GCSE MARKING SCHEME

JANUARY 2016

SCIENCE – Physics 1
4463/01/02

INTRODUCTION

This marking scheme was used by WJEC for the 2016 examination. It was finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conference was held shortly after the paper was 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 conference was to ensure that the marking scheme was 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' conference, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about this marking scheme.

Question Number								
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept

FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
1		*(a)*	i		1	Alpha	α		
			ii		1	Gamma	γ		
			iii		1	Gamma	γ		
		(b)			2	To <u>measure the</u> [dose of] <u>radiation</u> received (1) **Either × 1 mark:** - because [too much] nuclear radiation is dangerous / harmful to living <u>cells</u> / mutates <u>cells</u> / damage DNA - so they are removed from the workplace / limit exposure / limit the dose received	Accept "they ionise cells, or they kill cells" or "they cause cancer / radiation poisoning" or "so they know if the area they are in is safe" for the second mark	Some radiations can harm you	Type of radiation received for the 1st mark Cause illness for the 2nd mark
		(c)	i		1	Gamma	γ		More than one type identified
			ii		1	Beta or gamma	β, γ		More than one type identified
			iii		1	Alpha	α		More than one type identified
		(d)			2	Window A (1) because <u>alpha</u> is stopped by <u>cloth / material</u> (1)	β and γ can pass through cloth		Blocked by paper Or no absorber present
		Total			**10**				

Question Number					Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT	Sub-section							
2		*(a)*	i		1	Keep electricity available if some power stations fail			More than one answer underlined
			ii		1	Reduce energy losses in the cables			More than one answer underlined
			iii		1	Make the voltage smaller			More than one answer underlined
		(b)	i		2	They are <u>good emitters</u> (1) of heat [radiation] / so the tubes cool quicker (1)	The heat (1) is <u>radiated</u> <u>well</u> (1) They give off radiation well = 1 mark A good radiator = 1 mark		Good emitters and absorbers unless qualified Allows radiation to happen
			ii		2	Near the top of the tubes / hot liquids rise (1) because hot liquids are less <u>dense</u> (1) **The 2nd mark can only be awarded if it is linked to the 1st mark.**	Hot liquid floats on top of cooler liquid = 1 mark		Hot air rises
		Total			**7**				

Question Number				Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT	Sub-section						
3		*(a)*		1	20 <u>million years</u>	20 million y		20 million light years
		(b)		2	Tick in column B – top row (1) Tick in column A – bottom row (1)			More than one tick in a row
		(c)		2	The lines are in different places / wavelengths / more lines (1) so it shows that [different] gases / elements [are present in their atmospheres] (1) **The 2nd mark can only be awarded if it is linked to the 1st mark.**	Gases have got lines = 1 mark Gases have got different lines = 2 marks Different <u>gas</u> atoms		Different atoms
		(d)	i	1	[The wavelengths have] increased	Got bigger or longer		Expanded Stretched Widened Moved to the red end
			ii	1	[The galaxies] are further away	Moving <u>away</u> fast<u>er</u>		They are getting further away from us / far away / further apart
		(e)		1	Cosmic microwave background radiation (or CMBR)			
		Total		**8**				

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
4		*(a)*	i		1	5 [m]			
			ii		1	16:00	16 or 4pm		
			iii		1	12 [hours]			
			iv		1	Any of: 0:00 (or midnight), 06:00, 12:00, 18:00 (or 6pm), 24:00 (or midnight)	0,6,12,18,24		
			v		1	Any of: 0:00 (or midnight), 06:00, 12:00, 18:00 (or 6pm), 24:00 (or midnight)	0,6,12,18,24		
		(b)			2	$\dfrac{10}{16}$ (1) = 62.5 (1-ans)	If no workings shown 0.62[5] or 0.63 = 1 mark 63 = 2 marks 62 = 1 mark		
		(c)	i		2	**Any 2 × (1) from:** • No CO_2 / SO_2 / no polluting gases released / no pollution / no waste products • Renewable [source of energy] • No fossil fuels used up • No radioactive waste			CO_2 and SO_2 for two separate marks
			ii		1	Disturbs habitats, large area of land needed, danger to fish / wildlife			Effect on wildlife without qualification Reference to visual pollution
		Total			10				

4

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
5	**1**	*(a)*	i		2	Ultraviolet (1) Microwave (1)	UV		
			ii		3	At the same speed as (1) Lower than (1) Shorter than (1)			More than one answer underlined
		(b)	i		2	BF or AE (1) FG (1)			
			ii		1	**FOUNDATION TIER only** A wave of at least <u>one complete cycle</u> drawn with every crest and trough with smaller amplitude than the one shown – irrespective of any wavelength drawn			
		Total **FT** **HT**			**7** **8**				

5

Question Number					Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT	Sub-section							
6	**2**	*(a)*			1	Kilowatthour	kilowattshour		Kilowatt per hour
		(b)	i		1	463.9 – 445.2 = 18.7 [kWh]			19
			ii		3	$\dfrac{18.7(\textbf{ecf})}{8.5}$ (1) = 2.2 (1) = 2 200 [W] (1) **ecf** from 2.2	19 as an ecf If no workings shown 2.2 on answer line = 2 marks		
			iii		2	18.7(**ecf**) × 20 p = 374 (1) = [£]3.74 (1) **Alternative:** [18.7 **(ecf)** ×] 0.2 (1 - conversion) = [£]3.74 (1)	If no workings shown 374 on answer line = 1 mark		£3.74 p
		(c)			2	Quarter of the power: $\left(\dfrac{2.2}{4}\right)$ (**ecf** from (b)(ii)) shown **or** × 2 time (8.5 × 2) shown (1) £1.87 / 187 p (1) **ecf** from (b)(iii) N.B. If no workings shown answer should be half of answer to (b)(iii)	[£]$\dfrac{3.74}{4}$ (i.e. 93.5 p) **or** [£]3.74 × 2 (£7.48) **or** $\dfrac{18.7}{2}$ ok for first mark		£1.87 p
		(d)			2	[Lower power kettle] will need to be switched on for longer (1) so same electricity used / need to supply the same energy (1) **The 2ⁿᵈ mark can only be awarded if it is linked to the 1ˢᵗ mark.**	Reverse argument for the first mark		
		Total			11				

6

Question Number						Answer	Accept	Neutral answer	Do not accept
FT	HT	Sub-section			Mark				
7	**3**				6	**Indicative content:** Microwaves carry information via geosynchronous satellites. Infra-red or visible light send information through optical fibres. The signal travels a shorter distance by optical fibres but at a slower speed. Calculations of the time delay: 0.036 s for optical fibre, 0.24 s for each satellite. Therefore the delay is less by optical fibre. Signals sent by optical fibre do not suffer from interference. **5 – 6 marks** The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. **3 – 4 marks** The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. **1 – 2 marks** The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. **0 marks** The candidate does not make any attempt or give a relevant answer worthy of credit.	The speed is 2/3 but the distance is 1/10.	Cost	
		Total			**6**				

Question Number								
FT	**HT**	**Sub-section**			**Mark**	**Answer**	**Accept**	**Neutral answer**	**Do not accept**

FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	4	*(a)*			2	To <u>measure the</u> [dose of] <u>radiation</u> received (1) **Either × 1 mark:** • because [too much] nuclear radiation is dangerous / harmful to living <u>cells</u> / mutates <u>cells</u> / damage DNA • so they are removed from the workplace / limit exposure / limit the dose received	Accept "they ionise cells, or they kill cells" or "they cause cancer / radiation poisoning" or "so they know if the area they are in is safe" for the second mark	Some radiations can harm you	Type of radiation received for the 1st mark Cause illness for the 2nd mark
		(b)	i		2	Black, Black, Not black (1) all correct Black, Black, Black (1) all correct			Any other colours
			ii		2	The <u>clothing</u> will absorb the <u>alpha</u> radiation (1) so it will not be recorded on the film / a false reading will be obtained (1) **The 2nd mark can only be awarded if it is linked to the 1st mark.**			
		(c)	i		3	Scale on *x*-axis from 0 – 5.0 present with intervals of 1.0 **and** scale on *y*-axis from 0 – 90.0 present with intervals of 10.0 (1) All points plotted within ± ½ small square division (1) Smooth curve of best fit from *x* = 0 to 2.5 ± ½ small square division on each point (1)	If scale transposed or incorrect don't award the scale mark but if correct the plots and curve marks can be awarded (2.0, 19.0) plot is likely not to lie on the curve of best fit		Thick, wobbly, disjointed, wispy curves
			ii		2	The count rate decreases as the thickness of aluminium increases (1) The count rate decreases at a bigger rate at start <u>and</u> eventually reaches zero (1)			Gradient is less steep
			iii		2	3.5 mm indicated (1) 3.3 [$\times 10^{-13}$ J] (1) (± 0.1)			
		Total			13				

Question Number									
FT	HT	Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
	5	i		3	By studying <u>absorption lines</u> (1) which are caused by <u>gas atoms</u> (1) **Either × 1 mark**: • absorbing [light] at specific wavelengths • which are characteristic of an element **The 3rd mark can only be awarded if it is linked to the 2nd mark.**			
		ii		2	**Any 2 × (1) from:** • Wavelengths of absorption lines are increased / red shift • All are moving away • Further ones are moving faster	The red shift is greater for even more distant galaxies = 2 marks		
		iii		2	CMBR is a remnant of [radiation from the origin of the Universe] / high energy waves / gamma rays (1) which has 'stretched' as the Universe has expanded (1) **The 2nd mark can only be awarded if it is linked to the 1st mark.**		Red shift	
		Total		**7**				

9

Question Number								
FT	HT	Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
	6	*(a)*	i	3	Substitution: $1000 = \dfrac{mass}{700}$ (1) manipulation and answer = 700 000 / 7×10^5 (1) $\times$ 24 = 16 800 000 [kg] or 1.68×10^7 [kg](1) **Alternative:** $700 \times 24 = 16 800$ (1) mass = density $\times$ volume (1 – manipulation) $16 800 \times 1 000 = 1.68 \times 10^7$ [kg](1)	16.8 M[kg]		
			ii	3	matching pair of units (1) $\dfrac{1 \times 10^7}{3.5 \times 10^3} = 2 857$ [A] (1) $\times$ 24 = 68 571[.4 A] (1) **Alternative:** 10 [$\times 10^6$] $\times$ 24 = 240 [MW] [2.4×10^8] (1) matching pair of units (1) $\dfrac{2.4 \times 10^8}{3.5 \times 10^3} = 68 571$[.4 A] (1)	If no workings shown: 2 857 [A] = 2 marks 68 571 [A] = 3 marks If matching units are not used award a max of 2 marks – answer will be 68 571 $\times 10^n$		
			iii	2	$\dfrac{10}{16}$ (1) = 62.5 (1-ans)	If no workings shown 0.62[5] or 0.63 = 1 mark 63 = 2 marks 62 = 1 mark		
		(b)		2	Tidal [flow] is not constant / volume [per second] changes (1) Which causes the <u>power input</u> to the turbines to vary / <u>power input</u> is proportional to the volume [per second] (1) **The 2nd mark can only be awarded if it is linked to the 1st mark.**			The tide comes in twice a day / rises and falls

10

Question Number								
FT	HT	Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
		(c)		6	**Indicative content:** The large amount of concrete required/construction traffic will lead to large quantities of CO_2 being produced contributing to global warming. Very expensive to build. The barrage will change the tides/water level leading to a loss of habitat/disruption to wildlife. The barrage will affect water flow leading to silting of the river causing navigation problems for ships. The barrage would act as a barrier for fish affecting their migration. The barrage will not need a fuel supply to operate so running costs will be low and no waste will be produced. No greenhouse gases will be produced. Tidal power is a reliable and renewable source of energy. **5 – 6 marks** The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. **3 – 4 marks** The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.	Peak times – max flow could be in the middle of the night		

11

Question Number								
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
						1 – 2 marks The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. **0 marks** The candidate does not make any attempt or give a relevant answer worthy of credit.			
		Total			**16**				