GCE MARKING SCHEME

SUMMER 2016

PHYSICS PH1 - (LEGACY)
1321/01

INTRODUCTION

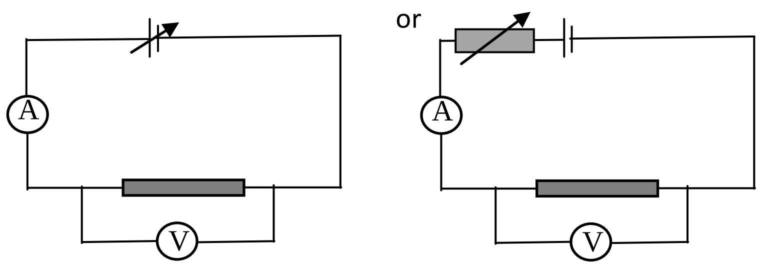
This marking scheme was used by WJEC for the 2016 examination. It was finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conference was held shortly after the paper was taken so that reference could be made to the full range of candidates'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

WJEC GCE PHYSICS PH1 - (LEGACY)
SUMMER 2016 MARK SCHEME

Question				Marking details	Marks Available
1	*(a)*			Vertical forces considered correctly e.g. 40 N forces cancel or $\Sigma F = 0$ in vertical plane (1) Horizontally, ΣF = 20 [N] to the left (1) Allow -20 [N]	[2]
	(b)	(i)		$T\cos36° = 800$ (1) T = 989 [N] (1) Accept 990 N but not 1 000 N	[2]
		(ii)		Vertical component of tension, T_v = 800tan36° = 581 N **Or** $T\sin36°$ = 581 N (1) L = 6 000 – 581 **or**: $T\sin36° + L$ = 6 000 (or equivalent seen) (1) = 5 419 [N] (1) (**ecf** on T_v)	[3]
	(c)			$v = \frac{40000}{800}$ [Sub into $P = Fv$] (1) v = 50 [m s^{-1}] (1)	[2]
				Question 1 total	**[9]**
2	*(a)*			Gradient (or acceleration) shown to be = $\frac{v-u}{t}$ (1) At least one algebraic step shown towards derivation of $v = u + at$ (1) Accept correct comparison with $y = mx + c$ and m equivalent to a stated (1) logical use of symbols to show $v = u + at$ (1)	[2]
	(b)	(i)		Two 'circles' positioned correctly on 'fired' flight-path- by eye (1) Initial vertical velocity of both fired and dropped balls = 0 (1) Accept "same" Vertical plane - acceleration at '9.81 m s^{-2}', same as 'dropped' ball (1) Accept "same vertical acceleration" Don't accept the only force acting on them is weight	[3]
		(ii)	I	Substitution into $s = ½ at^2$ [½ × 9.81 × 3.2^2] (1) s = 50.2 [m] (1)	[2]
			II	Vertical velocity = 31.4 [m s^{-1}] (1) Horizontal velocity = 112.5 [m s^{-1}] (1) Resultant velocity [31.4^2 + 112.5^2]$^{1/2}$ = 116.8 [m s^{-1}] (**ecf**) (1) At 15.6° below horizontal or 74.4° to the vertical or shown by diagram (**ecf**) (1)	[4]
				Question 2 total	**[11]**

Question			Marking details	Marks Available
3	*(a)*	(i)	Force × perpendicular distance from pivot or equivalent	[1]
		(ii)	$F \times 70 = 83.4 \times 12$ [2 × 1 marks for correct clockwise and anti-clockwise moments] F = 14.3 [N] (1)	[3]
		(iii)	83.4 **–** 14.3 = 69.1 [N] **ecf** on both mass and F	[1]
		(iv)	F needs to increase [to counteract this change/increase anti-clockwise moment] (1) C of G moved to right resulting in greater clockwise moment (1) Don't accept increased clockwise force	[2]
	(b)	(i)	$d = 2.2t$	[1]
		(ii)	$d = 1.5\ (t + 14)$	[1]
		(iii)	$2.2t = 1.5\ (t + 14)$ (1) **ecf** from (i) + (ii) t = 30 [s] (1) $d = 2.2 \times 30$ **ecf** (1) = 66 [m] **Or** substitute $t = \left(= \frac{d}{2.2}\right)$ from (i) into (ii) (1) Clear algebraic step (1) d = 66 [m] (1)	[3]
			Question 3 Total	**[12]**
4	*(a)*	(i)	Method of varying voltage (1) Ammeter and voltmeter positioned correctly and circuit correct (1) 	[2]

Question			Marking details	Marks Available
		(ii)	Suitable scales on both axes (0.1 intervals and start at origin) and axes labelled (1) All points plotted correctly (no tolerance) and line through all points and origin (± ½ small square tolerance) (1)	[2]
		(iii)	Resistance of conductor = 1.25 Ω **or** $\frac{V}{I}$ used in $\rho = \frac{RA}{l}$ (1) CSA calculated correctly or shown as πr^2 or equivalent (1) Sub: $\rho = \frac{1.25 \text{ x } \pi \text{ x} (2 \text{ x } 10^{-4})^2}{1.45}$ (10.8×10^{-8} [Ω m] seen) (1)	[3]
		(iv)	Accurately straight to (0.60, 0.24) from origin	[1]
	(b)	(i)	Mass = 7 310 × 1.45 × π × $(2 \times 10^{-4})^2$ correct manipulation and substitution (1) **ecf** on A $M = 1.33 \times 10^{-3}$ [kg] (1)	[2]
		(ii)	$\frac{1.33\text{x}10^{-3}}{1.97\text{x}10^{-25}}$ (1) (**ecf** on M) (= 6.76×10^{21}) $6.76 \times 10^{21} \times 4 = 2.7 \times 10^{22}$ (1)	[2]
		(iii)	n calculated (= 1.48×10^{29}) **ecf** on N from (ii) **or** used as $\frac{2.7\text{x}10^{22}}{\pi(2\text{x}10^{-4})^2\text{x}1.45}$ **ecf** on A **or** $\frac{7310}{1.97\text{x}10^{-25}} \times 4$ (1) $v = \frac{I}{nAe}$ and substitution (1) $v = 1.07 \times 10^{-4}$ [m s^{-1}] (1) **Alternative:** Use (from algebra) of $v = \frac{Il}{eN}$ ($N = 2.7 \times 10^{22}$) (2) **ecf** on N from (ii) Answer as above (1)	[3]
			Question 4 Total	**[15]**

Question			Marking details	Marks Available
5	*(a)*	(i)	Diagram A: Current through X less than current through Y (or vice-versa) *pd* across X same as than *pd* across Y [Both statements correct for 1 mark]	[1]
		(ii)	Diagram B: Current through X same as current through Y *pd* across X greater than *pd* across Y [Both statements correct for 1 mark]	[1]
	(b)	(i)	Resistance has decreased by factor 1.5 (or reduced to 2/3 original value) or other correct quantitative comparison. Do not accept reduced by 4 Ω (1) Therefore current increases by same factor (or × 1.5) etc. (1) Accept answers based on calculation: V across 12.0 Ω = 2.4 [V] (1) I through 8.0 Ω = $\frac{2.4}{8.0}$ (= 0.3 A) (1)	[2]
		(ii)	Current = 0.5 [A] (1) Total resistance = 10.8 [Ω] (1) 0.5 × 10.8 seen (1) **Alternative –** pd across parallel combination = 0.2 × 12 = 2.4 [V] (1) pd across 6.0 Ω = (0.2 + 0.3) × 6 = 3.0 [V] (1) Total pd = 2.4 + 3.0 (1) = [5.4 V]	[3]
		(iii)	Some voltage (accept energy) is lost/ given out as heat (1) .... in the internal resistance of the cell (1)	[2]
		(iv)	Substitution into $E = V + Ir$ (e.g. $r = \frac{6-5.4}{0.5}$) (1) r = 1.2 [Ω] (1) deduct 1 mark for incorrect sign	[2]
			Question 5 Total	**[11]**

Question				Marking details	Marks Available
6	*(a)*	(i)		**Before pd applied**: • [Free] electrons move randomly (vibrate)/no overall velocity/mean velocity zero/vector average velocity zero (1) reference to thermal velocity needs to be explained don't accept zero drift velocity only • [Free] electrons move very quickly/magnitude approx. 10^6 m s^{-1} (1) **After pd applied:** • [Free] electrons accelerated by pd/drift velocity/overall velocity due to pd (1) • Drift velocity is small/magnitude approx. 10^{-3} or 10^{-4} m s^{-1} (1)	[4]
		(ii)		Collisions between [free] electrons and lattice atoms/atoms /ions of metal. Don't accept molecules	[1]
	(b)	(i)	I	Use of $Q = It$ or area under graph: (0.05 × 5) (= 0.25) (1) × 3 600 Therefore Q = 900 [C] (1) [Accept 0.25 **Amp-Hours**] for second mark Deduct 1 mark for power of 10 slip	[2]
			II	Q = ½ × 1 × 0.05 × 3 600 = 90 [C] **ecf** on t and I	[1]
		(ii)		Substitution into $E = QV$ (900 × 3.2) **ecf** on 900 (1) E = 2 880 [J] **(**1) **Or** Substitution into I^2Rt or $\frac{V^2t}{R}$ (must include R given as $\frac{3.2}{0.05}$ or 64 Ω) (1) **ecf** on 0.05 and t E = 2 880 [J] **(**1)	[2]
		(iii)		$\frac{2\,880(\text{ecf})}{5 \times 3\,600}$ = 0.16 W **or** $\frac{0.25 \times 3.2}{5}$ = 0.16 W **or** 3.2 × 0.05 = 0.16 W **unit mark** Accept J s^{-1} or correct equivalent **ecf** on t and I	[1]
				Question 6 Total	**[11]**

Question			Marking details	Marks Available
7	*(a)*	(i)	Force per unit extension. Accept $\frac{F}{e}$ (or x) only if e (or x) defined as extension.	[1]
		(ii)	Base units of F shown: kg m s^{-2} (1) $\frac{\text{kg m s}^{-2}}{\text{m}}$ seen (1) **Alternative:** Base units of W shown: kg m^2 s^{-2} (1) $\frac{\text{kg m s}^{-2}}{\text{m}}$ seen (1) **Alternative:** Rearrangement of $T = 2\pi\sqrt{\frac{m}{k}}$ to show that $k = 4\pi^2 \frac{m}{T^2}$ (1) Units of k shown to be kg s^{-2} (1)	[2]
	(b)	(i)	4.0 N extends the spring by 0.20 m seen (1) award extension mark if 0.45 – 0.25 is seen (or 0.20) **Or** $k = \frac{4.0}{0.20}$ (gains first 2 marks) k = 20 [N m^{-1}] (1) Assumption: Hooke's law obeyed or force proportional to extension or elastic limit not reached (1)	[3]
		(ii)	1.0 N produces an extension of 0.05 m (or any other well-reasoned comment) (1) Original length = 0.20 [m] (1) Award 1 mark only for unsupported answer	[2]
		(iii)	Extension = 0.25 [m] **ecf** from (ii) (1) **Either:** Correct substitution into $W = ½ Fx$ (½ × 5.0 × 0.25) (1) W = 0.625 [J] (1) **Or:** Correct substitution into $W = ½ kx^2$ (½ × 20 **ecf** × 0.25^2) (1) W = 0.625 [J] (1) Use of 0.45 m award 0 marks	[3]
			Question 7 Total	**[11]**