WJEC
CBAC

GCSE MARKING SCHEME

SCIENCE - PHYSICS

JANUARY 2011

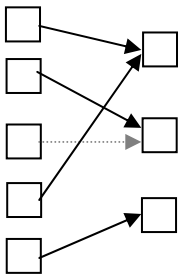
INTRODUCTION

The marking schemes which follow were those used by WJEC for the January 2011 examination in GCSE SCIENCE - PHYISCS. 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

Foundation Tier			Answer / Explanatory Notes	Marks Available
1.			 Each correct line (1) Each additional line – 1 [minimum 0]	4 **4**
2.	*(a)*		Hydrogen	1
	(b)	(i)	equal [to] (1)	
		(ii)	bigger [than] (1)	
		(iii)	Smaller [than] (1)	3 **4**
3.	*(a)*		…. <u>radiated</u> (1)…. <u>absorbed</u> (1) …	2
	(b)		Fibre glass contains <u>trapped air (or equiv)</u> [which is a good insulator]. [accept: contains air]	1 **3**
4.	*(a)*		[Energy wasted =] 2300 [kJ]	1
	(b)		% Efficiency = $\frac{1200}{3500} \times 100$ (1 – subs) [or by impl.] = 34.3% (1 – ans) [accept 34.29, 34.3, 34 not 34.28] N.B. 34.2 on its own gets 1st mark (by impl.)	2 **3**
5.	*(a)*		A	1
	(b)	(i)	<u>132 000</u> (1)	
		(ii)	<u>E</u> (1)	
		(iii)	<u>small</u> (1)	3 **4**

Foundation tier			Answer / Explanatory Notes	Marks Available
6.	*(a)*		Radio [waves] (1) ……Ultra violet [waves] [accept UV] (1)	2
	(b)	(i)	Infra red [accept radio or microwave](1)	
		(ii)	Microwave (1)	2
	(c)	(i)	Ultraviolet [or UV] / X [-rays] / Gamma [rays] (1)	2
		(ii)	Burns [however expressed e.g. heating.] (1) ["cancer"= neutral this time. Not just damages skin/cells]	
				6
7.	*(a)*	(i)	kilowatt / 1000 watts (1)	
		(ii)	4000 (1)	
		(iii)	Electric oven (1) (no e.c.f.)	3
	(b)		time = $\frac{12}{4}$ / 3 (subst or ans) N.B. $\frac{12}{4} = 6$ not s.i.f.	1
	(c)	(i)	18 [kWh] (ans)	1
		(ii)	216 / 2.16 / 18×12 (e.c.f) (1) 216p or £2.16 (1) [i.e. appropriate unit]	2
				7
8.	*(a)*		[Distance from Sun =] 100 [million km]	1
	(b)		Earth / earth	1
	(c)		0.9	1
	(d)		Mercury	1
				4
9.	*(a)*		2.5 / 2½	1
	(b)	(i)	AB (1)	
		(ii)	BC (1)	2
	(c)	(i)	Average wavelength = $\frac{240}{8}$ / 30 [cm] (subst or ans)	1
			[N.B. $\frac{8}{240} = 30 \rightarrow 0$]	
		(ii)	[wavespeed = 10 × 30 [e.c.f.]] 300 [cm/s] (answer) [Accept 3 m/s – only if m/s written in]	1
				5

Foundation tier			Answer / Explanatory Notes	Marks Available
10.	*(a)*		Scotland	1
	(b)		Any 2 × (1) from • Larger wind turbines can be built ✓ • It is windier at sea than on land [strength or consistency] ✓ • Larger wind turbines are more efficient ✓ • Larger area available / can build more ✓	2
	(c)		Mean power = $\frac{810}{18}$ (1) [or by impl.] = 45 [MW] (1)	2
				5
11.	*(a)*	(i)	Refraction [or refract / refracted]	1
		(ii)	Accept: change in medium[however expressed] / density / [wave]speed [Accept: it strikes the glass at an angle.]	1
	(b)		**Total internal reflection** [accept TIR]	1
	(c)	(i)	The angle [of incidence] is less/smaller than the critical angle [for glass and air]. [Accept the angle is less/smaller than a specified angle which should be between 42° and 45°]	1
		(ii)	Emergent ray drawn in the correct quadrant [arrow not required] showing refraction away from the normal. [N.B. Not accept a ray drawn along boundary.]	1
				5

Higher Tier			Answer / Explanatory Notes	Marks Available
1.	*(a)*		2.5 / 2½	1
	(b)	(i)	AB (1)	
		(ii)	BC (1)	2
	(c)	(i)	Average wavelength = $\frac{240}{8}$ / 30 [cm] (subst or ans)	1
			[N.B. $\frac{8}{240} = 30 \rightarrow 0$]	
		(ii)	[wavespeed = 10 × 30 [e.c.f.]] 300 [cm/s] (answer) [Accept 3 m/s – only if m/s written in]	1
				5
2.	*(a)*		Scotland	1
	(b)		Any 2 × (1) from • Larger wind turbines can be built ✓ • It is windier at sea than on land [strength or consistency] ✓ • Larger wind turbines are more efficient ✓ • Larger area available / can build more ✓	2
	(c)		Mean power = $\frac{810}{18}$ (1) [or by impl.] = 45 [MW] (1)	2
	(d)		Any 2 × (1) • Destruction of habitat / environment ✓ • Unsightly / would affect property values / deter tourism ✓ • Danger to shipping /mariners ✓	2
				7

Higher Tier			Answer / Explanatory Notes	Marks Available
3.	*(a)*	(i)	Refraction [or refract / refracted]	1
		(ii)	Accept: change in medium [however expressed] / density / [wave]speed [Accept: it strikes the glass at an angle.]	1
	(b)		**Total internal reflection** [accept TIR]	1
	(c)	(i)	The angle [of incidence] is less/smaller than the critical angle [for glass and air]. [Accept the angle is less/smaller than a specified angle which should be between 42° and 45°]	1
		(ii)	Emergent ray drawn in the correct quadrant [arrow not required] showing refraction away from the normal. [N.B. Not accept a ray drawn along boundary.]	1
	(d)	(i)	Infra red	1
		(ii)	Any 2 × (1) of: • less interference ✓ • less boosting ✓ • more signals carried/more data ✓ • difficult to tap into/security ✓	2
		(iii)	Time = $\frac{\text{distance}}{\text{speed}}$ (equation) Time = $\frac{4.8\times10^{7}}{2\times10^{8}}$ (1 – subs) = 0.24 (1) s (1 – unit) [N.B. Unit mark available even with incorrect working.]	1 3
				12
4.	*(a)*		Gravity pulls dust and hydrogen gas (1) together until the core gets so hot / pressure gets so big/ atoms move so fast towards each other [in the core] (1) to produce fusion of hydrogen (1) [N.B. Hydrogen required at least once for 3 marks.]	3
	(b)		• Red shift / lines move to red end of spectrum / wavelength increased (1) • Because galaxies [accept: stars] are moving away from us (1) • More distant galaxies show bigger red shift / are moving away faster (1) • [Time taken backwards implies that the] universe started at one point (1)	4
				7

Higher Tier			Answer / Explanatory Notes	Marks Available
5.	*(a)*	(i)	Much bigger R value [than free air] [Accept: big R value]	1
		(ii)	0.32	1
	(b)	(i)	$\frac{300 \times 25(1)}{6} = 1250$ [W] (1 – ans)	2
		(ii)	• $\div 1000$ (1) • $\times 24$ (1) • $\times 12$ (1) • Units (1)	4
		(iii)	Smaller outside wall area [or equiv.]	1
	(c)	(i)	thickness $= \frac{7.2}{2.4} \times 10$ cm /30 cm (1 – calc or ans)	1
		(ii)	(fibre glass) reduces <u>conduction</u> through the ceiling/ into the attic (1). This reduces <u>convection</u> in the attic space (1)	2
				12
6.	*(a)*	(i)	[%] Efficiency $= \frac{\text{Useful power transfer}}{\text{total power input}} \times 100$	1
		(ii)	[accept: in terms of energy] $34.3 = \frac{1200}{\text{total power input}} \times 100$ (1 – subst) total power input $= \frac{1200 \times 100}{34.3}$ (1 manip or in words) = 3498.5 or 3500 (Ans 1)	3
	(b)		• Division by 10 [at any stage] (1) • Conversion to consistent units [e.g. MW→W] (1) • Calculation using correct figures (1) [Expected answer = 272.7A]	3
				7

PHYSICS 2

Foundation Tier			Answer / Explanatory Notes	Marks Available
1.	*(a)*	(i)	A	
		(ii)	blue	
		(iii)	Insulation / to prevent short circuits / prevent shocks [Not protect wires or just safety, or prevent fire]	3
	(b)		[B –] D – A – C – E	
			[All correct → 3; 2 correct → 2; 1 correct → 1; 4 of same letter → 0]	**3**
				6
2.	*(a)*		Alter variable resistor / change resistance (1)	
			Change the voltage / power supply (1)	
			Not: add another resistor or battery	2
	(b)	(i)	6[.0] [V]	1
		(ii)	1[.0] A read from graph [or by impl.] (1)	
			answer of 2[.0] [Ω] (1) No e.c.f ½ = 2→ 1st mark only	2
		(iii)	Power = 6 × 2 (1 – subst) [or by impl.] = 12 [W] (1 – ans)	2
				7
3.	*(a)*	(i)	40 000 J indicated (1)	
		(ii)	80 000 J indicated (1)	2
	(b)	(i)	[Work done against] friction / air resistance / drag [Accept: Energy converted to heat]	1
		(ii)	Force = $\frac{80000}{40}$ (1 – subs e.c.f from (a) (ii)) [or by impl.] = 2 000 [N] (1 – ans)	2
			NB: $\frac{40}{80000} = 2000 \rightarrow 0$	
				5
4	*(a)*	(i)	air resistance (1)	
		(ii)	gravity (1)	
		(iii)	increases (1)	
		(iv)	stays the same (1)	4
	(b)		Constant speed [or equiv.] / steady pace	1
	(c)		Resultant force = 70 × 5 (1 – subs) [or by impl.] = 350 [N] (1 ans)	2
				7

Foundation tier			Answer / Explanatory Notes	Marks Available
5.	*(a)*	(i)	6 [hours]	1
		(ii)	6 [hours]	1
		(iii)	12 [hours]	1
	(b)		Alpha is absorbed easily / would not be detected outside the body.(1) It is highly ionising / causes damage to [DNA] in <u>cells</u> / tissues/organs [Not body].(1)	2
				7
6.	*(a)*	(i)	362[millirem] in the table	1
		(ii)	Radon	1
		(iii)	53 [millirem]	1
	(b)	(i)	Reference to less cosmic [rays] / atmosphere absorbs cosmic rays [or by implication, e.g. at sea level cosmic rays have to go through more air]	1
		(ii)	[under-floor] ventilation [however described] / seal floors	1
				5
7.		(i)	0.6 s	1
		(ii)	distance = 25 × 0.6 e.c.f (1 – subst) [or by impl.] = 15 [m] (1 – ans)	2
		(iii)	Use of 4.2 s [e.c.f from (i)](1) Answer (1) [Accept: $\frac{25}{4.2} = 5.95, 6.0, 6$]	2
				5
8.	*(a)*	(i)	Reading only affected by lead [or equiv.]	1
		(ii)	Any 2 from: • Reading is affected by paper, <u>so it emits alpha</u> (✓) • Reading not [further] affected by aluminium, <u>so there is no beta</u> (✓) • Some radiation penetrates 4 mm of aluminium <u>so there is gamma</u> (✓)	2
	(b)	(i)	gamma / it can penetrate the crate / box / packaging /food [accept converse reasoning, i.e. that alpha and / or beta cannot penetrate …]	1
		(ii)	To absorb gamma radiation (1) to protect workers (1) [Accept radiation poisoning]	2
				6

Foundation tier			Answer / Explanatory Notes	Marks Available
9.		(i)	To complete the circuit [of the live wire and electrical device] / returns circuit / lets current return.	1
		(ii)	Any 2 × (1) from • mcb's are quicker acting ✓ • mcb's are more sensitive ✓ • mcb's can be reset ✓ [Accept converse]	2
		(iii)	Too much current [accept a specified fault which would result in too much current]	1
				4

Higher tier			Answer / Explanatory Notes	Marks Available
1.		(i)	0.6 s	1
		(ii)	distance = 25 × 0.6 (1 – subst) [or by impl.] = 15 [m] (1 – ans)	2
		(iii)	[52.5 + 15 [e.c.f. =] 67.5 m	1
		(iv)	4.2 [s]	1
		(v)	Use of 4.2 s [e.c.f from (iv)](1) Answer (1) [Accept: $\frac{25}{4.2} = 5.95, 6.0, 6$]	2
		(vi)	Manipulation (1); subs /ans: 1200 × 5.95 [e.c.f.] = 7140 [N](1) [Ignore – sign]	2
				9
2.	*(a)*	(i)	Reading only affected by lead [or equiv.]	1
		(ii)	Any 2 from: • Reading is affected by paper, <u>so it emits alpha</u> (✓) • Reading not [further] affected by aluminium, <u>so there is no beta</u> (✓) • Some radiation penetrates 4 mm of aluminium <u>so there is gamma</u> (✓)	2
	(b)	(i)	gamma / it can penetrate the crate / box / packaging /food [accept converse reasoning, i.e. that alpha and / or beta cannot penetrate …]	1
		(ii)	To absorb gamma radiation (1) to protect workers (1) [Accept radiation poisoning]	2
		(iii)	Any reasonable answer, e.g. vary the speed of the conveyor belt, send same item through more than once replace the gamma source with one of different strength	1
	(c)	(i)	idea of testing food on animals [or humans] (1) and comparing the effects of irradiated food and non-irradiated food / showing that there are no [observed] ill effects / monitor their health (1) Measure radiation (1) ; radiation level not above background or equiv (1)	2
		(ii)	So people can make a [n informed] decision about eating or not eating treated food / eating irradiated food may be against their religious or moral views.	1
				10

Higher tier			Answer / Explanatory Notes	Marks Available
3.	*(a)*	(i)	To complete the circuit [of the live wire and electrical device] / returns circuit / lets current return.	1
		(ii)	Any 2 × (1) from • mcb's are quicker acting ✓ • mcb's are more sensitive ✓ • mcb's can be reset ✓ [Accept converse]	2
		(iii)	Too much current [accept a specified fault which would result in too much current]	1
	(b)		Fault causing leakage to earth (1) … … producing a [big] increase in current (1)… …the fuse [melts and] breaks the circuit. (1)	**3** **7**
4.	*(a)*		Imbalance in numbers of particles (1); protons and neutrons specified (1) accept: different number (1) of protons and neutrons (1) "Electrons" = s.i.f → 0	2
	(b)		Any 2 from • Alpha particles easily absorbed [by cancer cells / other tissues] highly ionising ✓ • …. so would not penetrate to tumour if not placed within [or must be directly in tumour, not in a case which would absorb the alpha particles] ✓ • surrounding healthy cells / tissue would not be harmed if the At-211 were inside the tumour ✓	2
	(c)	(i)	*It takes 7.2 hours [* ***or*** *this is the time taken]* for the activity / count rate / number of astatine[-211] nuclei *to halve* Italicised words [or equiv.] (1) Non-italicised words [or equiv.] (1)	2
		(ii)	36 hours = 5 half-lives [or by impl.](1) Fraction remaining = $\frac{1}{32}$ (1)	2 **8**

Higher tier			Answer / Explanatory Notes	Marks Available
5.	*(a)*	(i)	[Varying resistance] alters the [total] resistance of the circuit (1) leading to a varying current / a varying voltage [across the diode] (1)	2
	(b)	(i)	Answer in range 0.59 – 0.63 V	1
		(ii)	Current reading at 0.7 V in range 0.11 – 0.12 A (1) [Resistance = $\frac{0.7}{0.11 \rightarrow 0.12}$ =] 5.8 – 6.4 [Ω] (1)	2
	(c)	(i)	Current reduced [to very small value / nearly 0 / 0.001 – 0.002 A]	1
		(ii)	Resistance increased (1) to a very high value / a figure of several hundred ohms (1) [or allow matching pair of results, eg, $\frac{0.63}{0.01}$ or $\frac{0.6}{0}$ but $\frac{0.6}{0} = 0$ sif]	2
				8
6.	*(a)*	(i)	Equation: Kinetic energy = $\frac{\text{mass} \times \text{speed}^2}{2}$ or $\frac{1}{2}mv^2$	1
			Substitution: $75000 = \frac{1}{2} \times 60 \times v^2$ (1)	
			Speed = 50 m/s (1)	2
		(ii)	Friction[al force] / air resistance / drag (1) means some PE converted to heat / sound (1) [rather than KE] [**OR** Friction[al force] / air resistance / drag opposes motion (1), [so the resultant force is less] so the acceleration is less (1).]	2
	(b)		Initial KE [= ½ × 60 × 30^2] = 27 000 J (1) [or by impl.]	
			Manip / subst: Force = $\frac{27000}{20}$ (e.c.f) (1) [or by impl.] = 1350 N (1 – ans)	
			N.B. Use of 75000J: 2nd (manipulates) mark available.	3
				7

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