damaged	1
	(c)		'Step- up' to raise voltage (to a suitable level) (1) (for transmission) with minimum loss of energy (1) 'Step-down' to lower voltage to safe value for domestic use (1) Statement of value correctly used in transmission or domestic use, e.g. 132 000 V, 400 000 V 230[accept 240] V (1) **Award a maximum of 5 marks only for (b) and (c)**	3
				6
3.	*(a)*	(i)	800 (W)	1
		(ii)	800 × 60 = 48000 (J) Or = 0.8 x 60 = 48 kJ Subs (1) Ans (1) allow e.c.f.	2
	(b)		This is the frequency of the radiation used / or correct definition of frequency	1
	(c)		Wave speed = wavelength × frequency [accept $v = f\lambda$]	1
			Use of 2450×10^6 Hz [or equiv] i.e. conversion (1) $\lambda = \frac{3\times10^8}{2450\times10^6} =$ 0.122 (m) Substitution (1) Manipulation with formula or numbers (1) ($\frac{3\text{x}10^8}{50}$ award 1 mark only)	3
				8

Question			Answer / Explanatory Notes	Marks Available
4.	*(a)*	(i)	20 000 × 1000 = 20000000 (W) / 20 MW / 20 000 kW	1
		(ii)	$\%\ \text{Efficiency} = \frac{\text{Useful power [transfer]}}{\text{Total power [input]}} \times 100$	1
			$75 = \frac{20\,000\,000}{\text{input power}} \times 100$ substitution (1) Input = 26.7 M(W) / 2.67×10^7 (W) / 27 M(W) manipulation from formula or numbers(1) answer (1) allow e.c.f.	3
	(b)	(i)	Less demand for electricity at night or by implication	1
		(ii)	Heat is also given to the water in pumping / reference to efficiency of pumps	1
	(c)		Low start-up time so instant energy to grid [need reference to quickness](1) Must reuse water so only a finite amount of energy can be generated each day.(1)	2
				9
5.	*(a)*		(When it runs out of fuel it will expand and cool) to become a red super giant (1) and then produce a supernova (1) leaving dense neutron star or black hole (1)	3
	(b)		Fusion occurring (1) with example explained e.g. helium fuses into heavier elements (1)	2
				5
6.	*(a)*		3 x 10^8 (km / year)	1
	(b)	(i)	4.5 x 10^8 (km)	1
		(ii)	$\text{time} = \frac{2.67 \times 10^9}{5.8 \times 10^8}$ = 4.6 (yr) Substitution (1) Answer (1)	2
	(c)		Ceres by value of distance from Sun and an orbit time is between Mars + Jupiter (1) Temperature – 50 (°C) to -100 (°C) (1) allow e.c.f. from (b)(i) Or some mathematical way of working it out based on the distances of Mars +Jupiter + Ceres from the Sun or on orbital times. (2 e.c.f. marks can be obtained from (b)(ii))	2
	(d)		Travels more slowly (1) and has further to go (1)	2
				8

Question			Answer / Explanatory Notes	Marks Available
7.	*(a)*	(i)	Saving = 940 – 640 = £300 (1) Payback = $\frac{6000}{300}$ (1) for substitution = $16\frac{2}{3}$ (yrs)	2
		(ii)	Costs may increase or decrease, weather may change (colder not hotter)	1
	(b)		Less power generated Less fuels used Smaller carbon footprint / less greenhouse effect less acid rain Any (2 × 1)	2
	(c)		Cost = no. of units x cost of 1 unit £640 = no. of units x 40p No. of units = $\frac{640 \times 100(1)}{40}$ = 1600 (1) No. lost through cavity = $\frac{35}{100}$ (1) × 1600 = 560 (1) allow e.c.f. 2 marks available for correct methodology (£224 is 35% of £640 award 2 marks)	4
				9

PHYSICS 2 (LEGACY)

FOUNDATION TIER

Question			Answer / Explanatory Notes	Marks Available
1.	(a)		head rest [1] (Accept crumple [zone])	1
	(b)		crumple [zone] [1]	1
				2
2.	(a)		10 (m/s) [1] – no tolerance	1
	(b)		3.5 (s) [1] – no tolerance	1
	(c)	(i)	$\frac{10-4}{2}$ [1] = 3 (m/s^2) [1] (no penalty on negative sign)	2
		(ii)	line is less steep [1] (or equivalent, e.g. in 2 s the speed only decreases by about 3 m/s instead of 6 m/s – reference to speed change **and** time needed in this approach)	1
				5
3.	(a)		nucleus [1] Accept neutron / accept plurals.	1
	(b)	(i)	100 [1]	1
		(ii)	5700 + 5700 **or** 11 400 (years) [1] (Credit 5700 + 5700 or 2 x 5700 where the answer has been miscalculated) Not "2 half lives"	1
				3
4.	(a)		The fuse / switch is always in the live wire **or** it is connected / attached to / contains the fuse/switch [1] NOT "is closer to the fuse" "Wire A runs through the fuse" - ok	1
	(b)		OFF [1], ON [1]	2
	(c)		current = $\frac{115}{230}$ [1 - subs]= 0.5 (A) [1 Ans] (N.B 230/115 = 0.5 gets no credit)	2
	(d)		current is <<13 Amp / fuse [value] much bigger than current [1] (Do not accept 'is less than', accept 'Fuse wouldn't melt before danger of a fire'] A suggested lower value of fuse e.g. 3A or 5A ✓ Not the current will never get that high ×	1
	(e)		Earth [1] [Accept: ground]	1
				7

Question			Answer / Explanatory Notes	Marks Available
5.	(a)	(i)	stays the same / the same / same [1]	3
		(ii)	bigger / gets bigger [1]	
		(iii)	stays the same / the same / same [1]	
	(b)		**EITHER:** letter W plus arrow downwards [1] A plus arrow downwards [1] [**OR:** Both arrows downwards [1] both downward arrows labelled [1] – 2nd mark requires 1st] NB No requirement for arrows to make contact with ball but need to be within the horizontal extent of the ball.	2 **5**
6.			r.c.d. / residual current device [1] Accept r.c.b. m.c.b./ miniature circuit breaker [1] Accept m.c.d r.c.d. / residual current device [1] Accept r.c.b. NB – more than 1 answer - s.i.f.	3 **3**
7.	(a)		emits radiation [or a named form of nuclear radiation] [1], which damages [or harms] / ionises cells **or** causes mutations / cancer [1] No credit for reference to exposure. "radioactive waves" × "releases" radiation ✓	2
	(b)		cost [/ costly / expensive [1], danger of accident on take-off] (do not accept waste falling to earth on its own) [1] Accept: "can explode [in space and come back to Earth]" / "collide with space debris"	2
	(c)	(i)	long half life / long time to decay [1] Answer must relate to the time – not corrosion. "May be still active" ok	1
		(ii)	It can [or will] leak – reference to leakage [accept contamination of water, soil, food chain] [1]	1 **6**
8.	(a)		12 (m) [1]	1
	(b)	(i)	70 (m) [1] e.c.f. [ie 82 m – answer to (a)]	1
		(ii)	$t = \frac{70(\text{e.c.f.})}{10}$ = [1] 7 (s) [i.e ans to (b)(i)÷10]	2 **4**

Question			Answer / Explanatory Notes	Marks Available
9.	(a)		correct symbol for voltmeter [accept line through] in parallel with lamp [1] (Above or below it) Accept the voltmeter shown across the lamp / ammeter pair.	1
	(b)	(i)	decreases [1] [not "slows the current"]["changes" – not enough] Not "dimmer"; accept: "the bulb has a lower current through it."	1
		(ii)	decreases [1]	1
	(c)	(i)	cross on coordinate (6, 2.7) ± ½ division[1] reasonably straight line becoming curved after coordinate (4,2) [1] NB – line must include origin but don't penalise for lies beyond 8 V. Badly plotted point – line mark still possible ecf. No double lines.	2
		(ii)	$\frac{8}{3[1]}$ [1 for 3.0 in denominator]= 2.7 (Ω) [Ans 1] (Accept 2.67 or 2.667 but not 2.6, 2.66 or 2.666) NB 2.6, 2.66... → 1 mark] NB 2.6 dot in the calculation gets the second mark even if the answer line shows 2.6 only.	2 **7**
10.	(a)		total radiation [or strength of rad^n] received [1] (Accept 'as a control') "To see if any rad^n present" ✓ "To see if any rad^n let in without protection "✓ "Monitor amount of each type of rad^n" – not enough Ref to background radiation × Accept: "to measure radiation going in" [or equiv.] ✓ Accept "total dose" ✓ Accept "to see how much α / alpha" ✓	1
	(b)		THIRD COLUMN ANSWERS: gamma (only) [1], beta & gamma (only)[1]	2
	(c)		750 [accept 1450]	1 **4**
11.		(i)	$\frac{210\,000(\text{N})[1]}{3}$ = 70 000 (N) [1] (No credit for $\frac{200\,000}{3}$) [$\frac{190\,000}{3}$ = 63000 N → 1 mark (ans)] NB Accept 210 000 [N] whenever it appears for the first mark	2
		(ii)	$\frac{10\,000}{20\,000}$ [1] = 0.5 (m/s^2) [1] (N.B $\frac{20\,000}{10\,000}$ = 0.5 gets no credit)	2 **4**
			Totals for foundation paper	**50**

HIGHER TIER

Question			Answer / Explanatory Notes	Marks Available
1	(a)		correct symbol for voltmeter [accept line through] in parallel with lamp [1] (Above or below it) Accept the voltmeter shown across the lamp / ammeter pair.	1
	(b)	(i)	decreases [1] [not "slows the current"]["changes" – not enough] Not "dimmer"; accept: the bulb has a lower current through it.	1
		(ii)	decreases [1]	1
	(c)	(i)	cross on coordinate (6, 2.7) ± ½ division[1] reasonably straight line becoming curved after coordinate (4,2) [1] NB – line must include origin but don't penalise for lies beyond 8 V. Badly plotted point – line mark still possible ecf.	2
		(ii)	8/3.0 [1 for 3.0 in denominator]= 2.7 (Ohms) [Ans 1] (Accept 2.67 or 2.667 but not 2.6, 2.66 or 2.666) NB 2.6, 2.66... → 1 mark] NB 2.6 dot in the calculation gets the second mark even if the answer line shows 2.6 only.	2
		(iii)	EITHER: using calculations at early and late points[e.g. from (c)(ii)] [1], states that R has increased [1] OR Any 2 × (1) from • R constant up to 4 V ✓ • statement that gradient has decreased [after 4 V]✓ • states R has increased ✓ "The resistance of the lamp increases up to 4 V and then increases more slowly" → 0 marks "Rate at which the current increases gets less"✓	2 **9**
2.	(a)		total radiation [or strength of rad^{n}] received [1] (Accept 'as a control') "To see if any rad^{n} present" ✓ "To see if any rad^{n} let in without protection "✓ "Monitor amount of each type of rad^{n}" – not enough Ref to background radiation ×	1
	(b)		THIRD COLUMN ANSWERS: gamma (only) [1], beta & gamma (only)[1]	2
	(c)		750 [accept 1450]	1 **4**

Question			Answer / Explanatory Notes	Marks Available
3.	(a)	(i)	$\frac{210\,000(\text{N})[1]}{3}$ = 70 000 (N) [1] No credit for $\frac{200\,000}{3}$ [$\frac{190\,000}{3}$ = 63000 N → 1 mark (ans)]	2
		(ii)	$\frac{10\,000}{20\,000}$ [1] = 0.5 (m/s^2) [1] (N.B $\frac{20\,000}{10\,000}$ = 0.5 gets no credit)	2
	(b)		Any 3 × (1) from • mass decreases..✓ • because the fuel used up.✓ • <u>resultant</u> force increases ✓ • weight decreases ✓ NB weight decreases because gravity decreases – no additional credit.	3
	(c)		Graph starting at origin sloping upwards with correct curvature [increasing gradient] [1], never becoming vertical [1] NB Straight sloping line with upward curve [not vertical] at end → 1 mark NB Zero initial gradient loses first marking point.	2 **9**
4.	(a)		m.c.b. / miniature [accept: mini] circuit breaker, [1][mcd → bod] [1] r.c.d./ residual current device, [1] [rcb → bod] / e.l.c.b. / <u>earth-leakage</u> circuit breaker [1] accept earth lead / wire.✓ NB Not just "circuit breaker", Not insulated wires / plugs	2
	(b)		m.c.b breaks the circuit [1] because it is faster acting than a fuse[1] "Faster acting than fuses" ok even if referring to rcd. Accept "turn off the circuit" / more sensitive. Accept "fast acting" or "immediately" even if not compared to fuse.	2
	(c)		Current / electricity flows to earth [1] **Either** Then [accept senses / measures] there is a <u>difference</u> between the live and neutral <u>currents</u> [1] so r.c.d. breaks the circuit [1] **Or** Large <u>current</u> flows because it is a low resistance path [ ] so fuse [melts and] breaks the circuit [ ] Current through the Earth wire / lead – ok Large current flows causing fuse to melt → 1 mark	3 **7**

Question			Answer / Explanatory Notes	Marks Available
5.	(a)		time taken [1] for activity / substance / material / mass / nuclei / atoms to reduce by half [1] [Not radioactivity or radiation] accept "half the substance the substance / material to decay" Not ...."for the count to decrease by ½ " but accept "or the count rate to decrease by ½ "	2
	(b)	(i)	Strontium : needs to be beta because fewer beta particles pass through thicker aluminium (not just IT IS A BETA EMITTER)[1]; it has a [reasonably] long half-life [stand alone] [their choice must have at least 5 years ½ life] [1] absorbed if the aluminium is too thick – ok / can penetrate a certain thickness of aluminium - ok	4 max
		(ii)	technetium : must be a gamma emitter because it passes out of the body easily / equivalent [1]AND it has a short [enough] half life [to decay from the body in a short term] [[stand alone but their choice must be technetium or phosphorus] [1] Not just –ionising. + both sources correct [1]	
	(c)	(i)	decayed radon is continually being replaced [1] [however stated, e.g. "there is a constant flow of radon [through cracks]"]	1
		(ii)	subtraction of 30 from 550 = 520 [1] Danger factor $= \frac{520(\text{ecf})}{200} = 2.6$ **or** $\frac{520(\text{ecf})}{230}$ [Ans 1] 2.6 $\rightarrow$(2), 2.75 $\rightarrow$(1); 2.3 $\rightarrow$ (2); 2.4 $\rightarrow$ (1)	2
		(iii)	activity of radon = 0.6 x 200 [1] = 120 [Ans 1] Total activity = 120 + 30 = 150 [Ans 1] ecf on 230 from (ii) for first 2 marks: 0.6(✓) x 230(✓) = 138(✓) $\rightarrow$ 3 marks. +30 -1 penalty	3
				12

Question			Answer / Explanatory Notes	Marks Available
6	*(a)*	(i)	0.5 x 90 x 13 x 13 [1] = 7605 (J)[1]	2
		(ii)	PE = 90 x 10 x 6 [1] = 5400 (J) [1] KE = 0.5 x 90 x 5^2 = 1125 (J)[Ans 1] Total energy = 6525 (J)[1] Allow e.c.f. from error in PE or KE NB use of KE from (i) → only first two marks	4
	(b)		Energy conv to work = 7605-6525 = 1080 (J) [Ans 1] e.c.f.from (a)	3
			Force = $\frac{1080}{18}$ [1] [accept answer to (a)(i) &(ii) e.g. 7605 or 6525] = 60(N)[1] ecf from 2nd mark	
				9
			Total for higher tier paper	**50**

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