GCSE MARKING SCHEME

SUMMER 2019

PHYSICS COMPONENT 1 – HIGHER TIER
C420UA0-1

INTRODUCTION

This marking scheme was used by WJEC for the 2019 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 PHYSICS

COMPONENT 1 – Concepts in Physics

HIGHER TIER

MARK 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)*			[Positively charged] nucleus (1) surrounded by [negatively charged] electrons (1) electrons in different orbits or energy levels or shells with the nuclear radius much smaller than that of the atom / almost all of the mass in the nucleus (1)	3			3		
	(b)			Any single digit number $\times$ 10^{-15}	1			1		
				Question 1 total	**4**	**0**	**0**	**4**	**0**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
2	*(a)*	(i)		Temperature is measured from the thermometer (1) Volume is measured from the syringe (1) Measure volume at different temperatures (1)	3			3		3
		(ii)		Temperature	1			1		1
		(iii)		Mass of air / air pressure	1			1		1
	(b)	(i)		Scales: t on x-axis including labels and units - 0 to 50 (2 cm per 10 °C **and** V: either 0 to 60 (2 cm per 10 cm^3) or 50 to 60 (1 cm per 1 cm^3) (1) All points plotted correctly (2) 5 points plotted correctly (1) 4 or less points plotted correctly (0) Straight line (1) Does not pass through origin so do not agree (1)			5	5	4	5
		(ii)		As temperature increases the molecules gain energy / speed up (1) And their separation increases (1)	2			2		
				Question 2 total	**7**	**0**	**5**	**12**	**4**	**10**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
3	*(a)*	(i)		Substitution: KE = $0.5 \times 450\,000 \times 80^2$ (1) KE = $0.5 \times 450\,000 \times 6\,400$ (1) = 1 440 000 000 or 1.44×10^9 [J] (1)	1	1 1		3	2	
		(ii)		Work done = gain in KE (1) Force = $\frac{1\,400\,000\,000}{950}$ subs and manip (1) = 1 515 789 or 1.5×10^6 [N] (1)	1	1 1		3	2	
		(iii)		Drag force also acts [on aeroplane as it speeds up] (1) Thrust = RF + drag so agree OR RF = Thrust – drag (1)			2	2		
	(b)	(i)		PE = mgh or by implication (1) = $450\,000 \times 10 \times 9\,200$ (subs and conv) (1) = 41 400 000 000 [J] (1) Answer of 41 400 000 gets (2) 4.14×10^n where n not equal to 10 (2)	1	1 1		3	2	
		(ii)		Power = $\frac{\text{work done}}{\text{time}}$ (1) or by implication = $\frac{41\,400\,000\,000}{1\,200}$ **ecf** on numerator (subs and conv) (1) = 34 500 000 [W] (1) Answer of 2 070 000 000 (2) (20 min used)	1	1 1		3	2	
				Question 3 total	**4**	**8**	**2**	**14**	**8**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
4	*(a)*			Pressure = $h\rho g$ (1) So pressure at each point depends on the height of water above it (1) and heights in each column are the same so disagree (1)			3	3		
	(b)	(i)		Use of $p = h\rho g$ (1) = 1.5 × 1 000 × 10 (1) correct selection of data = 15 000 N/m^2 or Pa (1) **unit mark**	1	1 1		3	2	
		(ii)		Area of bottom of barge = 8 × 30 or 240 [m^2] (1) F upwards on barge bottom = $p \times A$ (1) recall and manipulation = 15 000 (**ecf**) × 240 (**ecf**) = 3 600 000 [N] (1) Therefore, <u>because forces are balanced</u> weight of barge is also 3 600 000 [N] (1) **Accept (for second, third and fourth marks):** Volume of water displaced = 240 × 1.5 = 360 [m^3] (1) Weight of water displaced = 360 (**ecf**) × 1 000 × 10 = 3 600 000 [N] (1) For **ecf** to apply there must be an attempt at calculating volume. Weight of barge = weight of water displaced (1)		4		4	4	
		(iii)		Extra submersion is 0.75 / loaded submersion is 1.5 times as big (1) which is an increase by a half so I agree (1)			2	2	2	
				Question 4 total	**1**	**6**	**5**	**12**	**8**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
5	*(a)*			**Indicative content:** **Enabling fusion:** • Neutrons need to be slowed down to be successfully absorbed by a nucleus of U-235. • This is achieved by a graphite moderator. **Controlling the chain reaction:** • The unstable U-236 nucleus splits creating e.g. 3 fission neutrons. These could cause fission of 3 more U-235 nuclei, then 9, then 27 etc. The chain reaction would be uncontrollable. • To avoid this, only 1 fission neutron is allowed to cause further fission. • Boron control rods absorb the extra neutrons. **Safety measures:** • The temperature of the reactor is controlled by raising or lowering the control rods. • In the event of an emergency requiring complete shutdown, the control rods are fully dropped into the reactor. • The reactor is shielded by thick concrete to reduce penetration by radiation from the reactor. • The reactor is cooled to dissipate heat. **5-6 marks** Full and logical account. All aspects covered including full details from first two sections and at least two from safety. *There is a sustained line of reasoning which is coherent, substantiated and logically structured. The information included in the response is relevant to the argument.*	6			6		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
				3-4 marks Partially complete account which includes references to at least two of the sections. *There is a line of reasoning which is partially coherent, supported by some evidence and with some structure. Mainly relevant information is included in the response but there may be some minor errors or the inclusion of some information not relevant to the argument.* **1-2 marks** Limited detail from any section. *There is a basic line of reasoning which is not coherent, supported by limited evidence and with very little structure. There may be significant errors or the inclusion of information not relevant to the argument.* **0 marks** *No attempt made or no response worthy of credit.*						
	(b)	(i)		$^{99}_{43}\mathrm{Tc}$ (1) 56 (**ecf**) (1) 43 (**ecf**) (1)		3		3		
		(ii)		Gamma radiation is more penetrating (1) so there is less ionisation (of body cells) (1) The half-life of Tc is much less / smaller (1) so it decays more quickly (inside the body) / less exposure to radiation (over time) (1)			4	4		
				Question 5 total	**6**	**3**	**4**	**13**	**0**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
6	*(a)*	(i)		Sound waves require a medium to travel through/can't travel through a vacuum.	1			1		
		(ii)		Transverse waves have vibrations at 90^{o} to the direction of wave motion / energy transfer (1) Whereas in longitudinal waves the vibrations are in the same direction (1) **OR:** Vibrations (1) are perpendicular to wave direction for transverse waves **and** parallel for longitudinal waves (1)	2			2		
		(iii)		They produce oscillations (1) of charges or current inside a circuit/aerial (1)	2			2		
	(b)			Density or stiffness varies with depth because of curved paths (1) There must be a liquid core (1) since S waves cannot {penetrate it / travel through liquids} (1)	3			3		
	(c)	(i)		Refraction (1) due to change in density of medium / speed of light changes (1)	2			2		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(ii)		Must be appropriate scale i.e. at most 5 cm per 2 cm square otherwise only third, fourth and sixth marks can be awarded. Focus or foci correctly positioned (1) Object shown of correct size and scaled position (1) **Any 2 of the following for the rays** (2 maximum) - Ray drawn parallel to principal axis emerges as if coming from the focus - Ray drawn through the optical centre continues un-deviated - Ray to focus emerges parallel to principal axis Image located 2.4 [cm] <u>and</u> size = 2 [cm] (1) Virtual <u>and</u> erect (1)		6		6	6	6
				Question 6 total	**10**	**6**	**0**	**16**	**6**	**6**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
7	*(a)*			Polythene becomes negatively charged (1) and fur has an <u>equal</u> positive charge (1)	2			2		
	(b)	(i)		Charged dome <u>attracts</u> the ball (1) charging it similarly (1) and like charges repel (1)	1	1 1		3		3
		(ii)		**Either** (assuming dome is negative) Negative charge flows from the dome to the pinwheel [through the support] (1) Electrons 'spray' into the air from the points on the pinwheel [forming a negative cloud] (1) Each negative pinwheel prong is repelled by its negative cloud **OR** N3 reasoning (e.g. points exert repulsive force on electrons which exert an equal and opposite force on the points) (1) Since the dome does not retain its charge the pinball is not attracted towards it (1) **Or** (assuming dome is positive) Negative charges flow from pinwheel to dome [making the points positive] (1) Positive points [ionise air molecules] and repel +ve {ions / charges} away (1) Each positive point is repelled by its positive cloud **or** N3 reasoning (as above) causing pinwheel to rotate (1) Since the dome does not retain its charge the pinball is not attracted towards it (1)	1 1	1 1		4		4
				Question 7 total	**5**	**4**	**0**	**9**	**0**	**7**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
8	*(a)*	(i)		LDR has higher resistance in the dark (1) which is represented by line 2 {since it is <u>less steep or</u> $R = \frac{1}{\text{gradient}}$ } (1)		2		2		2
		(ii)		At greater values of I or V each component increases in temperature (1) This causes an increase in R of the lamp so line becomes less steep as in graph 2 **OR** this causes a decrease in R of the thermistor so line becomes steeper as in graph 1 (1)		2		2		2
	(b)			Set variable resistor to its maximum/minimum value (1) Take readings of current/I/ammeter and voltage/V/voltmeter (1) Vary value of variable resistor and repeat readings (1) Reverse polarity of power supply and repeat (1)	4			4		4
				Question 8 total	**4**	**4**	**0**	**8**	**0**	**8**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
9	*(a)*	(i)		Use FLHR or description (1) Anticlockwise / accept arrow on diagram (1)	1	1		2		
		(ii)		Commutator/split ring (1) Reverses the current in the coil every time the coil passes through a perpendicular plane (1)	2			2		
	(b)	(i)		F = 0.6 × 1.2 × 5 (1) × 10 (1) cao = 0.36 N (1) includes conversion Zero force on 3 cm side (1)		4		4	4	
		(ii)		Moment = $F \times d$ (1) recall = (0.36 **ecf** × 0.015) = 0.0054 (1) Total moment = 2 × 0.0054 **ecf** = 0.0108 / 0.011 [N m] (1) **or** 0.36 × 0.03 (1) subs and conv for middle mark	1	1 1		3	2	
		(iii)		As coil turns (perpendicular) distance between F and shaft changes **or** at some points the current and hence force is zero (1) so moment changes so disagree (1)			2	2		
		(iv)		Keep electrical power to motor and h the same (1) Calculate output power to lift W (1) Efficiency = $\frac{\text{power output}}{\text{power input}}$ (1)			3	3		3
				Question 9 total	**4**	**7**	**5**	**16**	**6**	**3**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
10	*(a)*			Speed is the same at X and Y (1) velocity is different due to change in direction (1) Velocity at X is opposite to velocity at Y / At X velocity is in direction SE and at Y velocity is in direction NW (1)	1	1 1		3		
	(b)	(i)		Subs and conversion into $15^2 = 1^2 + (2 \times a \times 300)$ (1) Rearranging so $a = \frac{224}{600}$ (1) = 0.37 [m/s^2] (1)		3		3	3	
		(ii)		Subs and rearrange so $t = \frac{14}{0.37}$ (1) = 37.8 / 38 [s] (1) **OR** Use of $x = ½ (u + v)$ (subs and rearrange) (1) t = 37.5 [s] (1)		2		2	2	
		(iii)		To cover distance in 120 s (1) needs mean speed of 15 m/s (1) but horse's mean speed is less due to 38 s of acceleration so disagree (1) **OR** Time to run 1 500 m at 15 m/s = 100 s (1) Plus time to run first 300 m while accelerating (38 s **ecf**) giving a total time of 138 s (1) 2 mins 18 s which is more than 2 mins therefore disagree (1)			3	3	3	

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)			Initial momentum = final momentum (1) Momentum = mv (1) Increase in momentum of jockey = 50 × 2 = 100 [kg m/s] (1) ∴ Decrease in momentum of horse = 100 [kg m/s] ∴ Decrease in velocity = $\frac{100}{550}$ = 0.18 [m/s] (1) ∴ New velocity of horse = 13.82 [m/s] (1) **OR** Momentum = mv (1) Initial momentum = (550 + 50) × 14 = 8 400 [kg m/s] (1) Final momentum = (550 × v) + (50 × 16) = 8 400 [kg m/s] (1) Final momentum of horse = 8 400 – 800 = 7 600 **Or** 550v = 8 400 – 800 [= 7 600] (1) so $v = \frac{7\,600}{550}$ = 13.82 [m/s] (1)	1 1	1 1 1		5	3	
				Question 10 total	**3**	**10**	**3**	**16**	**11**	**0**

HIGHER TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	4	0	0	4	0	0
2	7	0	5	12	4	10
3	4	8	2	14	8	0
4	1	6	5	12	8	0
5	6	3	4	13	0	0
6	10	6	0	16	6	6
7	5	4	0	9	0	7
8	4	4	0	8	0	8
9	4	7	5	16	6	3
10	3	10	3	16	11	0
TOTAL	**48**	**48**	**24**	**120**	**43**	**34**