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GENERAL CERTIFICATE OF SECONDARY EDUCATION
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MARKING SCHEMES

SCIENCE - PHYSICS
GCSE Units P1, P2 and P3

SUMMER 2008

INTRODUCTION

The marking schemes which follow were those used by WJEC for the Summer 2008 examination in GCSE 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.

PHYSICS 1

F H		Answer / Explanatory Notes	Marks Available
1. (a)		Oval/ellipse **NOT** arc, egg shape, rugby ball, eclipse. IGNORE neutral extras.	1
(b)		Speeding up **NOT** going faster/quicker	1
(c)	(i)	moons (1)	
	(ii)	stars (1)	
	(iii)	stars / red giant (1) **NOT** galaxies	3
			5
2. (a)(i)		2	1
(ii)		40 [cm] No ecf from (i)	1
(iii)		10 [cm] ignore - sign	1
(b)		160 [subs 1] 4(Hz) [ans 1] could award (2) ecf for ans only of 8m/s 40 ecf	2
			5
3.		Box 2 [1] Box 3 [1] Box 5 [1] Box 6 [1] (any 3 x 1) 4 ticks max 2; 5 ticks max 1; 6 ticks 0.	3 **3**
4. (a)	(i)	Loft [with no insulation]	1
	(ii)	Fibre glass (insulation) / loft insulation **NOT** loft	1
(b)	(i)	54 + 4 [kJ] (1) = 58 [kJ] (1)	2
	(ii)	54 − 10 / = 44 subs/ans (1)	1
			5
5.		**Advantages of nuclear** Don't give out greenhouse gases / no air pollution Produce energy [for long periods] without needing refuelling Reliable if qualified / produce lots of energy if qualified } Any 1 (1) **Disadvantage of nuclear** Expensive to build [or equiv.] / problems with decommissioning / rad waste problems / non-renewable/risk of terrorist attack/danger of explosion (1) **Advantage of wind farms** Don't use fuel / renewable / no air pollution (1) **Disadvantage of wind farms** Built in wilderness [or equiv.] Only operate when windy Only produce small amount of electricity [or equiv.] Unreliable if qualified Unsightly NOT noisy } Any 1 (1)	4 **4**

F H			Answer / Explanatory Notes	Marks Available
6.	(a)	(i)	Mercury	1
		(ii)	A	1
		(iii)	D	1
		(iv)	A	1
	(b)		Any number x such that $3000 < x < 4900$ **NOT** 4900	1
				5
7.	(a)	(i)	(UV)A	1
		(ii)	(UV)C	1
	(b)		Tick (✓) in the correct place to the immediate right of visible	1
	(c)		X-rays or gamma	1
				4
8.	(a)	(i)	radiation	1
		(ii)	convection	1
	(b)	(i)	Units = 70 (mark for ans – ignore units)	1
		(ii)	Cost = 70(ecf) x 10 or £7 or 700p for 1 mark (70 x 10 = £700 would get the mark)	1
				4
9. 2.	(a)		renewable / no air polluting / instant start up / no fuel costs / no use of fossil fuels	1
	(b)	(i)	National park / area of outstanding natural beauty / not unsightly NOT safety or protect cables	1
[redacted]		(ii)	Changes the voltage, volts, current or amps (1), [to] reduce energy losses (1)	2
		(iii)	Power = voltage × current	[1]
			Power = 110 000 × 2 000 = 220 000 000 [W] (ans) (1)	[1]
	(c)	(i)	I. accept any time between 7 to 9 a.m.	1
			II. People making some domestic use of electricity	1
		(ii)	Other power stations produce more than is needed / low demand at night	1
				7 / 9

F H		Answer / Explanatory Notes	Marks Available
10. 1. (a)	(i)	total internal reflection / TIR	1
	(ii)	greater than critical angle [or 42 - 45°] (1)	1
(b)		less dense	1
(c)		correct direction – deviates away from the normal	1
[redacted] (d)		Any 2 × (1)from: Increased data transfer [or number of signals carried] / less interference or cross-talk / more difficult to tap / cheaper (to produce glass fibres) / less boosting / easier installation / smaller / lighter etc. NOT faster.	[2]
			4 / 6
11. 3. (a)		$\text{Efficiency} = \frac{\text{Useful energy transfer}}{\text{Total energy input}} \times 100\%$ (Must include subject)	1
		$\text{Efficiency} = \frac{24\,000}{30\,000}(\times 100)(1\,\text{subst}) = 80\%(1)$	2
(b)	(i)	(Plastic) is a good insulator [or equiv.]	1
[redacted]	(ii)	[Higher only] Convection	[1]
[redacted] (c)		[Higher only] more heat supplied to it [or equiv.]	[1]
			4 / 6
4 (a)	(i)	(61 300 – 17 460) (1) + (47 580 – 14 220) (1) = 77 200 (answer appearing on its own earns 2)	2
	(ii)	$\frac{77\,200}{60(1)} = 1286.7\ \text{W} = \frac{1286.7}{1000\,(1)}(\text{kW})$ wrong input data/60 then /1000 (1)	2
(b)	(i)	Units saved = 1.15 × 12 (1) × 7 (1) = 96.6 Money saved = 96.6 × 8 (1) **or** 772.8 p (1 – unit)	4
	(ii)	$\frac{£1500}{£7.728} = 194.1\,\text{weeks}$ [e.c.f.] (subs 1)	1
(c)	(iii)	Reduction in greenhouse effect / CO_2 emissions **or** Reduction in SO_X emissions / acid rain	1
			10

F H		Answer / Explanatory Notes	Marks Available
5 (a)		wavelength = wave speed/frequency	1
		wavelength $= \frac{3\times10^{8}}{5\times10^{14}}$ (1) [subst]= 0.6×10^{-6} [m] (1)	2
(b)	(i)	The light travels further / galaxies further away	1
	(ii)	The light is moved towards the red end of the spectrum / wavelength stretched	1
	(iii)	(Galaxies) moving away from us / each other (1) Universe is expanding / started at some point with a big bang (1)	2
			7
6		Any 3 × (1) reasoned points from: Day to day safety Risk of terrorist attack Cost of decommissioning Problems with decommissioning the site Danger of explosion Danger from radioactive waste Any 3 × (1) reasoned points from: Dirty Carbon dioxide effect Sulphur dioxide effect Respiratory problems of neighbours Transport of coal	**6**
7 (a)		Sun has to be millions of years old [too] (1) Chemical energy would only power the Sun for a few thousand years (1)	2
(b)		Its atoms / Hydrogen (1) undergo fusion (1)	2
(c)		Helium / lighter substances undergo fusion (1) During the death of a star / named stage in the death of a star (1)	2
			6

PHYSICS 2

Question F	Question H		Details	Mark Available
1.		(i)	fuse / m.c.b.	1
		(ii)	r.c.d.	1
		(iii)	Earth	1
		(iv)	fuse	1
				4
2.	(a)		Power $= 8 \times 230(1) = 1840$ [W] (1)	2
	(b)	(i)	13 A	1
		(ii)	Cooker takes more than 16 A / too much current [Answer must mention *current* or *amps*]	1
				4
3.	(a)	(i)	Plots (2) [within 1 small □, –1 for each mistake] [Must include (0,0) but allow if line passes through origin Line [through all points including (0,0)](1)	3
		(ii)	Increases / higher [**Not** lower time]	1
		(iii)	Between 2 and 3 m [e.c.f. from graph]	1
	(b)	(i)	Increases	1
		(ii)	Increases	1
	(c)		Air bag (1), seat belts (1)	2
				[9]
4.	(a)		20	1
	(b)	(i)	0 [n e.c.f.]	1
		(ii)	paper does not affect count rate	1
		(iii)	radiation drops with aluminium	1
		(iv)	beta	1
	(c)	(i)	Less	1
		(ii)	Halved	1
				7

Question F	Question H		Details	Mark Available
5.	(a)	(i)	voltage across	1
		(ii)	current through	1
	(b)		Its resistance can be changed / change the current / change the speed of the electrons / change the voltage [across] lamp [**Not**: change brightness of lamp / power or to obtain a set of results]	1
	(c)	(i)	2 A	1
		(ii)	3 Ω	1
				5
6.	(a)	(i)	1 s	1
		(ii)	alcohol (1) tiredness (1) [–1 for each extra circle]	2
	(b)	(i)	12 [m/s]	1
		(ii)	12 [m/s] or "0 to 12"	1
		(iii)	6 [s]	1
				6
7. 1.	(a)	(i)	Cracks / gaps / wooden floors	1
		(ii)	Alpha [emitter] (1) trapped inside body / highly ionising / absorbed by cells / ionises [molecules in] cells (1)	2
	(b)		10 (1) × 20 (1)	2
	(c)		Seal floors / block cracks (1) [Not insulate] increase ventilation / <u>extractor</u> fan / open doors etc.(1)	2
				7

Question F	Question H		Details	Mark Available
8.	2. (a)	(i)	Speeding up / goes faster / more particles [hit] per second	1
		(ii)	Stays the same / nothing	1
	(b)	(i)	Speeds up [answer must clearly imply acceleration, not just that the skydiver is falling more quickly]	1
		(ii)	Constant / terminal speed / motion [accept max speed]	1
	(c)		$\text{Acceleration} = \frac{\text{change in speed}}{\text{time}}$ [N.B. Full equation needed]	1
			$\text{Acceleration} = \frac{35}{7}$ (1 - subst/ans) $= 5\ \text{m/s}^2$	1
	(d)	(i)	Increases	1
		(ii)	Slows down / decreases / gets slower	1
				8
	3. (a)		$\text{current} = \frac{\text{power}}{\text{voltage}}$	1
			Iron: 920 W (2) Dishwasher: 8 A (1)	3
	(b)	(i)	Trips if too much current (1) to prevent overheating (1)	2
		(ii)	Trips [if a fault] (1) [causes] a difference between live and neutral currents (1)	2
				8
	4. (a)		$\frac{300}{600}(1) = 0 \cdot 5$ [counts per second] (1) $\left[\frac{300}{10} = 30 \rightarrow (1)\right]$	2
	(b)		Any 3 × (1) paper makes no difference (so can't be alpha) (✓) Thick aluminium blocks all cobalt's rad^n (so can't be gamma) (✓) Only background detected (✓) Must be β (✓)	3
	(c)		4 half lives (1), so $^1/_{16}$ left (1) = 2·5 [mg] (1) [halving wrong thing 4 times →(2); halving any no. of times →(1) 4 half lives (1): using number of half lives (1)]	3
				7

Question F H			Details	Mark Available
5.	(a)		$KE = \frac{\text{mass} \times \text{speed}^2}{2}$	1
			$KE = \frac{800 \times 30^2}{2}$ (1 - subst) $= 360\,000$ [J] (1 – answer)	2
	(b)	(i)	Scales (1) [accept starting speed axis at 10 m/s, or squiggle] plots [± ½ □] (1), curve (1)	3
		(ii)	No because it's a curve [e.c.f on graph]	1
	(c)		Work = Force × distance	1
			Substitution / manipulation (1) Answer – 5333 N (1) [Use $F = ma$ & show correct method (2)]	3
	(d)		Energy reduced over a bigger distance (1) so a smaller force (1)	2
				13
6.	(a)		Vary resistance (1) changing the current / lamp voltage (1)	2
	(b)	(i)	Voltage = current × resistance	1
			Substitution (1); Manipulation (1) Answer 2.5 [Ω] [e.c.f.](1) [N.B. At $V = 4$ V, the English version of the paper has $I = 1.60$ A; the Welsh language version has $I = 1.65$ A]	3
		(ii)	Gradient decreases / line gets flatter Or Extra calculation to show increased resistance.	1
				7

PHYSICS 3

Question F	Question H		Details	Mark Available
1.		(i) (ii) (iii) (iv)	S (1) P (1) P (1) P (1)	 4 **4**
2.	(a)	(i) (ii)	Electrons(1); Negative (1) Neutrons (1); none / zero / neutral (1)	2 2
	(b)	(i) (ii)	3 (1) 7 (1)	 2 **6**
3.	(a)		20 km	1
	(b)	(i) (ii) (iii)	AB (1) lowest slope / travelled least distance in an hour / travelled up mountain (1) Speed increases beyond B (1)	 3
	(c)	(i) (ii)	15 km (1) $\frac{15}{\frac{1}{2}} = 30$ [km/h] (1)	 2 **6**
4.	(a)		D, C, F (3 × 1)	3
	(b)		Foetal/baby/organ scans (1) Breaking up gall / kidney stones (1)	 2 **5**

Question F	Question H		Details	Mark Available
5.	(a)		[B →] E → A → D → C [4 or 3 correct → 3; 2 correct → 2; 1 correct → 1]	3
	(b)		Fewer secondary coils / more primary coils	1
				4
6.		(i)	Rutherford (1), nuclear (1)	
		(ii)	plum pudding (1), Thomson (1)	4
				6
7.	(a)		Waves // (1) ⊥ to new direction line (1)	2
	(b)	(i)	Speed changes (1) [**not** depth changes]	
		(ii)	Increased wavelength (1)	2
				4
8.	(a)	(i)	23 m/s (1)	
		(ii)	15 s (1)	2
	(b)		Slowing down / decelerating	1
	(c)		$a = \frac{v-u}{t}$ or acceleration = gradient of a velocity-time graph	1
			$a = \frac{23-20}{5}(1) = 0 \cdot 6$ [m/s^2](1)	2
	(d)		distance travelled (1), when car accelerates to overtake [**or** between 5 s and 10 s] (1)	2
				8

Question F	Question H		Details	Mark Available
9.	(a)	(i)	U-235 (1)	
		(ii)	Boron readily absorbs neutrons (1) [or equiv.]	
		(iii)	Removed from a reactor by a hot gas (1)	3
	(b)	(i)	Splitting of U^{235} nucleus (1) by neutron capture (1)[or w.t.t.e. – **not** implication that force of impact shatters nucleus]	2
		(ii)	Moderator slows down neutrons (1) enabling them to split further U^{235} nuclei (1).	2
		(iii)	Partial removal increases rate (1) because few neutrons are absorbed / more neutrons available for fusion (1)	2
				9
1.	(a)		Waves // (1) ⊥ to new direction line (1)	2
	(b)	(i)	Speed changes (1) [**not** depth changes]	
		(ii)	Increased wavelength (1)	2
				4
2.	(a)		$a = \frac{v-u}{t}$ or acceleration = gradient of a velocity-time graph	1
			$a = \frac{23-20}{5}(1) = 0 \cdot 6$ [m/s^2](1)	2
	(b)		distance travelled (1), when car accelerates to overtake [**or** between 5 s and 10 s] (1)	2
	(c)		$s = \frac{u+v}{2}t$	1
			or distance travelled = area under a velocity-time graph	
			$s = \frac{23+20}{2} \times 10(1) = 215$ [m](1)	2
				8

Question F	Question H		Details	Mark Available
3.	(a)	(i)	Splitting of U^{235} nucleus (1) by neutron capture (1)[or w.t.t.e. – **not** implication that force of impact shatters nucleus]	
		(ii)	Moderator slows down neutrons (1) enabling them to split further U^{235} nuclei (1).	
		(iii)	Partial removal increases rate (1) because few neutrons are absorbed / more neutrons available for fusion (1)	6
	(b)	(i)	Nucleus contains 92 protons (✓) 235 – 92 = 143 neutrons (✓) 235 particles in nucleus (✓) } any 2 × (1)	2
		(ii)	Mass no. = 143 (1) Atomic number = 56 (1)	2
				10
4	(a)	(i)	Max flux / field lines cut (1) per second (1) [or equiv., e.g. rate of change of flux]	2
		(ii)	B → A	1
	(b)	(i)	Current falls to zero when coil vertical (1) reverses and rises to maximum at 180° (1)	2
		(ii)	2 complete waves drawn (✓) Maxima at 0, 360, 720 (✓) Minima at 180, 520 (✓) } any 2 × (1)	2
		(iii)	More rotations per second / frequency increased	1
				8
5.	(a)	(i)	2800 km	1
		(ii)	Speed decreases (1) because the density increases / the stiffness decreases [from the mantle to the core] (1)	2
	(b)	(i)	5000 – 2800 = 2200 km (ans)	1
		(ii)	$\frac{12-7\cdot5}{2}=9\cdot75[\text{km/s}]$ (ans)	1
	(c)		$\text{speed}=\frac{\text{distance}}{\text{time}}$	1
			$9\cdot75=\frac{2200}{\text{time}}(1-\text{subs})$; time = 225.6 s (1) (e.c.f.)	2
				8

Question F H		Details	Mark Available
6. (a)	(i)	Δ momentum $= 0.01 \times 1000 - 0.01 \times 100$ [Numbers (1), sign (1)] $= 9$ [kg m/s] (1 – ans) [Or equiv working]	3
	(ii)	$\text{Force} = \frac{\text{change in momentum}}{\text{time}}$	1
		$\text{Force} = \frac{9}{0 \cdot 0005}(1) = 18000$ N (1) [Accept working based upon calculating deceleration and then F = ma]	2
(b)	(i)	$\text{KE} = \frac{1}{2}mv^2$	1
		Total KE $= \frac{1}{2} \times 1 \cdot 25 \times 8^2(1) + \frac{1}{2} \times 0 \cdot 01 \times 1000^2(1)$ $= 40 + 5000 = 5040$ (1)	3
	(ii)	Smallest fragments travel further in 1 second because of high velocity (1). They have large energies which cause damage (1)	2
			12

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