GCSE MARKING SCHEME

SCIENCE - PHYSICS

SUMMER 2015

INTRODUCTION

The marking schemes which follow were those used by WJEC for the Summer 2015 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.

Physics 1 – Summer 2015
Foundation Tier

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
1		(a)			2	320 [MJ] (1) 150 [MJ] (1)			
		(b)	(i)		1	chemical [energy]			
			(ii)		1	electrical [energy]	electricity		
		(c)	(i)		1	coal	C		
			(ii)		2	Wasted as heat (thermal) energy (1) Since turbines, pipes etc become hot / water cools (1) **Alternative:** Wasted as sound energy (1) Because of the noise [released by the machines] (1) **The 2nd mark can only be awarded if it is linked to the 1st mark.**	Cooling towers/chimney/ Transformers / friction in moving parts Steam	Other types of named energies References to CO_2	Friction only Smoke
		(d)			2	$\text{efficiency} = \frac{\text{useful power transfer}}{\text{total power input}} \times 100$ $\text{efficiency} = \frac{170}{500} \times 100$ Selection of 170 anywhere (1) Efficiency = 34 (1)	Answer alone gains both marks $\frac{500}{170} = 34$ gets 1 mark only Answer only of 0.34 gets 1 mark		170 on the answer line
		(e)			3	**Oil:** causes [increased] greenhouse effect / global warming / climate change (1) **Nuclear:** must be stored safely for a long time / problems linked to storage or leaks (1) **Coal:** causes acid rain (1)		Global warming when referring to problems with SO_2	Leaves nuclear waste / ozone layer / harmful to humans or wildlife
		Total Mark			12				

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
2		(a)	(i)		3	Gamma [rays] , Ultraviolet [waves] / UV , Micro[waves] 3 × (1)			
			(ii)		3	At the same speed as (1) Shorter than (1) Lower than (1)			
		(b)	(i)		2	Volume (1) As different volumes will cool at different rates (1) **The 2nd mark can only be awarded if it is linked to the 1st mark.**	Amount / mass / same level of water		Quantity
			(ii)	I	2	**Curve always** below given line starting from somewhere above room temperature starting on the *y*-axis (1) **Levelling** sooner at room temperature (1)		Line not at same starting point	Any lines to the right
				II	2	Line for black flask is steeper / black flask cooled quicker (1) Because black surfaces are better / good emitters [of IR] (1) **The 2nd mark can only be awarded if it is linked to the 1st mark.** **No ecf from the previous part**	Accept converse argument about white		Don't cool at the same rate because they're different colours
		Total Mark			12				

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
3		(a)	(i)		1	30 [p]			
			(ii)		2	30 × 4 000 **ecf** (1) 120 000 p (1) **Alternative:** 0.3 × 4 000 **ecf** (1) £1 200 (1)	120 000 **or** 1 200 – no workings shown award 1 mark only £1 200 p award 1 mark only		
			(iii)		2	$\frac{4\,000}{2\,000}$ (1) 2 [kW] (1)			$\frac{2\,000}{4\,000} = 2$
		(b)			2	4 000 × 0.5 (1) 2 000 [kg] (1)			
		Total Mark			7				

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
4		(a)	(i)		1	3.3 [years]			3.3 light years
			(ii)		1	99 000 [light years]			
			(iii)		1	4 500 [million km]			
		(b)	(i)		1	380 [units]			
			(ii)		1	5 [number of waves per cm]			
		Total Mark			5				

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
5		(a)	(i)		2	One quarter / 25% (1) × 20 = 5 [cpm] (1)	Alternative routes to get an answer of 5		
			(ii)		2	Repeat the test / counts per minute / take more readings (1) and find the mean (1) **OR** count / reading / measure over longer period of time (1) and divide by that number of minutes (1)			
			(iii)		1	Radon **OR** buildings / soil	Ground / earth		Named rocks / uranium
		(b)	(i)		2	350 – 20 (1 - for subtraction of 20 from any value) = 330 [cpm] (1)			
			(ii)		2	Alpha (1) Because the reading is reduced [to background level] by thin card / can't penetrate thin card (1) **The 2nd mark can only be awarded if it is linked to the 1st mark.**	**Alternative for the 2nd mark:** If it was beta or gamma the reading wouldn't be reduced by thin card		Alpha with beta or gamma Alpha absorbed by card and gamma absorbed by lead
			(iii)		1	Range of alpha is only a few [about 30] cm in air / can't penetrate the skin or clothes / not very penetrating	Short range in air can't reach them		Only harmful inside the body
			(iv)		2	Aluminium has no effect on the count rate (1) because only gamma passes through aluminium / beta can't pass through aluminium (1) **The 2nd mark can only be awarded if it is linked to the 1st mark.**	There's still a [small] count rate [beyond lead] (1) only gamma goes through lead (1)	Reference to alpha	
			(v)		1	Background count varies over time / random			
		Total Mark			13				

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
6		(a)			2	Increases or steps up the voltage / reduces the current (1) to reduce energy / heat losses [in the cables] (1) **The 2nd mark can only be awarded if it is linked to the 1st mark.**		Improves efficiency (given)	Reduces the power No heat loss
		(b)			1	950 000 000 [W]	950×10^6		950 MW
		(c)			2	Reduce the voltage (1) to a safer value [for use in the home] / because high voltages are more dangerous (1) **The 2nd mark can only be awarded if it is linked to the 1st mark.**	Step-down the voltage	Increase the current	
		(d)			6	**Indicative content:** Some types of power station continue working for 24 hours a day and for 365 days a year. These include nuclear, coal and oil powered stations which take a long time to shut down and to start up again. Through the day, however, demand changes, the demand being small at night while most of the population is sleeping but during the daytime there are peaks of demand, notably at breakfast time and again in early evening. To meet this demand some power stations are needed which can be brought on stream at very short notice. This is where hydroelectric power stations are very useful because they can start up within seconds by just opening a valve to let the water flow. They, along with reserve oil and gas powered stations can also be used to maintain supply during maintenance or breakdown times of other stations. **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.			
		Total Mark			11				

Physics 1 – Summer 2015
Higher Tier

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	1	(a)	(i)		2	One quarter / 25% (1) × 20 = 5 [cpm] (1)	Alternative routes to get an answer of 5		
			(ii)		2	Repeat the test / counts per minute / take more readings (1) and find the mean (1) **OR** count / reading / measure over longer period of time (1) and divide by that number of minutes (1)			
			(iii)		1	Radon **OR** buildings / soil	Ground / earth		Named rocks / uranium
		(b)	(i)		2	350 – 20 (1 - for subtraction of 20 from any value) = 330 [cpm] (1)			
			(ii)		2	Alpha (1) Because the reading is reduced [to background level] by thin card / can't penetrate thin card (1) **The 2nd mark can only be awarded if it is linked to the 1st mark.**	**Alternative for the 2nd mark:** If it was beta or gamma the reading wouldn't be reduced by thin card		Alpha with beta or gamma Alpha absorbed by card and gamma absorbed by lead
			(iii)		1	Range of alpha is only a few [about 30] cm in air / can't penetrate the skin or clothes / not very penetrating	Short range in air can't reach them		Only harmful inside the body
			(iv)		2	Aluminium has no effect on the count rate (1) because only gamma passes through aluminium / beta can't pass through aluminium (1) **The 2nd mark can only be awarded if it is linked to the 1st mark.**	There's still a [small] count rate [beyond lead] (1) only gamma goes through lead (1)	Reference to alpha	
			(v)		1	Background count varies over time / random			
		Total Mark			13				

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	2	(a)			2	Increases or steps up the voltage / reduces the current (1) to reduce energy / heat losses [in the cables] (1) **The 2nd mark can only be awarded if it is linked to the 1st mark.**		Improves efficiency (given)	Reduces the power No heat loss
		(b)	(i)		1	950 000 000 [W]	950×10^6		950 MW
			(ii)		2	$I = \frac{P}{V}$ $I = \frac{950\,000\,000}{475\,000}$ (manip & subst- 1) **ecf** from (b)(i) I = 2 000 [A] (1) **Alternative:** Calculations with matching units e.g. mega or kilo	An answer of 2×10^n [A] other than 2×10^3 award 1 mark only unless **ecf** rule applies		$\frac{475\,000}{950\,000\,000}$ = 2 [A]
		(c)			2	Reduce the voltage (1) to a safer value [for use in the home] / because high voltages are more dangerous (1) **The 2nd mark can only be awarded if it is linked to the 1st mark.**	Step-down the voltage	Increase the current	
		(d)			6	**Indicative content:** Some types of power station continue working for 24 hours a day and for 365 days a year. These include nuclear, coal and oil powered stations which take a long time to shut down and to start up again. Through the day, however, demand changes, the demand being small at night while most of the population is sleeping but during the daytime there are peaks of demand, notably at breakfast time and again in early evening. To meet this demand some power stations are needed which can be brought on stream at very short notice. This is where hydroelectric power stations are very useful because they can start up within seconds by just opening a valve to let the water flow. They, along with reserve oil and gas powered stations can also be used to maintain supply during maintenance or breakdown times of other stations. **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			

Question Number								
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	2	(d)				**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.			
		Total Mark			13				

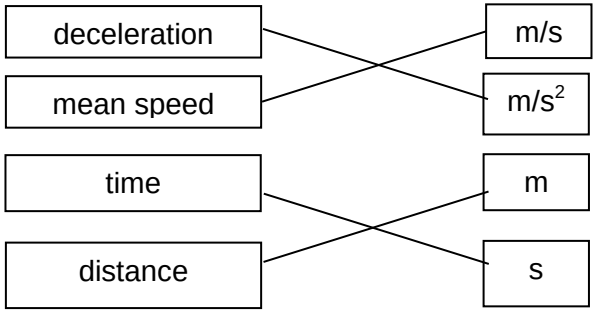
Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	3	(a)	(i)		1	20 [J/m^2]			
			(ii)		4	20% × 700 (1 - for use of 700) = 140 [W/m^2] (1) 1 000(conversion-1) ÷ 140 **ecf** = 7.14 (ans-1) [m^2] **Alternative solution:** 20% × 1 400 (1 - for use of 1 400) = 280 [W/m^2] (1) 1 000(conversion-1) ÷ 280 **ecf** = 3.57 (ans-1) [m^2] Incorrect rounding loses answer mark.	1 000 [J/s] (1) So need 5 000 [J/s] (1) Area = $\frac{5\,000}{700}$ (1) Area = 7.14 (ans-1) [m^2]		
		(b)			3	Radiation [IR / visible] from the Sun is absorbed by the surface of the Earth (1) The ground [gets heated and] emits radiation [IR] with an <u>increased wavelength</u> (1) which is absorbed by / trapped in the atmosphere (1)		Other em regions referred to	Different wavelength Blocked by the atmosphere Bounces back
		Total Mark			8				

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	4	(a)	(i)		3	Scale on x-axis from 0 – 4.0 present with intervals of 0.5 **and** scale on y-axis from 0 – 6.0 present with intervals of 1.0 (1) Points plotted within ± ½ small square division (1) don't penalise for point (0,0) not being present Smooth curve of best fit from origin ± 1 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		Thick, wobbly, disjointed, wispy curves
			(ii)		2	As the depth increases the wave speed increases (1) At a decreasing rate (1) No **ecf** from graph	Positive correlation (for the 1st mark) Slower rate	Non-linear	For a straight line graph they are proportional Answer for incorrect wave speed
		(b)	(i)		3	5.3 (1) = $f \times 8.1$ (1) f = 0.65 [Hz](1) N.B. **Speed value must be taken from candidate's graph** N.B. If speed is: 5.0 then f = 0.617 [Hz] 5.1 then f = 0.630 [Hz] 5.2 then f = 0.642 [Hz] 5.4 then f = 0.666 [Hz] 5.5 then f = 0.679 [Hz]			
			(ii)		2	Waves have decreasing wavelength [from A to B] (1) because speed decreases [but f remains constant] (1) **The 2nd mark can only be awarded if it is linked to the 1st mark.**		Any reference to amplitude change	
		Total Mark			10				

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	5	(a)			2	Time $= \frac{3\,900}{3}$ (1) = 1 300 $\frac{1300}{52}$ **(ecf)** = 25 [hours](1) **Alternative solution:** Time = $= \frac{3\,900}{52}$ (1) = 75 $\frac{75}{3}$ **(ecf)** = 25 [hours](1)			
		(b)	(i)		4	3 900 × 30 p (1) =117 000 p (1) conversion to [£]1170 (1) $\frac{7\,500}{1170}$ **(ecf)** = 6.41 [years] (1) Incorrect rounding loses answer mark. **Accept alternative routes**	If 16 p used, time = 12.02 [years] award 3 marks If 14 p used, time = 13.74 [years] award 3 marks		
			(ii)		2	Money saved <u>each year</u> would increase (1) reducing the pay-back time (1) **The 2nd mark can only be awarded if it is linked to the 1st mark.**			
		(c)			2	Units saved = 3 900 × 25 = 97 500 (1) CO_2 saving = 97 500 **(ecf)** × 0.5 = 48 750 [kg] (1)			25 × 0.5
		Total Mark			10				

Question Number								
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	6	(a)			6	**Indicative content:** Absorption spectra from distant galaxies consist of coloured light crossed with black lines. The wavelengths of the black lines are shifted to the red end of the spectrum when compared with light from similar sources in the laboratory. The black lines from more distant galaxies are more red shifted due to the expansion of space itself. This suggests that the Universe began its existence at a single point and has expended outwards ever since. CMBR on the other hand initially existed as gamma radiation of very small wavelength but an expanding Universe has caused the wavelength to increase into the microwave region of the em spectrum. **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.			
		Total Mark			6				

Physics 2 Summer 2015
Foundation Tier

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
1		(a)			3	 All 4 correct – 3 marks 2 or 3 correct – 2 marks 1 correct only – 1 mark	Squiggly lines		2 lines to one box (award no mark) 2 lines from any box (award no marks)
		(b)	(i)		1	5 [s] **and** 65 [s] (both answers required for 1 mark)			
			(ii)		2	acceleration = $\frac{40}{10}$ (1-sub), = 4 [m/s^2] (1-ans)	$\frac{10}{2.5}$ = 4 or any correct gradient calculation		
		(c)	(i)		2	momentum = 1 200 × 40 (1-sub) = 48 000 [kg m/s] (1-ans)			
			(ii)		2	$F = \frac{(0 - 48\,000)}{30}$ (ecf on 48 800) (1-for 30 shown anywhere) = [-] 1 600 [N] (1)	(48 000 – 0) or 48 000 in the numerator		30 on answer line
		Total Mark			10				

Question Number								
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
2		(a)			2	Ticks in boxes 3 and 4 (2)	Crosses in boxes		Extra crosses in other boxes (minus 1 for each)
		(b)	(i)		1	400 [counts/min]			
			(ii)		1	100 [days]			
			(iii)		1	Same answer as (ii)			
			(iv)		1	Line drawn below the curve from (0,800) Allow ± one small square tolerance on (0,800) plot	Line that curves upwards at the end Line that does not extend all the way to 400		A straight line. A line that crosses / touches the one given / touches the time axis. Line on previous grid.
		Total Mark			6				

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
3		(a)			2	$\frac{1.8}{6.0}$ (1-sub) = 0.3 (1-ans)	0.3 anywhere		$\frac{6.0}{1.8}$ = 0.3
		(b)			1	Current			Amps
		(c)	(i)		3	Points plotted within ± ½ small square division (2) (-1 mark for each incorrect plot to a maximum of 2 marks) Straight line of best fit ± ½ small square division on each point within the range of values plotted (i.e. 10 - 75 cm) (1)			Line joined dot to dot, whispy lines, double lines
			(ii)		2	As length increases resistance increases (1) In a uniform way / steady rate (1)	Bigger wire / In a linear way / In proportion. Resistance is [directly] proportional to length **gets 2 marks.** It is proportional **gets 2 marks.** For <u>every</u> 10 cm resistance increases by 2 Ω **gets 2 marks.** Length is equal to 5 times the resistance **gets 2 marks.** 10 cm has 2 Ω resistance and 20 cm has 4 Ω resistance **gets 1 mark.** As length increases resistance increases equally **gets 1 mark**		Stronger resistance. Graph is proportional

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
		(d)			2	The resistance of 100 cm would be 20 Ω / 30 Ω requires a 150 cm length (1) therefore the statement is not true (1) **ecf** it must be consistent with the first mark **The 2nd mark can only be awarded if it is linked to the 1st mark.**	10 cm has 2 Ω so 100 cm is not 30 Ω **gets 1 mark only**		
		(e)			1	Yes - To check <u>repeatability</u> **or** No- Results all lie on a straight line / there are no anomalous results	To check if the results match.	Any reference to reliability or accuracy.	To make it more repeatable. Make sure they're right / ok
		Total Mark			11				

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
4		(a)			2	P = 120 × 5 (1 - substitution) = 600 [W] (1)			
		(b)	(i)		2	Mass is a measure of inertia of the bricks (1) Weight is [a measure of the force of] gravity acting on the bricks (1)	Mass is the amount of material (stuff) / matter / particles in an object. Mass is in kg and weight is in N **gets 1 mark**		Number of particles. Weight is how heavy it is.
			(ii)		1	mass = $\frac{5\,000}{10}$ = 500 [kg]			
		(c)	(i)		2	5 000 and 400 used in addition or subtraction (1) 5 400 [N] (1)	Answer only of 4 600 **gets 1 mark**		
			(ii)	I	1	"bigger than"			
				II	1	"equal to"			
		Total Mark			9				

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
5		(a)	(i)		2	Uranium [nucleus] / it absorbs neutron[s] (1) splits into 2 [smaller] nuclei and neutrons [are released] (1)	Atoms Neutron capture Named elements		Force of impact shatters nucleus. Don't accept collides.
			(ii)		2	Slows down the neutrons (1) **so** they can be absorbed / captured by uranium [nuclei] (1) **The 2nd mark can only be awarded if it is linked to the 1st mark.**	For 2nd mark: Split uranium nuclei **or** they cause fission of uranium **or** the reaction of uranium		
			(iii)		2	Fewer or no neutrons absorbed (1) **so** increase [in rate of] fission [of uranium nuclei] (1) **The 2nd mark can only be awarded if it is linked to the 1st mark.**	For 1st mark: So more neutrons available for fission		Taken out / removed / more energy released
		(b)	(i)		3	Ticks in the 2nd, 3rd and 4th boxes A nucleus of U-230 least number of neutrons (1) ✓ A nucleus of U-235 contains 143 neutrons (1) ✓ A nucleus of U-234 contains 92 protons (1) ✓			Extra tick attracts -1
			(ii)		2	234 (1) $^{234}_{92}U$ (1) as shown here			
		Total Mark			11				

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
6		(a)	(i)		2	**No credit is given for just naming the radioisotope** **Astatine** Alpha particles highly ionising **or** easily absorbed [by cancer cells] **or** would not penetrate beyond the tumour [to affect healthy cells] (1) It decays [to a safe level] quickly or equivalent (1) **Alternative solution:** **Tellurium** Beta penetrates all of the tumour (1) It decays [to a safe level] quickly or equivalent (1)	Alpha is not able to spread far [The source] won't last long in the body		**Answers for any other radioisotope** Attacks / kills the cancer cells the best. It is highly ionising. Any statement implying that it leaves the body quickly / the half-life is short.
			(ii)		2	**Cobalt / Caesium** Beta / gamma will penetrate the packaging/box **or** kills bacteria (1) It won't need replacing for a long time / it lasts a long time (1)			It has a long half-life
		(b)	(i)		1	5			
			(ii)		2	288 – 144 – 72 – 36 – 18 - 9 Process of halving from 288 (1) 5 times to arrive at 9 (1) **ecf**	Answer only of 9 **gets 2 marks**		An incorrect answer with no workings shown e.g. 18 except for 4 half-lives in (b)(i) which gets 2 marks
		Total Mark			7				

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
7					6	**Indicative content:** If the vehicle is travelling faster then the thinking distance is increased and the braking distance is also increased. This means that the overall stopping distance is greater (or the converse for a vehicle travelling more slowly). If the brakes are worn (or poor road surface conditions) the thinking distance is unaffected but the braking distance is increased. This again leads to an increased stopping distance (or the converse for new brakes). If the driver has drunk alcohol or is tired the reaction time is bigger and so the thinking distance is greater. Although the braking distance is unaffected the overall stopping distance is greater. **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.			
		Total Mark			6				

Physics 2 Summer 2015
Higher Tier

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	1	(a)	(i)		2	Uranium [nucleus] / it absorbs neutron[s] (1) splits into 2 [smaller] nuclei and neutrons [are released] (1)	Atoms Neutron capture Named elements		Force of impact shatters nucleus. Don't accept collides.
			(ii)		2	Slows down the neutrons (1) **so** they can be absorbed / captured by uranium [nuclei] (1) **The 2nd mark can only be awarded if it is linked to the 1st mark.**	For 2nd mark: Split uranium nuclei **or** they cause fission of uranium **or** the reaction of uranium		
			(iii)		2	Fewer or no neutrons absorbed (1) **so** increase [in rate of] fission [of uranium nuclei] (1) **The 2nd mark can only be awarded if it is linked to the 1st mark.**	For 1st mark: So more neutrons available for fission		Taken out / removed / more energy released
		(b)	(i)		3	Ticks in the 2nd, 3rd and 4th boxes A nucleus of U-230 least number of neutrons (1) ✓ A nucleus of U-235 contains 143 neutrons (1) ✓ A nucleus of U-234 contains 92 protons (1) ✓			Extra tick attracts -1
			(ii)		2	234 (1) $^{234}_{92}U$ (1) as shown here			
		Total Mark			11				

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	2	(a)	(i)		2	**No credit is given for just naming the radioisotope** **Astatine** Alpha particles highly ionising **or** easily absorbed [by cancer cells] **or** would not penetrate beyond the tumour [to affect healthy cells] (1) It decays [to a safe level] quickly or equivalent (1) **Alternative solution:** **Tellurium** Beta penetrates all of the tumour (1) It decays [to a safe level] quickly or equivalent (1)	Alpha is not able to spread far [The source] won't last long in the body		**Answers for any other radioisotope** Attacks / kills the cancer cells the best. It is highly ionising. Any statement implying that it leaves the body quickly / the half-life is short.
			(ii)		2	**Cobalt / Caesium** Beta / gamma will penetrate the packaging/box **or** kills bacteria (1) It won't need replacing for a long time / it lasts a long time (1)			It has a long half-life
		(b)	(i)		1	5			
			(ii)		2	288 – 144 – 72 – 36 – 18 - 9 Process of halving from 288 (1) 5 times to arrive at 9 (1) **ecf**	Answer only of 9 **gets 2 marks**		An incorrect answer with no workings shown e.g. 18 except for 4 half-lives in (b)(i) which gets 2 marks
		Total Mark			7				

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
	3				6	**Indicative content:** If the vehicle is travelling faster then the thinking distance is increased and the braking distance is also increased. This means that the overall stopping distance is greater (or the converse for a vehicle travelling more slowly). If the brakes are worn (or poor road surface conditions) the thinking distance is unaffected but the braking distance is increased. This again leads to an increased stopping distance (or the converse for new brakes). If the driver has drunk alcohol or is tired the reaction time is bigger and so the thinking distance is greater. Although the braking distance is unaffected the overall stopping distance is greater. **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.			
		Total Mark			6				

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	4		(i)		2	Repeat <u>the</u> experiment / gather more data (1) and if the current values or results are <u>close to the first set</u> of readings [the results are repeatable] (1) **The 2nd mark can only be awarded if it is linked to the 1st mark.**	Or opposite comment		
			(ii)		3	As the length doubles the current is halved (1) V is constant (1) so the resistance doubles (1) **Alternative solution:** For a length of e.g. 10 cm, R = 2 Ω and for a length of e.g. 30 cm, R = 6 Ω (2) therefore tripling l, triples R (1) **For 2 marks, the first and third statements need to be linked**	When the length doubles the current is halved (1) since resistance is inversely proportional to current this agrees with the statement (1)		As length increases, current decreases so resistance increases
			(iii)		3	Points plotted within ± ½ small square division (2) (-1 mark for each incorrect plot to a maximum of 2 marks) Curved line of best fit ± one small square division of each point within the range 20 - 75 cm (1)			Line joined dot to dot, whispy lines, double lines
			(iv)		2	Award 2 marks for <u>inversely</u> proportional Award 1 mark for as the length increases current decreases	If length doubles, current is halved **gets 2 marks** Decreases at a decreasing rate **gets 1 mark**		Directly proportional. In a non-linear way for the 2nd mark

Question Number								
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
			(v)		4	0.2 A identified from the graph (1) will be dependent on their graph line $R = \frac{V}{I} = \frac{1.8}{0.2}$ = 9 [Ω] (1) **ecf** on 0.2 A So $\frac{9}{45}$ = 0.2 Ω/cm (1) **ecf** on 9 [Ω] Yes or No must be consistent with their answer (1) **Alternative solution:** V = 0.2 (1) × 0.2 = 0.04 V cm^{-1} (1) 0.04 × 45 cm = 1.8 V (1) So correct V (1) **Alternative solution:** R = 0.2 (1) × 45 = 9 Ω (1) $I = \frac{V}{R} = \frac{1.8}{9}$ = 0.2 A (1) So correct value for I (1)	0.2 A identified from the graph (1) will be dependent on their graph line Resistance = 0.2 × 45 = 9 Ω (1) $V = IR$ = 0.2 × 9 = 1.8 V (1) Yes because that was the voltage used (1)		$V = IR$ = 0.2 × 45 = 9 Ω
		Total Mark			14				

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	5	(a)	(i)		2	$P = VI$ = 120 × 5 (1) = 600 [W] (1)			
			(ii)		1	9 000 [J]	9 if k placed before J		9 kJ if given J not crossed out
			(iii)		2	GPE = mgh = 50 × 10 × 14 (1) = 7 000 [J] (1)			
			(iv)		1	Lost as heat / due to friction / energy to lift blocks and hook			Lost to atmosphere / energy wasted / energy lost / air resistance
		(b)	(i)		2	50 (1) × 10 = 500 [N] (1)	$F = \frac{W}{d}$ $= \frac{7\,000(1)}{14}$ = 500 [N] (1)		$\frac{9\,000}{14}$ Substitution of 50 into the PE equation
			(ii)		2	Resultant / unbalanced force (1) so velocity increases / object accelerates (1) **The 2nd mark can only be awarded if it is linked to the 1st mark.**			Statements of Newton's laws Reference to air resistance
			(iii)		3	Change in GPE = gain in KE (1) KE = ½ mv^2 => v^2 = $\frac{2\text{KE}}{m}$ (1 rearranged) **ecf** from (a)(iii) $\frac{2 \times 7\,000}{50}$ = 280 [m^2/s^2] => v = 16.7 [m/s] (1)	Answer of 17 [m/s]		7 000 substituted into any equation other than an energy one
		Total Mark			13				

Question Number								
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	6	(a)			3	Area: (½ × (60 × 30)) + (60 × 35) + (½ × (60 × 15)) So: (900 + 450) (1) - triangles + 2 100 (1) - rectangle = 3 450 [m] (1) **Alternative solution:** Area of a trapezium = ½ × (80 + 35) (1) × 60 (1) = 3 450 [m] (1)			
		(b)			6	**Indicative content:** In the first 30 s there is a resultant force acting in the forward direction which makes the passenger accelerate. Calculations to show the acceleration is 2 m/s^2 and the force is 140 N. Between 30 and 65 s the speed is constant so the resultant force is zero. For the last 15 s the there is a resultant force opposite/backward causing the passenger to decelerate to zero. Calculations to show the deceleration is 4 m/s^2 so the force is 280 N. **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.			
		Total Mark			9				

PHYSICS 3 Summer 2015
Foundation Tier

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
1		(a)			2	Hydrogen (1) Helium (1)	H He		h HE he
		(b)			4	LHS: red giant (1), white dwarf (1) RHS: supernova (1), black hole (1)			Any words not in box
		Total Mark			6				

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
2		(a)			2	Appropriate field lines on both sides (at least 2 above and 2 below) (1) Direction arrows (north → south) (1)	Lines that touch / cross at the poles		Crossing or touching lines above and/or below Lines that don't start at either pole
		(b)	(i)		3	1 mark for each one correct. Upwards moving wire – points to +2 Other 2 diagrams – points to 0			
			(ii)		2	Move the metal rod faster / quicker (1) Make the magnets stronger / stronger magnetic field (1)	Move magnets closer together / more conductive metal bar / wider magnet / thicker metal bar / shorter metal bar		Use a coil of wire, bigger magnet, longer metal bar / more metal bars / curved magnets
		(c)	(i)		1	Alternates between + and -			The ammeter needle keeps moving back and fore / up and down / it will change
			(ii)		2	The wire moves up through the field and then down/changes its direction of travel through the field (1) So current is <u>induced / generated</u> one way and then the other (1) **The 2nd mark can only be awarded if it is linked to the 1st mark.**	Wire cuts field to induce a current (1)		
		Total Mark			10				

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
3		(a)	(i)		2	27 (1) 350 (1)			
			(ii)		3	Plots (2) no tolerance allow **ecf** on 350 K Straight line joining plotted points (1) ± ½ small square tolerance	A curve if **ecf** applied for the last point		
			(iii)		2	Show the line extended backwards **to the origin** (1) Reading of pressure consistent with their intercept (1)	1 mark if answer of 0 with no extrapolated line shown		Answer of 0 if extrapolated line does not go through 0
			(iv)		2	Pressure increases with temperature / positive correlation (1) In a uniform way (1)	Award 2 marks: [Directly] proportional / as one doubles the other doubles too		
		(b)			2	12 (1) × 80 = 960 [N] (1)			
		Total Mark			11				

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
4		(a)			2	Ticks in bottom 2 boxes Lose 1 mark for each extra tick			
		(b)			3	Any number of TIR shown (1) **or** 3 TIR shown (2) Straight line joining outgoing ray (1)			
		(c)			4	Refract (1) Travel along the boundary (1) Totally internally reflect / TIR (1) Totally internally reflect / TIR (1)			
		Total Mark			9				

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
5		(a)	(i)		2	0.1 × 8 (1) 0.8 [kg m/s] (1)			
			(ii)		1	- 0.6 [kg m/s]			+0.6
			(iii)		1	Total momentum before collision = + 0.2 [kg m/s] (**ecf** from parts (i) &(ii) probably giving an answer of +1.4)			
			(iv)		1	Same answer as (iii)			
			(v)		2	$v_B = \frac{0.2}{0.2}$ 1 mark for the numerator (**ecf** from (iv)) 1 mark for the denominator (i.e. 0.2)	If no workings shown: Award 2 marks for an answer of 1 [m/s] Award 2 marks for an answer of 7 [m/s] when **ecf** applied		
		(b)	(i)		2	$t = \frac{(0-8)}{-160}$ 1 mark for the numerator of (0 - 8) **or** (8 - 0) 1 mark for the denominator of -160 **or** 160 respectively	If no workings shown: Award 2 marks for an answer of 0.05 Award 1 mark for an answer of -0.05		
			(ii)		2	Force = 1.6 [N] (1) To the left / opposite [direction to force applied to B] (1)	In the negative vector / velocity direction (for second mark) Accept = -1.6 [N] for both marks Award 1 mark for: force on A is equal and opposite / same size and opposite		Force is backwards / same size
		Total Mark			11				

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
6		(a)	(i)		1	Gravity **and** radiation / pressure			
			(ii)		1	Forces are balanced / they are balanced	Equal and opposite / forces cancel each other out		The same / equal / because it has a supply of hydrogen / its balanced
		(b)	(i)		1	${}_1^1\mathrm{H} + {}_1^1\mathrm{H} + {}_1^1\mathrm{H} + {}_1^1\mathrm{H} \rightarrow {}_2^4\mathrm{He} + {}_1^0\mathrm{e} + {}_1^0\mathrm{e}$	$4{}_1^1\mathrm{H} \rightarrow {}_2^4\mathrm{He} + 2{}_1^0\mathrm{e}$		
			(ii)		3	Four hydrogen [nuclei] / protons join / fuse (1) to form a helium [nucleus] (1) and two positrons (1)	Antielectron instead of positron		Positive electron / react / bond / collide / alpha particle
		(c)			1	Energy / gamma is released	They annihilate / destroy each other / cancel each other out	An explosion takes place	They neutralise each other
		Total Mark			7				

Question Number				
FT	HT	Sub-section	Mark	Answer
7			6	**Indicative content:** Conduction in solids occurs because the atoms are regularly positioned and are close together. The atoms in the hot part of the solid vibrate faster than those elsewhere. They pass on their energy to their neighbours by collisions and so the energy travels through the solid. In metals this is improved by free electrons which move at speed from the hot region, colliding with metal ions in the lattice, transferring their energy in the process. Convection occurs in gases because the particles in the hotter region have more energy and push each other further apart in violent collisions. This region becomes less dense and rises above the cooler region setting up a circulating current, transferring thermal energy to all parts of the gas. **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.
		Total Mark	6	

PHYSICS 3 Summer 2015
Higher Tier

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	1	(a)	(i)		2	0.1 × 8 (1) 0.8 [kg m/s] (1)			
			(ii)		1	- 0.6 [kg m/s]			+0.6
			(iii)		1	Total momentum before collision = + 0.2 [kg m/s] (**ecf** from parts (i) &(ii) probably giving an answer of +1.4)			
			(iv)		1	Same answer as (iii)			
			(v)		2	$v_B = \frac{0.2}{0.2}$ 2 mark for the numerator (**ecf** from (iv)) 1 mark for the denominator (i.e. 0.2)	If no workings shown: Award 2 marks for an answer of 1 [m/s] Award 2 marks for an answer of 7 [m/s] when **ecf** applied		
		(b)	(i)		2	$t = \frac{(0-8)}{-160}$ 1 mark for the numerator of (0 - 8) **or** (8 - 0) 1 mark for the denominator of -160 **or** 160 respectively	If no workings shown: Award 2 marks for an answer of 0.05 Award 1 mark for an answer of -0.05		
			(ii)		2	Force = 1.6 [N] (1) To the left / opposite [direction to force applied to B] (1)	In the negative vector / velocity direction (for second mark) Accept = -1.6 [N] for both marks Award 1 mark for: force on A is equal and opposite / same size and opposite		Force is backwards / same size
		(c)			3	Before KE = ($\frac{1}{2}$ × 0.1 (8^2)) +($\frac{1}{2}$ × 0.2 (3^2)) = 3.2 + 0.9 = 4.1 [J] (1) After KE = 0 +($\frac{1}{2}$ × 0.2 (1^2)) = 0.1 [J] (1) **ecf** from (a)(v) KE lost = 4.1 – 0.1 = 4.0 [J](1) N.B. **ecf** from (a)(v) gives KE = 0 +($\frac{1}{2}$ × 0.2 (7^2)) = 4.9 [J] and energy loss = -0.8 [J]	Award mark for correct subtraction where energies are wrong		Final answer of 0.8 from **ecf**s (Award 2 max for KE calculations)
		Total Mark			14				

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	2	(a)	(i)		1	Gravity **and** radiation / pressure			
			(ii)		1	Forces are balanced / they are balanced	Equal and opposite / forces cancel each other out		The same / equal / because it has a supply of hydrogen / its balanced
		(b)	(i)		1	$^{1}_{1}\mathrm{H} + {}^{1}_{1}\mathrm{H} + {}^{1}_{1}\mathrm{H} + {}^{1}_{1}\mathrm{H} \rightarrow {}^{4}_{2}\mathrm{He} + {}^{0}_{1}\mathrm{e} + {}^{0}_{1}\mathrm{e}$	$4\,{}^{1}_{1}\mathrm{H} \rightarrow {}^{4}_{2}\mathrm{He} + 2\,{}^{0}_{1}\mathrm{e}$		
			(ii)		3	Four hydrogen [nuclei] / protons join / fuse (1) to form a helium [nucleus] (1) and two positrons (1)	Antielectron instead of positron		Positive electron / react / bond / collide / alpha particle
			(iii)		3	Mass on left hand side = $4 \times 1.00728 = 4.02912$ (1) [Mass on right hand side = 4.00151] Mass defect = 4.02912 **ecf** – 4.00151 = 0.02761 [u] (1) $E = mc^2$ =0.02761 **ecf** $\times 1.66 \times 10^{-27}$ $= 4.58326 \times 10^{-29}$ [kg] (1) $\times (3 \times 10^{8})^2 = 4.12 \times 10^{-12}$ [J] (1) **Alternative solution:** LHS: $4 \times 1.00728 = 4.02912$ (1) 4.02912 **ecf** $\times 1.66 \times 10^{-27} = 6.6883392 \times 10^{-27}$ [kg] **and** RHS: $4.00151 \times 1.66 \times 10^{-27} = 6.6425066 \times 10^{-27}$ [kg] (1) LHS: 6.6883392 **ecf** $\times (3 \times 10^{8})^2 = 6.01950528 \times 10^{-10}$ [J] **and** RHS: $6.6425066 \times (3 \times 10^{8})^2 = 5.97825594 \times 10^{-10}$ [J] (1) Energy loss = (6.01950528 - 5.97825594) $\times 10^{-10}$ J $= 4.12 \times 10^{-12}$ [J] (1)			
		(c)			1	Energy / gamma is released	They annihilate / destroy each other / cancel each other out	An explosion takes place	They neutralise each other
		Total Mark			11				

Question Number				
FT	HT	Sub-section	Mark	Answer
	3		6	**Indicative content:** Conduction in solids occurs because the atoms are regularly positioned and are close together. The atoms in the hot part of the solid vibrate faster than those elsewhere. They pass on their energy to their neighbours by collisions and so the energy travels through the solid. In metals this is improved by free electrons which move at speed from the hot region, colliding with metal ions in the lattice, transferring their energy in the process. Convection occurs in gases because the particles in the hotter region have more energy and push each other further apart in violent collisions. This region becomes less dense and rises above the cooler region setting up a circulating current, transferring thermal energy to all parts of the gas. **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.
		Total Mark	6	

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	4	(a)			2	Full core drawn so as to pass inside both coils and labelled <u>IRON CORE</u> (1) Function is to take the magnetic field [from the primary coil] into the secondary coil / linking the <u>magnetic field</u> of primary and secondary coils (1)	To increase the field strength through the secondary coil		A half core drawn or a single line drawn Links the two coils for the 2nd mark
		(b)	(i)		2	As the number of turns on the input coil increases, the output voltage decreases (1) at a decreasing rate (1)	Award 1 mark for negative correlation Award 2 marks for inversely proportional		….in a non-linear way / non-uniform way / reference to the gradient
			(ii)		2	$\frac{400}{60} = \frac{2\,000}{N_2}$ (e.g. using paired values from graph) (1-subs) $N_2 = 2\,000 \times \frac{60}{400} = 300$ (1-ans)			
			(iii)		3	(1-for 120 from graph) $P = VI$ so $I = \frac{480}{120}$ (1-substitution) $I = 4$ [A] (1-manipulation and answer)	480 = 120 × I gets first 2 marks Use of voltage value between 0 – 230 V		
			(iv)		1	Line drawn to the left and always below the line that is given in the question			Any touching of the original line
		Total Mark			10				

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	5	(a)	(i)		3	Scale added to temperature axis in 10 °C intervals (1) Points ± ½ small square division (1) Best fit straight line with some points either side (1)			
			(ii)		1	Decreases			0 K
			(iii)		1	0 [J]			
		(b)			4	T_1 = 270 K, T_2 = 315 K $p_1 = 3 \times 10^6$, p_2 = ? $p_2 = p_1 \times \frac{T_2}{T_1} = 3 \times 10^6 \times \frac{315}{270}$ (1 – temp conversions) (1 – substitution) $p_2 = 3.5 \times 10^6$ (1- manipulation and answer) Comment which is dependent on their calculation (1) e.g. if correct answer – no danger of explosion stated	$\frac{p_1}{T_1} = \frac{p_2}{T_2}$ $\frac{3 \times 10^6}{-3} = \frac{p_2}{42}$ $p_2 = -42 \times 10^6$ [Pa] No danger of explosion Award: 0 for Kelvin conversion 1 for substitution of - 3 °C 1 for answer **with** negative sign 1 for correct comment based on their answer		
		Total Mark			9				

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	6	(a)			3	Speed = $\frac{1958\mathbf{(1)}}{240\mathbf{(1)}}$ = 8.1583 / 8.16 [km/s] (1)	8.2 [km/s]		8.15 [km/s]
		(b)			6	**Indicative content:** Similarities: • P and S waves will both arrive at Tokyo and Hawaii. • P waves will always arrive before S waves. Differences: • Tokyo and Hawaii traces will start later than Hong Kong because they have further to travel. Tokyo calculation for arrival of P waves: Time = $\frac{4\,100}{8.16}$ **ecf** = 502.6 s (8.4 min) [so trace starts at 2:36:24] Hawaii Calculation: Time = $\frac{11020}{8.16}$ **ecf** = 1351 s (22.5min) [so trace starts at 2:50:31] • Tokyo trace to have a greater gap (than Hong Kong trace) between P and S waves arriving. Hawaii trace to have an even longer gap between P and S waves arriving. <u>Delay Calculations</u>: From Hong Kong data: Speed of S wave: $\frac{1958}{485}$ = 4.04 km/s Tokyo time for S waves: $\frac{4\,100}{4.04}$ = 1 015.6 [s] [So Tokyo lag time: 1 015.6 – 502.6 = 513 [s]] Hawaii time for S waves: $\frac{11020}{4.04}$ = 2 729 [s] [So Hawaii lag time: 2 729 – 1 351 = 1 378 [s]] Amplitude at Tokyo less than Hong Kong and less still at Hawaii (These figures are within a range of 30 s depending on rounding off.)			

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	6					**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.			
		(c)			1	The earth in San Francisco may have a different stiffness or different density.	Incorrect change in velocity for a correct property. Waves travel faster in some rocks than others.		Different materials
		Total Mark			10				

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