WJEC
CBAC

MS4
£4.00

GCSE MARKING SCHEME

SCIENCE – PHYSICS

SUMMER 2009

INTRODUCTION

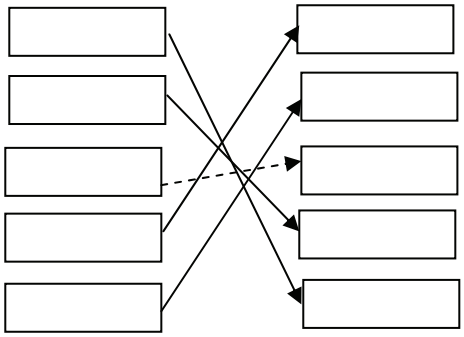
The marking schemes which follow were those used by WJEC for the Summer 2009 examination in GCSE SCIENCE – PHYSICS. They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so 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.

	Page
P1	1
P2	7
P3	12

P1

Question **F** **H**		Details	Mark Available
1.	(i)	matt black (1)	
	(ii)	silvery (1)	
	(iii)	matt black (1)	3
			3
2. (a)		Wasted energy = 3000 – 900 = 2100 [J] [subs or ans]	1
(b)		Efficiency $= \frac{900}{3000} \times 100$ (subs) (1)	
		= 30 % (ans) (1)	2
			3
3.		 3 correct arrows (3 × 1) Only 1 arrow per box allowed. (1 mark per arrow)	3
			3
4. (a)	(i)	coal – accept 28 [MJ]	1
	(ii)	more MJ / energy per £1 cost [or for the same price]	1
(b)	(i)	12 × 20 **or** 240 p (1) [accept £2.40 – must have £ sign]	
	(ii)	12 × 28 **or** 216 [MJ] (1)	2
			4

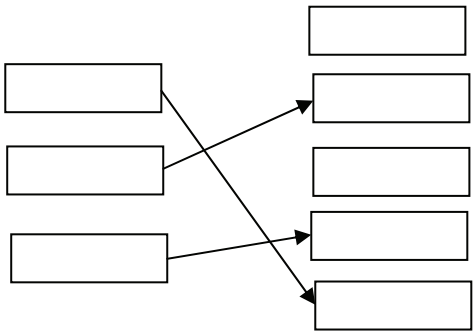
Question F	Question H		Details	Mark Available
5.	(a)	(i)	Step up / increase voltage [for transmission] (1) [or reduce current] Not: Increase the electricity	
		(ii)	At power station / between power station and grid (1)	2
	(b)		Easy to respond to demand / lack of demand (1) Maintain supply when during breakdowns or maintenance (1) [accept: ensure reliability]	2
				4
6.	(a)	(i)	….. is passing into a more dense medium. (1)	
		(ii)	….. hits at an angle greater than the critical angle (1)	
		(iii)	……is passing into a less dense medium **or** ….. hits at angle less than the critical angle (1)	3
	(b)		Improves rate [accept speed] of data transfer or signal quality / carries more signals / better signal [quality] / low interference / fewer boosters needed / cannot be tapped	1
				4
7.		(i)	0.2 [Hz]	1
		(ii)	wave speed = 0.2 e.c.f. × 40 = 8 (subst or ans)	1
		(iii)	time = $\frac{5600}{8}$ = 700 [s] (ans) e.c.f.	1
		(iv)	…10 [m] (1) ……1400 [s] [accept $\frac{5600}{4}$ in gap](1) – **no** e.c.f.	2
				5
8.	(a)	(i)	100 – 15 – 35 – 25 – 10 = 15 % (ans) (1)	
		(ii)	Named floor coverings / carpet (1) [accept: insulation]	
		(iii)	Good insulators / poor conductors (1) [**not** harder for heat to escape]. [If insulation credited in (ii) must explain why it insulates]	3
	(b)		• Greatest % heat loss is through both roof and floor ✓ • Cost of insulation much smaller [than double glazing] ✓ • Shorter payback time. ✓ } Any 2 × (1)	2
				5

Question **F** **H**		Details	Mark Available
9. 1. (a)		7340 – 6840 = 500 [kWh] (ans)	1
(b)		Cost per unit = $\frac{\text{Cost}}{\text{units used}}$ [must be full equation] [accept alternative form of the equation]	1
		Cost per kWh = $\frac{45}{500}$ e.c.f.(subst) (1) [or by impl.]= £ 0.09 = 9 [p] (ans in p) (1) [N.B. 0.09 anywhere → 1 mark]	2
(c)		Any action that would reduce electricity usage, e.g. low power bulbs, boil partly filled kettle, turn off when not in use, not stand by or any micro-generation. [**Not** "insulate the house" unless electrical central heating specified.]	1
			5
10. 2 (a)		Venus has a thick / CO_2 atmosphere / atmosphere keeps heat in [mentioning volcanoes – s.i.f.].	1
(b)		Anything between –25 °C and –120 °C	1
(c)		• Appropriate surface temperature [accept 20 °C] ✓ Accept some planets to warm **and** some too cold] • Oxygen atmosphere ✓ • Solid rock surface ✓ } Any 2 × (1) [**Not** "water" or "gravity" as these are not in the table]	2
(d)	(i)	Lowest temperature (1)	
	(ii)	appears more like the inner planets / not like the outer 4 planets (1) [Accept: it's rocky / frozen water]	2
			6

Question **F** **H**		Details	Mark Available
11. 3. (a) [F-only]	(i) (ii)	electromagnetic (1) uv, X or γ (1)	2/-
(b) [F-only]		Study involves small numbers (1) Study not replicated (1) ["Study not conclusive" → 1 mark but only by itself]	2/-
(c)/(a)		• used by emergency services • Uses more powerful microwaves • Private system } Any 2 × (1)	2
(d)/(b)		Local authorities are the approving authority / must give approval for all installations / regulatory / give approval	1
(e)/(c)		Tetra uses more powerful signals (✓) [which might have a greater effect on people that existing mobiles] / <u>more</u> cell damage / <u>more</u> likely to have a bad effect.	1
			8/4
4. (a)	(i)	Conduction	1
	(ii)	Air gap [trapped air] is poor conductor / good insulator [Accept "air insulates"]	1
(b)	(i)	Rate loss decreases as gap size increases [however expressed] (1), non-linearly / the effect decreases as the gap becomes larger (1)	2
	(ii)	Reasonable extrapolation shown to vertical axis (1) 106 – 108 [W/m^2] (1) [NB scale read correctly]	2
	(iii)	Gap > 20 mm produces only small savings [and is not worth the extra manufacturing / installation costs]	1
(c)	(i)	60 [W/m^2] (from graph) identified (1) Heat loss rate = 60 × 30 **or** 1800 W (1)	2
	(ii)	Energy transferred = Power × time Energy transferred = 1800 × 60 × 60 = 6.48 × 10^6 [J] / 6.48 M[J] / 6 480 000 [J] Use of 1800 e.c.f. (1) × 60 × 60 (1) [or answer]	1 2
			12

Question **F** **H**		Details	Mark Available
5. (a)		time $= \frac{\text{distance}}{\text{speed}}$	1
		time $= \frac{3.6\times10^4}{3\times10^8}$ (1) × 2 (1) × 1000 (1) (subst.) [= 0.24 s]	3
(b)	(i)	Distance is very much shorter	1
	(ii)	• Less interference ✓ • Less energy loss ✓ • Less costly than satellite in orbit ✓ } Any 2 × (1) [Allow multiple signal channels / more information] [Allow comparisons with copper conductors e.g. security / interference / boosting distance / easier to maintain]	2
			7
6. (a)		Efficiency $= \frac{\text{useful power output}}{\text{total power input}} \times 100$ [No penalty for energy equation]	1
		$20 = \frac{\text{power output}}{6000} \times 100$ (subst. or manip)(1)[or 20% of 6000] Output power = 1200 [W] (ans) (1)	2
(b)		Number of kWh $= \frac{1200}{1000} \times 10$ ÷ 1000 (1); × 10 (1) = 12 [kWh]	2
(c)		Any 3 × (1) valid points, e.g. • Low efficiency of panels ✓ • High capital cost / long payback time ✓ • Low likelihood of producing daily needs ✓ • ..therefore backup supply needed ✓ [N.B. full e,c,f on incorrect answers in (b)]	3
			8

Question **F** **H**		Details	Mark Available
7. (a)	(i)	Hotter / larger / brighter / colour (1)	
	(ii)	stable / balanced forces / fusing hydrogen / main sequence (1)	2
(b)	(i)	• Hydrogen used up ✓ • Helium fusion starts ✓ • forces become unbalanced / radiation [or pressure] force becomes greater than gravity ✓ } Any 2 × (1)	
	(ii)	Any **two** from: brighter / larger / cooler / redder (1)	3
(c)	(i) & (ii)	• Outer layers blown away / shed ✓ • Nuclear fusion ceases / runs out of energy ✓ • Gravity compresses star / outward force becomes small [to White dwarf] ✓ } Any 2 × (1) Star becomes • Dimmer ["brighter" – s.i.f.] ✓ • hotter ✓ • smaller ✓ } Any **2** → (1)	3
			8

Question **F** **H**		Details	Mark Available
1.		 Each correct arrow (1) Each additional arrow −1	3 **3**
2. (a)		14 (1) 36 (1)	2
(b)	(i)	credit answers in space below. four times – accept circled answer.	1
	(ii)	doubles, increases NO, increases by 2 NO, increases by × 2 YES.	1 **4**
3.		Sequence: [D→] A → B → C → E 3 boxes correct →(3); 2 correct → (2); 1 correct →(1) repeated letter -1	3 **3**
4. (a)		54 Answer on line, space or table	1
(b)	(i)	Either 2 × 4.5 or 4 × 0.5 (1), 11 [A] (1) (answer) [**Or** Total Power = 132W, current = 11 A (1) (answer)]	2
	(ii)	15 (A) e.c.f. Answer must agree with (b) (i) e.g. 4A in (b) (i) gives 5A (answer)	1 **4**

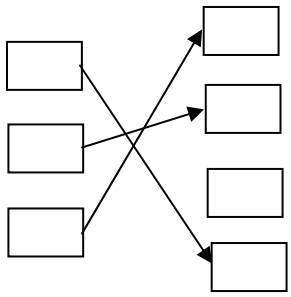
Question F H			Details	Mark Available
5.	(a)		Cosmic	1
	(b)		Radon gas	1
	(c)		Radon gas / ground and buildings <u>not</u> cosmic rays	1
	(d)		14.5 %	1
	(e)		<u>Only</u> 0.5 % from nuclear power [or similar] accept very small (%) or implied	1 **5**
6.	(a)		$\frac{50000}{2500}$ (1) = 20 [m] (1)	2
	(b)		<u>energy</u> (1); <u>stopping force</u> (1) [or circle] extra answer -1	2 **4**
7.		(i)	fuse (1) [extra answer -1]	
		(ii)	rcd or mcb (1)	
		(iii)	mcb (1)	
		(iv)	rcd (1); plastic covering (1)	5 **5**
8.	(a)	(i)	Higher voltage [in the UK] accept more voltage	1
		(ii)	lower power [hair dryer in the USA] [<u>not</u> Wattage, <u>not</u> low] accept less heat <u>per second</u>	1
	(b)		Japan's	1 **3**
9.	(a)		1 (thin) card ✓ 2 Aluminium ✓ 3 Lead ✓ 2 or 3 correct → (2) 1 correct → (1)	2
	(b)		1 precaution relating to: • Screen ✓ • time limit / radiation badge ✓ • breathing apparatus / ventilation ✓ • increasing separation [e.g. tongs] ✓ Any 2 × (1) N.B. No marks for clothing-related answers / <u>not</u> food and drink, <u>not</u> regular health-checks, <u>not</u> don't touch or handle	2 **4**

Question **F** **H**		Details	Mark Available
10. 1 (a)	(i)	• Alpha particles [accept radiation] are (very / most) ionising or damages cells (1) • gas breathed into our bodies (1) • or α [accept radiation] - trapped inside our bodies (1) (any 2)	2
H- only	(ii)	seal cracks (in the floor) (1) Ventilate the house / under the floor cavity (1) Accept - extractor fan	0/2
(b)	(i)	0.2 %	1
	(ii)	130 [Bq/m^2]	1
			4/6
11. 2. (a)	(i)	Y	1
	(ii)	I. X / variable resistor II. Increase the resistance / increase the value of X not put an extra resistor in	1 1
(b)	(i)	Resistance = $\frac{12}{1.5}$ (1) = 8 [Ω] (1)	2
	(ii)	2 – 2.6 [V]	1
			6
12 3. (a)		Acceleration = $\frac{\text{change in speed}}{\text{time}}$ [accept in symbols]	1
		Acceleration = $\frac{80}{2.5}$ (1) = 32 [m/s^2] (1)	2
(b)		Distance = 42.5 × 4.0 (1 – for retrieving 4.0 from graph) = 170 [m] (1)	2
H-only (c)		deceleration = $\frac{40}{0.5}$ (1) = 80 [m/s^2] (1) [ignore sign] Force = 400 × 80 e.c.f. (1) = 32 000 [N] (1) [400 (80 – 40) = 16 000 → 1] Or $\frac{80}{0.5}$ × 400	4
H-only (d)		The acceleration is zero / constant speed / forces balanced not terminal speed	1
			10

Question F H		Details	Mark Available
4. (a)		Power = current × voltage	1
		1500 = current × 230; current = $\frac{1500}{230}$ (1 – subst or manip.)	
		Current = 6.5(2) [A] (1) [N.B. 6.5217A]	2
(b)		35.3 = $\frac{110}{\text{current}}$; current = $\frac{110}{35.3}$ (1 – subst or manip.)	
		Current = 3.1 [A] (1) [3.116 A]	2
		Power = 110 × 3.1 = 341 [W] (ans) (e.c.f.) 341, 343.2, 342.8)	1
(c)		Power would be too big / element would burn out / current or power too big (<u>not</u> strong) / overheating	1
(d)	(i)	Smaller risk of death when getting an electric shock	1
	(ii)	Bigger current flows [for the same power] Accept - to have a lower resistance Not – more electricity flows	1
			9
5. (a)		the <u>time</u> taken (1) for the activity [or equiv.] to fall by half (1) [or no. of r / a atoms / nuclei or mass]	2
(b)		Its nuclei are stable whilst others are unstable [accept atoms] Imbalance between n + p in other nuclei	1
(c)		[Na-24 identified because] • beta can be detected outside the body (1) • it has a suitable half life (1) – must interact with half-life	2
(d)	(i)	[Low level] radiation around us all the time [or equiv.]	1
	(ii)	Subtraction of background from initial and final count [to give 720 and 90] (1) 720 to 90 = 3 half lives (1) 3 × 2.6 = 7.8 (years) (1)	3
			9

Question F	Question H	Details	Mark Available
6. (a)		Grav potential energy = $m\ g\ h$ [or in words]	1
		g.p.e. = 80 × 10 × 8 (1) = 6 400 [J] (1)	2
(b)		KE = $\frac{1}{2}mv^2$ or $\frac{mv^2}{2}$ or in words	1
		$1960 = \frac{1}{2} \times 80 \times v^2$ $v = \sqrt{\frac{1960}{40}}$ or equiv. (1 – subst or manip) or $v^2 = \frac{1960}{40}$ = 7 [m/s] (1)	2
(c)	(i)	Work done = 6400 – 1960 = 4440 [J] (ans) (1) e.c.f. from (a)	
	(ii)	4440 = Force × 160 Friction = $\frac{4440}{160}$ } subst / manip (1) e.c.f. = 27.75 [N] (1)	2
(d)		It does not have enough energy to do the work against friction in this distance [or equiv.] (e.c.f) or examples: Distance travelled with this frictional force = 70 m [so won't travel 160 m] Frictional force needed to stop in 160 m = 12.25 N So Frictional force too much	1
			6

Question **F** **H**		Details	Mark Available
1.	(i)	Protons, electrons	2
	(ii)	Nucleus	1
	(iii)	Neutrons	1
			4
2. (a)	(i)	Y [accept 9]	1
	(ii)	4 [s]	1
(b)		$\frac{27(1)}{9(1)}$ [=3 m/s^2] [NB No credit for $\frac{9}{27} = 3\,\text{m/s}^2$]	2
			4
3. (a)	(i)	Plots (2) [−1 for each mistake]	
		Line (1) [origin not necessarily included]	3
	(ii)	15	1
	(iii)	15	1
	(iv)	Straight line [through origin] / double one the other doubles	1
(b)		Field [or current or voltage] not changing	1
			7
4. (a)	(i)	Current	1
	(ii)	Magnetic field	1
(b)	(i)	Move further to the left	1
	(ii)	To the right	1
	(iii)	No deflection [accept "nothing"]	1
		assume that changes start from 0 in all cases	**5**

Question **F** **H**		Details	Mark Available
5. (a)		$\frac{1500}{15}$ (subs, 1) = 100 [s] (1)	2
(b)	(i)	Car 1	1
	(ii)	Only took 80 [s] [or took less than 100 s]/ mean speed was more than 15 [m/s] [steepest **not** accepted]	1
(c)		Travelling in opposite directions	1
			5
6.	(i)	$^{4}_{2}\alpha$	1
	(ii)	 3 × (1)	3
			4
7.	(i)	700 × 25 (1 – subs) = 17500 (1 – ans)	2
	(ii)	Air bag (1) crumple zone / seat belt [not collapsing steering column](1)	2
			4
8. 1.	(i)	Line with arrow shown at correct angle [angle clearly < 90° to original direction]	1
	(ii)	Waves drawn at right angle to the wave direction (1) with the same wavelength as the incident waves (1) [< 4 waves → –1] [Waves penetrating barrier instead of reflecting or "reflecting" from the normal → 0]	2
			3

Question **F** **H**		Details	Mark Available
9. 3. (a)	(i)	Fusion – atoms / nuclei join together (1) Fission – atoms / nuclei split (1) ["particles" → 1 max]	2
	(ii)	[Raw material] not radioactive (1) No [high-level] radioactive waste (1) [Accept "no mining"]	2
	(iii)	Found in sea water	1
(b)	(i)	Helium (1) and a neutron (1)	2
	(ii)	High temperature to overcome repulsion; high pressure to squeeze atoms for fusing (1) Containment problem (1) [NB Just High T and p → 0]	2
			9
10. 2. (a)	(i)	P-waves are longitudinal; S-waves are transverse and (1) P-waves can travel through liquids; S-waves can only travel in solids [accept: water](1)	2
	(ii)	Vibrations are perpendicular to the direction of travel in transverse waves and parallel in longitudinal [accept vibrations in different direction to the waves] [Correct reference to transmission medium can be credited in (i) if not already done so]	1
[F only] (b)	(i)	Faster	1/-
	(ii)	Distance from the [focus / epicentre of] earthquake [accept: location of earthquake]	1/-
[H only] (b)	(i)	P waves travel faster than S waves	-/1
	(ii)	Further distance of B	-/1
	(iii)	Lag = 71 s (1); 852 [km] (1) [NB e.c.f. from time for 2nd mark]	-/2
[H only] (c)		Liquid core which S waves do not pass through (1) • Refraction [shown] / change in speed✓ • through layers of different density / stiffness ✓ • .. of a solid mantle ✓ } Any 2 × (1)	-/3
			5/10

Question **F** **H**		Details	Mark Available
4. (a)		$a = \frac{v-u}{t}$ (1) $\frac{27-0}{6}$ (1) = 4.5 (1) m/s^2 (1)	4
(b)		$x = \frac{u+v}{2}t$ (1) [or average speed = $\frac{\text{distance}}{\text{time}}$] $\frac{0+27}{2} \times 8$ (1) = 108 [m] (1)	3 **7**
5.	(i)	[A –] straight through, so [atom is] mostly empty space (1) [B –] repelled, so [nucleus] must be +ve (1) [C –] rebounds from small central [massive] nucleus (1) [NB "Nucleus" must be mentioned at least once for both 2nd and 3rd marks to be awarded; "empty space" and "small positive nucleus" → 1 only]	3
	(ii)	Energy levels explained or shown [or 2 or more shells] (1) Electron transition downwards / to lower level (1) Emit e-m radiation (1) [only awarded if 2nd mark also given]	3 **6**
6. (a)		• Changing field [not I or V] through primary ✓ • …linked through the iron core..✓ • …passes through secondary …✓ } Any 3 × (1) [NB 2nd and 3rd marks can be awarded even if I or V stated]	3
(b)	(ii)	Equations: $\frac{V_1}{V_2} = \frac{N_1}{N_2}$ [or equiv.] (1) Substitution (1) [ratio 20 or 1/20 seen] Answer 800 [turns] (1)	3 **6**

Question F	H		Details	Mark Available
7.	(a)		50 [km/s] or 50 000 m/s	1
	(b)	(i)	Substitution (1) [or by impl.] 1.25×10^{11} (1)	2
		(ii)	Space probe gains energy from planet (1); planet loses an equal amount [or energy] (1) ["space probe gains energy from planet" → 2 marks as equality implied]	2
	(c)	(i)	[centripetal] force <u>towards centre</u> of planet / planet's gravitational <u>pull</u>.	1
		(ii)	5 000 000 or 2 000 000 (1) sign / direction (1) Difference (1) [3 000 000 by itself → 1 mark 3 000 000 from calculation of 5 000 000 & 2 000 000 → 2 7 000 000 by itself → 3 marks]	3
				9

WJEC
245 Western Avenue
Cardiff CF5 2YX
Tel No 029 2026 5000
Fax 029 2057 5994
E-mail: exams@wjec.co.uk
website: www.wjec.co.uk/exams.html