GCE AS MARKING SCHEME

SUMMER 2017

AS (NEW)
PHYSICS - UNIT 1
2420U10-1

INTRODUCTION

This marking scheme was used by WJEC for the 2017 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.

GENERAL INSTRUCTIONS

Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark (except for the extended response question).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

Marking rules

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

Extended response question

A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with both the content statements and the communication statement.

Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao = correct answer only
ecf = error carried forward
bod = benefit of doubt

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
1	*(a)*		Ductile: Can be drawn into wires **or** can be easily deformed [plastically] (1) Don't accept reference to malleability Steel: addition of [carbon] atoms inhibits movement / correct reference to impact of atoms on movement (1) of [edge] **dislocations** (1) Don't accept any reference to planes of atoms slipping over each other – needs movement of dislocation	3			3		
	(b)	(i)	$\varepsilon = 7.5 \times 10^{-4}$ **or** 7.5×10^{-2} % - no unit penalty		1		1	1	
		(ii)	$\sigma = \varepsilon \times E$ $= 200 \times 10^{9} \times 7.5 \times 10^{-4}$ (1) (substitution) **(ecf on ε)** $= 1.5 \times 10^{8}$ [N m^{-2} or Pa] (1)	1	1		2	2	
		(iii)	Force = $\sigma \times$ CSA $= 1.5 \times 10^{8} \times \pi\ (0.3 \times 10^{-3})^{2}$ (1) (conversion and substitution) **(ecf on σ)** = 42[.4 N] (1) **N.B. no marks for using diameter but ecf for powers of 10 error in radius e.g. using 0.3^2**		2		2	2	
		(iv)	$W = ½\ F\ \Delta l$ $= ½ \times 42.4 \times 1.8 \times 10^{-3}$ (1) **(ecf on force)** = 0.038 [J] or 0.04 [J] (1) **Alternative:** Use of $½\ kx^2$ substitution (1) and answer (1)	1	1		2	2	

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
	(c)	(i)	**T** on lower surface between the pillars **and C** on upper surface - accept in pillars	1			1		
		(ii)	Pre-stressed bar drawn horizontally inside concrete beam from inner edges of supports, towards lower surface (on or below mid-point). Don't accept rectangular shapes which overlap the middle of the concrete beam or go underneath.	1			1		
		(iii)	**Concrete / beam under compression** (accept reduces tension) / cracks **in concrete / beam** forced to close (1) Inhibits crack propagation (1)		2		2		
			Question 1 total	**7**	**7**	**0**	**14**	**7**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
2	*(a)*	(i)		Mean = 50 cm (1) [accept 49.8 cm] Uncertainty = $\frac{(54-46)}{2}$ = [±] 4 cm (1) [accept 4.0 cm] **Alternative for 2nd mark:** Uncertainty = 54 - 49.8 = 4.2 cm (1) [accept 4.0 cm or 4 cm]		2		2	2	2
		(ii)		% uncertainty = $\left(\frac{4}{50}\right)$ x 100 (**ecf on mean and uncertainty)** = ± 8% accept 8.4 % if alternative method used in (i) allow 1 or 2 sig figs		1		1	1	1
	(b)	(i)		Conservation of energy (1) accept energy can't be created or destroyed – don't accept principle of energy Energy held in / work done by compressed spring transferred to gravitational potential energy (1) Accept: $\frac{1}{2} kx^2 = mgh_{mean}$	1	1		2		
		(ii)	I	Very small uncertainty in both measurements **or** high precision **or** small resolution [when compared to uncertainty in jump height] (1) Accept calculations – 0.3% and 0.02%. Don't accept reference to accuracy Hence negligible effect on [overall] uncertainty **or** when compared to 8% (1)			2	2		2
			II	Substitution: e.g. $k = \frac{(2 \times 48.4 \times 10^{-3} \times 9.81 \times 50)}{3.20^2}$ (**ecf on mean**) Ignore powers of 10 (1) k = 4.6 N cm^{-1} **or** 460 N m^{-1} **(unit mark)** (1) accept 4.62 or 462 if 49.8 used and unit J m^{-2} Uncertainty = ± 8% × 4.64 = ± 0.4 N cm^{-1} or 40 N m^{-1} (1) (**ecf on both % uncertainty and k)** **Allow 1 or 2 sig figs or same number of sig figs as h** **Accept answers when uncertainties in mass and x have been calculated by candidates e.g. total uncertainty = 8.32%**	1	1 1		3	3	3

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
			III	Candidate's answer to k too low or actual value of k higher (1) h affected by air resistance or energy lost due to vibrations during take-off or toy moves slightly before release so x is not = 3.20 cm or less than 100% of the EPE is transferred to GPE (1) Don't accept only general references to sound and heat			2	2		2
	(c)			Use freeze frame technology/ camera/ i-Pad etc to measure jump height [with greater precision or more accurately] Multiple repeats <u>of h</u> [to reduce random error] Accept laser or light distance measuring system to measure distance [with greater precision or more accurately] Don't accept use of light gates or using a different spring or reduce parallax error			1	1		1
				Question 2 total	**2**	**6**	**5**	**13**	**6**	**11**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
3	*(a)*	(i)	Acceptable line of best fit by eye – bisects data points at (0.4,0.925) and (0.5,1.25) (1) Doesn't need to pass through zero but needs to be drawn back to an axis Gradient calculated. Accept range: 2.3 – 2.5 (1) No unit penalty		2		2	2	2
		(ii)	Unit of force (Newton) seen as kg m s^{-2} (1) $\frac{\text{m s}^{-2}}{\text{kg m s}^{-2}}$ seen [= kg^{-1}] (1) Accept: Gradient = $\frac{a}{F} = \left(\frac{\text{N}}{\text{kg N}}\right)$ argument award 2 marks	1	1		2	1	2
		(iii)	$\frac{1}{\text{gradient}}$ = 0.40 – 0.44 [kg] (1) (**ecf** on gradient). Accept correct use of data points. 0.42 = M + 0.06 (1) M = 0.36 [kg] (1) Accept range: 0.34 – 0.38 [kg]			3	3	3	3
		(iv)	Quality: Points lie close to line of best fit so quality acceptable or reference to possible anomaly at 0.5 N (1). Don't accept reference to measuring apparatus. Sufficiency: Too few points plotted **or** more needed between 0.0 and 0.4 N or results missing at e.g. 0.1 N or 0.3 N (1)			2	2		2
	(b)	(i)	Weight of glider = 9.81 × M (= 3.1 – 3.7) N (**ecf on M**) (1) Force due to air must be **same answer** as weight of glider (1)		2		2	1	
		(ii)	Forces act on the same body (1) Forces are not of the same kind **or** details provided e.g. contact/electrostatic and gravitational (1)	2			2		
			Question 3 total	**3**	**5**	**5**	**13**	**7**	**9**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
4	*(a)*		[A surface that] absorbs all em radiation falling on it / perfect absorber [and emitter] of em radiation / no body is a better emitter of radiation at any wavelength than a black body at the same temperature	1			1		
	(b)	(i)	Polaris [surface] temperature > Chi Pegasi [surface] temperature (1) Intensity of radiation from Polaris > Chi Pegasi [for all λs] accept Polaris brighter than or more luminous than Chi Pegasi (1) Polaris appears 'blue-white' **and** Chi Pegasi appears 'red-orange' (1) Don't accept they are different colours	3			3		
		(ii)	Peak λ identified (400 nm) (1) Application of Wien's law: $\frac{2.9 \times 10^{-3}}{400 \times 10^{-9}}$ = [7 250 K](1) **Alternative:** $\frac{2.9 \times 10^{-3}}{7\,250}$ seen (1) Reference to peak wavelength on graph (400 nm) (1) **Alternative:** Peak wavelength (400 nm) and 7 250 K used correctly (1) to confirm Wien's constant (1)	1	1		2		
		(iii)	$L = 4.05 \times 10^{-9} \times 4\pi \times (431 \times 9.46 \times 10^{15})^2$ (1) - substitution $L = 8.46 \times 10^{29}$ [W] seen (1)	1	1		2	2	
		(iv)	$A = \frac{8.46 \times 10^{29}}{5.67 \times 10^{-8} \times (7\,250)^4}$ (1) - substitution $A = 5.40 \times 10^{21}$ m^2 (1) $4\pi r^2 = 5.40 \times 10^{21}$ $r = 2.07 \times 10^{10}$ [m] (1) (**ecf** on A)		3		3	3	
			Question 4 total	**6**	**5**	**0**	**11**	**5**	**0**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
5	*(a)*		$v = at$ and $v^2 = 2ax$ seen (i.e. consequence of u = 0 on equations) (1) $a^2t^2 = 2ax$ seen (1) [implies first mark]	1	1		2	2	
	(b)		Graph 3 (1) Vertical: constant acceleration due to [force of] gravity (1) Horizontal: **no** acceleration (accept constant speed or constant velocity) because no forces act (1)	1	1 1		3	1	
	(c)	(i)	$t = \frac{1.8}{3.4}$ [= 0.53 s] (1) Height = ½ × 9.81 × 0.53^2 (1) substitution and u = 0 **(ecf on *t*)** Height = 1.37 [m] (1)	1	1 1		3	3	
		(ii)	Vertical velocity = 9.81 × 0.53 = 5.2 [m s^{-1}] (1) **(ecf on *t*)** [Alternative: vertical velocity = $((2 \times 9.81 \times 1.37)^{1/2})$ **(ecf on *h*)** Pythagoras: $V_R^2 = 5.2^2 + 3.4^2$(1) **(ecf on vertical velocity)** V_R = 6.2 [m s^{-1}] (1) At 57° to the horizontal (1) (apply **ecf** if incorrect vertical or resultant velocity used to calculate angle)	1	1 1 1		4	4	
	(d)		Untrue **and** link to ... Flight time depends on **(two** × (1) **from):** • drop height • acceleration [due to gravity] • [initial] vertical velocity [Award 1 mark only for untrue because horizontal and vertical motions are independent of each other]			2	2		
			Question 5 total	**4**	**8**	**2**	**14**	**10**	**0**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
6	*(a)*		No net force (1) Accept resultant of or sum of. Don't accept equal forces. No net moment (1) Accept all or sum of CM = sum of ACM	2			2		
	(b)		Moments taken about hinge. Clockwise moment shown to be 240 $\times$ 2 or 480 seen (1) Anticlockwise moment: T sin 35° $\times$ 1.4 seen (or cos 55°) (1) T = 597.8 [N] (1)		3		3	3	
	(c)	(i)	1.5 mm cable (1) Safe working load > than 600 N [at 3:1 ratio] **or** only just above 600 N so to be safe will use 2 mm cable (1)			2	2	1	
		(ii)	**Accept two** $\times$ (1) from the following options: • Shopkeeper does not have necessary expertise to decide on appropriate cable to use • Should seek advice of engineer as suggested on web page or expert advice • Shopkeeper should verify/ validate/ confirm/ authenticate wire rope data • Taken rod to be weightless • [If unsure] should have opted for higher diameter or applied higher safer working ratio • Weather/high winds could affect tension • Chosen wire does support the sign so made an informed choice			2	2		
			Question 6 total	**2**	**3**	**4**	**9**	**4**	**0**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
7			1.Neutron decays into a proton, electron and an electron antineutrino 2.Charge conservation shown: $0 \rightarrow +1 + (-1) + 0$ 3.Baryon conservation shown: $1 \rightarrow 1 + 0 + 0$ **or** quark number conservation shown: $3 \rightarrow 3 + 0 + 0$ 4.Lepton conservation shown: $0 \rightarrow 0 + 1 + (-1)$ 5.Quark analysis shown: udd → uud **or** d quark 'becomes' an u quark so neither u quark number or d quark number are individually conserved there is a change in quark flavour 6.This is a 'weak' interaction (or interaction involving the weak force) because neutrino involvement or change in quark flavour **5-6 marks** 5 or 6 of the above areas covered accurately *There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured.* **3-4 marks** 3 or 4 of the above areas covered accurately or attempt made at 5 or 6 areas *There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure.* **1-2 marks** 1 or 2 of the above areas covered accurately or attempt made at 3 or more areas *There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure.* **0 marks** *No attempt made or no response worthy of credit.*	4	2		6		
			Question 7 total	**4**	**2**	**0**	**6**	**0**	**0**

AS UNIT 1: Motion, Energy and Matter

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	7	7	0	14	7	0
2	2	6	5	13	6	11
3	3	5	5	13	7	9
4	6	5	0	11	5	0
5	4	8	2	14	10	0
6	2	3	4	9	4	0
7	4	2	0	6	0	0
TOTAL	**28**	**36**	**16**	**80**	**39**	**20**