GCSE MARKING SCHEME

SUMMER 2016

SCIENCE - PHYSICS P3
4503/01/02

INTRODUCTION

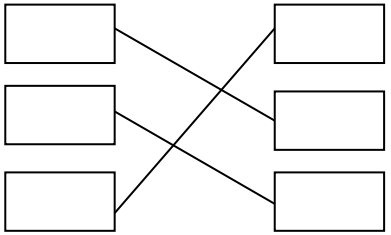
This marking scheme was used by WJEC for the 2016 examination. It was finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conference was held shortly after the paper was taken so that reference could be made to the full range of candidates' 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.

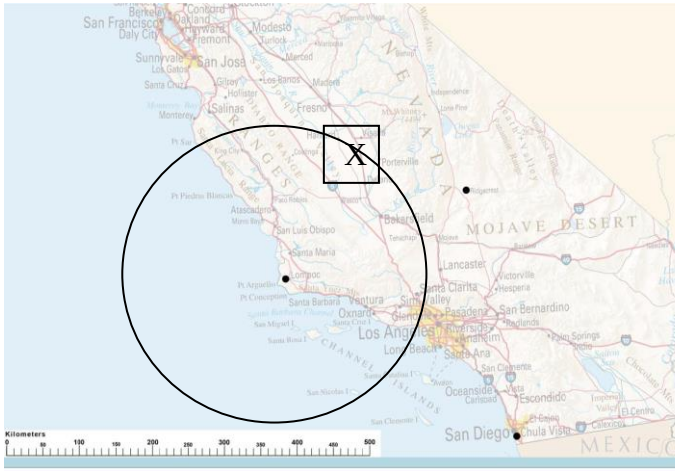
GCSE SCIENCE - PHYSICS P3

SUMMER 2016 MARK SCHEME

Question Number								
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
1		(a)			2	 All 3 lines correct – 2 marks 1 or 2 lines correct – 1 mark More than one line drawn from or to a box – loses 1 mark	Accept curved lines joining boxes		
		(b)			3	All 4 labels in correct places – 3 marks 2 or 3 labels correct – 2 marks 1 label correct – 1 mark Accept complete terms only			
		(c)			1	Magnetic field left to right across the diagram Arrow can be drawn anywhere	Not having a label		Curved line
		(d)			2	**Any 2 × (1) from**: • weaker magnet, • fewer turns on coil, • smaller current / lower voltage [cell or battery], • smaller [area] coil	Fewer coils /shorter coil / move magnets further apart / add a resistor / less field lines / smaller or decrease magnetic field		Smaller magnets / remove wires
		(e)			1	**Any 1 from:** • reversing the magnetic field / swap N + S [poles around] or magnets • reversing the cell/battery / change polarity of battery • reversing the current			Reversing cell <u>and</u> magnetic field / change the current
		Total			**9**				

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
2		(a)			1	75 [%]			
		(b)	(i)		1	4			
			(ii)		1	4			
			(iii)		1	Positron	positive electron / anti electron		
		(c)	(i)		2	Gravity / gravitation (1) [Radiation / gas] pressure (1)			Radiation on its own / expanding force
			(ii)		1	Our Sun is not big enough / not massive or heavy enough	It is too small / only supernovae produce uranium / only very big stars produce uranium		Any answer that doesn't refer to size e.g. only produces elements up to iron
		Total			**7**				

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
3		(i)			2	momentum = 50 000 × -2 (1-subs) = -100 000 [kg m/s] (1 –ans)	100 000 to the left gets 2 marks. NB1:50 000 × 2 = 100 000 gets 1 mark. NB2: 50 000 × -2 = 100 000 gets 1 mark NB3: 50 000 × 2 = -100 000 **gets 1 mark** NB4: 50 000 × 2 = 100 000 to the left **gets 1 mark**		50 000 + -2 = ±100 000
		(ii)			1	The negative of answer in (i) i.e. 100 000 [kg m/s] **ecf**			
		(iii)			2	Answer from part (ii) ÷ 80 000 (1-subs) = 1.25 [m/s] or correct answer for their substitution (1)	If no answer in part (ii) and answer from part (i) used to get a correct answer award 1 mark only		
		Total			**5**				

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
4		(a)	(i)		2	distance = 6 × 25 (1-subs) = 150 [km] (1-ans)	Use of scale – 3 × 50 = 150 [km]		
			(ii)		1	 The circle should be crossed in the position of the X marked above i.e. on the N, A or T of "NATIONAL"			
		(b)	(i)		1	P waves travel faster than S waves or converse		Reference to surface waves in addition to S waves	They set out later / surface waves are slower than P waves / S waves take longer to travel
			(ii)		1	6 hours [0]1 minute 42 seconds			01 min 42 secs or just 42 secs
		Total			**5**				

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
5		(a)			2	Temperature = 0 [K] - 1 mark Pressure = 12 [N/cm^2] – 1 mark			
		(b)			2	The molecules travel faster / have more energy (1) More frequent / harder collisions / collide more often [with the container] (1)		More frequent / harder collisions with each other	They collide more / there is more energy / increased number of collisions
		Total			**4**				

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
6		(a)			1	The speeds are bigger [between 2 and 4 seconds]	The speed is bigger / moving faster / it is accelerating		
		(b)	(i)		2	$a = \frac{(40-10)}{(4-1)}$ using any matching speeds and times (1) = 10 [m/s^2] (1-ans)	Errors in expression e.g. (40 – 10) = $\frac{30}{3}$ = 10 [m/s^2] award 2 marks		Confusion between u and v values
			(ii)		2	$x = \frac{1}{2}(20+40) \times 2$ (1-sub) = 60 [m] (1-ans)			
		(c)			1	<u>Air resistance</u> has a bigger effect [on the feather than on the stone.]	Because the feather is lighter / smaller mass		More air resistance acts on the feather / smaller terminal velocity / feather is less dense / less momentum / reference to surface area
		Total			**6**				

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
7	**1**	(a)			1	It has more <u>secondary</u> or <u>output</u> turns or coils [than primary turns] or converse	A <u>step-down</u> transformer has more <u>primary or input</u> turns or coils [than secondary turns]		Reference to left and right
		(b)			2	Ticks in the 2nd i.e. Decreasing the number of turns on the primary coil (1) and 4th boxes i.e. Increasing the number of turns on the secondary coil (1) If 3 boxes ticked a maximum of 1 mark can be awarded			
		(c)			2	An a.c. creates a changing [magnetic] field (1) which creates / induces a voltage / current in the <u>secondary or output</u> coil (1) **The 2nd mark can only be awarded if it is linked to the 1st mark.**	Changing flux	Reference to linkage	Moving magnetic field / cutting flux / core flips
		(d)	(i)		1	100			
			(ii)		3	All plots correct (2) (-1 for each incorrect plot – no tolerance allowed) **ecf from (i)** Straight line through the points from 50 – 300 turns (1)		Line extended back to origin	Thick, wobbly, disjointed, wispy lines
			(iii)		2	Output voltage increases as number of secondary turns increase (1) proportionally / uniformly / constant rate (1) **OR** output voltage is proportional to number of secondary turns (2)	Voltage doubles as turns double (2) Positive correlation (1)		
			(iv)		1	125 – no tolerance	Reading from their line		
			(v)		2	Less steep line / smaller gradient (1) because each output or voltage would be less [halved] (1) **The 2nd mark can only be awarded if it is linked to the 1st mark.**	Voltages would be smaller (1)	Line would be different	Graph increases less
		Total			**14**				

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
8	**2**	(a)	(i)		1	*c* shown in correct position on middle drawing i.e. drawn between the normal and the ray	Labelling using the words critical angle or 42^{o}		
			(ii)		6	**Indicative content:** When the angle of incidence is less than the critical angle the light is refracted away from the normal as it passes into the air (A). This happens because light travels faster in air than in glass **or** the light is travelling into an optically less dense medium. When the angle of incidence is equal to the critical angle the light just escapes from the glass and travels along the glass-air boundary (B). If the angle of incidence is greater than the critical angle then total internal reflection occurs (C). TIR occurs when light is travelling from a more dense towards a less dense medium at an angle bigger than the critical angle. **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.			
		(b)			3	Correct refraction at A i.e. refracted towards the normal (1) TIR shown - at the glass sides with straight lines (1) reflections show $i = r$ by eye (1)			
		Total			**10**				

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	3	(a)	(i)		2	Forces due to gravity / gravitation **and** [gas/radiation] pressure named (1) Which are balanced / equal and opposite (1) **The 2nd mark can only be awarded if it is linked to the 1st mark.**	Cancels each other out		Equal only / one force counters the other / radiation energy
			(ii)		2	Red giant (1) White dwarf (1) Need the correct order			Red supergiant Planetary nebula
			(iii)		2	4 (1) 2 (1)			
		(b)			3	$3.9 \times 10^{26} = m \times (3 \times 10^{8})^{2}$ (1) Manipulation (1) Answer = 4.33×10^{9} [kg] (1)	If no substitution shown: $\frac{3.9 \times 10^{26}}{3 \times 10^{8}} =$ 1.3×10^{18} award the manipulation mark only		Use of KE equation
		Total			**9**				

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	4	(a)			2	Substitution into $x = ut + ½ at^2$ i.e. $x = [0 +] (½ \times 10 \times 2.8^2)$ (1) Answer = 39.2 [m] (1)	Combinations of equations of motion – find the mean speed (14 m/s) (1) and use of distance = speed × time = 39.2 [m] (1)		$2.8 \times 28 =$ 78.4 [m]
		(b)			3	Substitution into $v = u + at$ i.e. $v = [0] + 10 \times 2.8$ (1) v = 28 [m/s] (1) Momentum = mv = 0.3×28 (**ecf**) = 8.4 [kg m/s] (1)	Use of energy argument to get value for v i.e. PE = 117.6 J (**ecf**) (1) use KE to find v = 28 [m/s] (1) Substitution into $v^2 = u^2 + 2ax$ **ecf** on x (1) v = 28 [m/s] (1)		
		(c)	(i)		2	Substitution into KE = $½ mv^2$ i.e. KE = $½ \times 0.3 \times 14^2$ (1) Answer = 29.4 [J] (1)			KE = $½ \times 0.3 \times 14$
			(ii)		2	Momentum after bounce = [-] 4.2 (1) Change in momentum = - 4.2 - 8.4 **ecf** = [-]12.6 [kg m/s] (1)	Change in momentum = 8.4 **ecf** + answer for momentum after bounce – award 2 marks		
			(iii)		2	Change in momentum of the ball (1) is equal [and opposite] to the change in momentum of the Earth (1) **The 2nd mark can only be awarded if it is linked to the 1st mark.**			Statement of principle of conservation of momentum
		(d)			2	Force on Earth / ground from the ball (1) <u>equal and opposite</u> force on ball from Earth / ground (1)	Force on Earth from the ball = force on ball from Earth (1)		Statement of N3rd Law
		Total			**13**				

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	5	(a)	(i)		1	100 000	100 with a k added in front of the Pa		
			(ii)	I	4	Use of pV = constant i.e. $100\,000 \times 3.8 \times 10^{-4} = 38$ (1) So $p_D = \frac{38}{V_D} = \frac{38}{5 \times 10^{-4}}$ (1) = 76 000 Pa (1) **answer + unit** Use of graph to find altitude = 1 600 (± 50) (1) **ecf** on p	Correct substitution into $p_1V_1 = p_2V_2$ award 2 marks $\frac{pV}{T}$ = 0.1297 (1) $p_D = \left(\frac{0.1297}{5 \times 10^{-4}}\right) \times 293$ (1) = 76 000 Pa (1) **answer + unit** Allow calculations in kPa		
				II	3	Use of $\frac{p}{T}$ = a constant $\frac{76\,000}{293} = \frac{100\,000}{T}$ (1) T = 385.5 K (1) So: 385.5 (**ecf**) – 273 = 112.5 [^oC] (1)	Use of $\frac{pV}{T}$ = constant i.e. $\frac{(76\,000 \times 5 \times 10^{-4})}{293} = \frac{38}{293}$ = 0.1297 (1) $100\,000 \times 5 \times 10^{-4} = T \times 0.1297$ T = 385.5 K (1) So: 385.5 (**ecf**) – 273 = 112.5 [^oC] (1) Allow calculations in kPa Accept a ratio of 1.3 – 1 mark		

Question Number								
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
		(b)			6	**Indicative content:** Gas molecules move slower / have lower energy at lower temperature. The separation of molecules is less at lower temperatures and they collide with the walls less frequently. The volume and pressure of a gas are proportional to the absolute temperature measured in Kelvin. Absolute zero is the temperature at which the energy / speed of molecules would be zero as would the pressure and volume. The absolute temperature scale (measured in K) uses the properties whereby zero volume and zero pressure coincide with 0 K. **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			**14**				