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GENERAL CERTIFICATE OF SECONDARY EDUCATION
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MARKING SCHEME

PHYSICS

JANUARY 2009

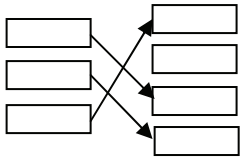
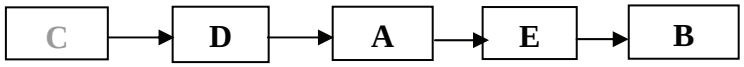
INTRODUCTION

The marking schemes which follow were those used by WJEC for the January 2009 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

F H		Answer / Explanatory Notes	Marks Available
1.		Nuclear → Box 3 [Cooling water] (1) Tides → Box 4 [River estuaries and wildlife] (1) Wind farm → Box 1 [Noise] (1) [additional lines –1] 	3 **3**
2. (a)		270 000 J – 160 000 J ✓[= 110 000 J]	1
(b)		$P = \frac{270\,000}{90}(1) = 3000\,\text{W}$ (1) [subst ✓, ans ✓] $\left[\text{NB.}\frac{90}{270\,000} = 3000 \rightarrow (0)\right]$	2 **3**
3.		 4 or 3 correct (3); 2 correct (2); 1 correct (1)	3 **3**
4.	(i) (ii) (iii)	150 kW 2 m/s stops working / output becomes nothing / zero [or equiv.]	1 1 1 **3**
5. (a)	(i) (ii) (iii)	Infra red Microwaves Gamma rays	1 1 1
(b)		Can cause cell damage / organ damage / cancer / infertility / ionising Ref to body ×, high frequency – not enough, radiation poisoning ×	1 **4**
6.	(i)	Cost of 1 unit = $\frac{100}{5} = 20$ p (ans), $^1/_5$ p ×, £$^1/_5$ ✓, £0.2 ✓	1
	(ii)	Time = $\frac{5}{2}(1) = 2\frac{1}{2}$ h (1) [accept 2:30, 2 h 30 m]	2 **3**

F H		Answer / Explanatory Notes	Marks Available
7. (a)	(i)	Wavelength = 80 m (1)	
	(ii)	Amplitude = 1.5 m (1)	2
(b)		Speed = 80 (e.c.f.) × 0.14 (1) = 11.2 m/s (1) [subst ✓, ans ✓] [Accept (a)(i) × 0.14 ans ✓✓ e.c.f.]	2 **4**
8. (a)	(i)	radiation	1
	(ii)	convection	1
(b)		Efficiency $= \frac{2.88}{6}(1) \times 100 = 48\%$ (1) [subst ✓, ans ✓]	2 **4**
9. (a)	(i)	..a chemical change / a change within a cell	1
	(ii)	The change was … found in cell division / found in cancer cells	1
	(iii)	Heating [Cooking × - too vague]	1
(b)		More research (1) New guidelines to take into account the results of this research (1) [Alt: One of above marking points ✓ + reduce radiation from phones or relevant other personal change, e.g use phones less / shorter calls]	2 **5**
10. 1. (a)	(i)	[Sun's] gravity	1
	(ii)	Fusion of hydrogen to helium [accept: fusion / hydrogen. **Not** burn hydrogen]	1
	(iii)	Less energy [or light /heat] received [from the Sun]	1
(b)	(i)	12 months / 1 year / 365 ± 1 days [accept no unit but **not** incorrect unit]	1
	(ii)	2 years / 24 months 730 days – no e.c.f.	1
	(iii)	Venus has completed almost a full orbit in the same time that the Earth has completed half an orbit [or equiv.] – comparative from diagram. Accept: Venus almost completed at orbit Earth only completed ½ an orbit Venus has travelled further [around the Sun]	1
(c)		Further distance to travel / larger orbital path / larger orbit / slower [orbital] speed	1 **7**

F	H			Answer / Explanatory Notes	Marks Available
11	2		(i)	Microwaves (1); Infra red (1) [microwave <u>power</u> × (s.i.f.), i.r. ✓, heat rays ×]	2
			(ii)	[0·8 + 1·2 =] 2 kW (ans)	1
			(iii)	Units used (kWh) = Power (kW) × time (h)	1
				No. of units = $2 \times 1\frac{1}{2} = 3$ kWh (e.c.f. on power)	1
					5
12	3	(a)		**C**	1
		(b)		Method (2) + Answer (1) e.g. [Double glazing saving = 2000 – 1200 =] 800 J ✓ [Cavity wall insulation saving = 2000 – 700 =] 1300 J ✓ Total energy saving = 2100 J ✓	3
		(c)	(i)	Conduction	1
			(ii)	No convection loss [**not** heat] with foam (1) because of trapped air (1)	2
		(d)		**H-tier only**	
			(i)	It is losing most heat. To keep a constant temperature [difference] the heating system must provide as much heat as is lost.	1
			(ii)	2 arguments linked to generation (2) e.g. Less power to be generated / fewer power stations needed ✓ Less fuel used ✓ / Less CO_2 produced ✓ / Less SO_2 produced ✓	2
					6_{max} / 9_{max}
	4	(a)		Efficiency = $\frac{\text{useful energy transfer}}{\text{total energy input}} \times 100\%$	1
				Efficiency = $\frac{2100}{6000}$ (subst - 1) $\times 100 = 35\%$ (ans - 1)	2
		(b)	(i)	Transport of fuel or waste	1
			(ii)	Access to water for cooling [Not: water needed for steam]	1
		(c)	(i)	$80 = \frac{\text{useful output}}{5000} \times 100$ (1) Useful output = 4 000 MJ/s (1) [subst – 1; ans – 1]	2
			(ii)	National grid = $\frac{30}{100} \times 4000$ ✓ = 1200 MJ So district heating = 4000 – 1400 = 2800 MJ ✓ [method – 1; ans – 1] [Alt: % to district heating = 100 – 30 = 70%, then 70% of 4000 = 2800]	2
					9

F H		Answer / Explanatory Notes	Marks Available
5 (a)		Orbital period of the satellite is the same as that of the Earth / is 24 hours (1) Satellite remains above the same part of the Earth (1). Not: Stays at same place ✗ - but same place as viewed from the Earth ✓	2
(b)	(i)	Totally [internally]reflected / TIR (1) through fibre because the angles [of incidence] of the signals on the walls > critical angle [or stated angle $\geq 42°$](1)	2
	(ii)	Speed = $\frac{\text{distance}}{\text{time}}$ or time = $\frac{\text{distance}}{\text{speed}}$ $2\times10^8 = \frac{4.8\times10^6}{\text{time}}$ (1) subst. time = $\frac{4.8\times10^6}{2\times10^8} = 0.024$ s (1)	1 2
	(iii)	Distance the [microwave] signal travels is [very much] greater [accept converse].	1
			8
6 (a)		Produces energy **or** light /heat energy / star becomes visible (1) Produces outward radiation pressure ✓ Pressure balances gravity ✓ Becomes stable / stops collapse ✓ Heavier elements produced ✓ } any 2 × (1)	3
(b)	(i)	The galaxy is moving away (1)	
	(ii)	The galaxy is further away (1) and is moving away faster than galaxy 1 (1) } Mark together	3
			6
7 (a)		Cost per unit = $\frac{\text{cost}}{\text{units used}}$	1
		Cost of 1 unit = $\frac{949.65}{37986}$(subst - 1) = £0.025 [2.5 p] per kWh (ans – 1)	2
(b)	(i)	No. of units from panel = 36958 – 33446 (1) = 3512 (ans – 1) [no. ecf]	
	(ii)	Money saved = 3512 (e.c.f.) × 2.5 p (e.c.f.) = £87.80 (ans – 1)	
	(iii)	Payback time for solar panel = $\frac{2000}{87.80\text{(e.c.f.)}}$ (subst – 1) = 22.77 years (1)	
	(iv)	Sunnier summers [increase output] / fuel prices could increase (1) Higher use of heating = greater savings so shorter payback time !	6
			9

F H		Answer / Explanatory Notes	Marks Available
1.	(i) (ii) (iii)	high speed using a telephone **or** old age worn tyres **or** wet road [In (ii) and (iii), if 2 answers are given they must both be correct]	1 1 1 **3**
2.	(i) (ii) (iii)	<u>smaller than</u> <u>equal to</u> <u>gets bigger</u> (1); <u>continues to fall</u> (1)	1 1 2 **3**
3.	(i) (ii)	crumple zone Any 2 × (1) from seat belt(s) / air bag(s) / passenger or safety cell / collapsing steering column / anti-submarine seats N.B. the answers may be given in any order	1 2 **3**
4. (a)	(i) (ii)	A **or** ammeter [not: ampmeter, amp meter **but** lenient on ameter, ammetre] $\frac{8}{0.5}$ (subst. – 1)= 16 Ω (ans – 1)	1 2
(b)	(i) (ii) (iii)	decreases (1) decreases (1) stays the same (1)	 3 **6**
5.	(i) (ii) (iii) (iv)	400 [counts per minute] (1) 20 [hours] (1) 40 [hours] (1) 100 [counts per minute] (1) } Ignore incorrect units	 4 **4**
6. (a)	(i) (ii)	**C** [**not** 50 000] **A** and **D** [both required]	1 1
(b)		[50 000 × 3 =] 150 000 [J] (ans) [allow answer in working space or table]	1
(c)		30 000 [N]	1 **4**

F H		Answer / Explanatory Notes	Marks Available
7. (a)		5 [m/s]	1
(b)		10 [s]	1
(c)		35 [s]	1
(d)		30 [s] and 34 [s]	1
			4
8. (a)		It contains [radio]active material / it is [radio]active [dangerous or harmful – not enough]	1
(b)		Very radioactive / high activity (1) [accept: more active more radioactivity **but** not reactive] Has a long half-life (1) [N.B. the answers may be given in either order]	2
(c)	(i)	Will not be touched by / inaccessible to humans for a long time (1)	
	(ii)	May get into water supply / geological instability (1)	2
			6
9. 1. (a)		**[Foundation tier only]** Space [accept: the Sun]	1/-
(b)		These could not pass through the aeroplanes' bodies [or clear implication] **Or** converse argument: e.g. <u>It</u> gets through the aluminium	1
(c)		Distance = speed × time	1
		Distance = 800 × 6 **or** 1600 × 3 (subst – 1) = 48 000 km (ans – 1)	2
(d)	(i)	They fly lower [Accept: Concorde was higher; **not** they fly higher]	1
	(ii)	They spend longer in the air [accept: time is greater]	1
(e)		**[Foundation tier only]** Tick (✓) in middle ["more research"] box	1/-
			8/6

F H		Answer / Explanatory Notes	Marks Available
10. 2. (a)		It has a <u>metal base</u> / protects user from electrocution / shock / safety [qualified]	1
(b)		To break the circuit / stop the current(1) if too much current flows [through the flex] / if there is a power or current surge / to prevent overheating(1)	2
(c)		Any 2 × (1) of • Detects a difference ✓ • between the live and neutral currents ✓ • And a magnetic switch breakes the circuit. ✓	2
(d)	(i)	Current = $\frac{\text{power}}{\text{voltage}}$	1
		Current = $\frac{100}{230}$ (subst – 1) = 0.43 A (ans – 1)	2
	(ii)	3 A e.c.f.	1
(e)		**[Higher tier only]** Resistance = $\frac{\text{voltage}}{\text{current}}$	0/1
		Resistance = $\frac{230}{0.43\text{(e.c.f.)}}$ (subst – 1)= 535 Ω (ans – 1)	0/2
			9/12
3 (a)		[The carriage moves at a] <u>constant speed</u> [or steady pace / motion] <u>of 5 m/s</u>	1
(b)		Acceleration = $\frac{45}{5}$ (subst – 1) = 9 m/s^2 (ans – 1)	2
			5

F H		Answer / Explanatory Notes	Marks Available
4 (a)		Change in potential energy = *mgh* [or in words] [Change in] potential energy = 80 × 10 × 2000 (subst – 1) = 1 600 000 J (ans – 1)	1 2
(b)		Kinetic energy = $\frac{mv^2}{2}$ [or in words] Allow if squared omitted and answer correct Kinetic energy = $\frac{80\times50^2}{2}$ (subst – 1)= 100 000 J (ans – 1)	1 2
(c)	(i)	1 500 000 J e.c.f. from (a) and (b) [1.5 MJ but not 1.5 mJ]	1
	(ii)	work = force × distance Force = $\frac{1500\,000(\text{e.c.f.})}{2000}$ (subst or manip – 1) = 750 N (ans – 1)	1 2
(d)		800 N (ans)	1
(e)		Shape of graph (1) [Rising to plateau – concave to distance axis] 1 × (1) of: • Levelling out at 800 N • Levelling out <~500m	 2
			13
5 (a)		(Half life is) the time taken (1) for the activity (of a radioactive substance) to fall by half [or equiv.] (1) [accept: count rate, mass of substance, number of radioactive atoms; **not** radioactivity, counts, radiation]	2
(b)	(i)	Background radiation	1
	(ii)	I. All of 80, 67, 48, 34, 28, 24 entered into table II. Points plotted 20 units below those on the graph [e.c.f.] (1) and a smooth curve drawn through the points (1).[passing through (20±0.5, 40)] III. Half life found correctly from graph = 20 hours (e.c.f.) (1) Horizontal and vertical lines drawn to show how the ½ life was found (1) [Incorrect graph → 0]	1 2 2
(c)		Suitable industrial application stated, e.g. thickness control [for foil] (1). This source not suitable because the ½ life is too short. (1) [Not medical application; not leak tracing]	 2
			10

F H		Answer / Explanatory Notes	Marks Available
6 (a)		Resultant force = 0.5 × 0.6 (subst – 1) = 0.3 N (ans – 1)	2
(b)		0.3 = 2.8 – friction (subst – 1) Friction = 2.5 N (ans – 1) [negative answer −1]	2
(c)	(i)	Force = 0.6 N e.c.f.	1
	(ii)	0.6 = pulling force – 4.5 **or** Answer of 5.1 N e.c.f.	1
			6

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