Rewarding Learning

General Certificate of Secondary Education
2023

GCSE Physics

Unit 1
Higher Tier

[GPY12]

THURSDAY 25 MAY, MORNING

MARK SCHEME

General Marking Instructions and Mark Grids

Introduction
Mark schemes are intended to ensure that the GCSE examination is marked consistently and fairly. The mark schemes provide markers with an indication of the nature and range of candidates' responses likely to be worthy of credit. They also set out the criteria that they should apply in allocating marks to candidates' responses. The mark schemes should be read in conjunction with these marking instructions.

Quality of candidates' responses
In marking the examination papers, examiners should be looking for a quality of response reflecting the level of maturity which may reasonably be expected of a 16-year-old which is the age at which the majority of candidates sit their GCSE examinations.

Flexibility in marking
Mark schemes are not intended to be totally prescriptive. No mark scheme can cover all the responses which candidates may produce. In the event of unanticipated answers, examiners are expected to use their professional judgement to assess the validity of answers. If an answer is particularly problematic, the examiners should seek the guidance of the Supervising Examiner.

Positive marking
Examiners must be positive in their marking, giving appropriate credit for description, explanation and analysis, using knowledge and understanding and for the appropriate use of evidence and reasoned argument to express and evaluate personal responses, informed insights and differing viewpoints. Examiners should make use of the whole of the available mark range of any particular question and be prepared to award full marks for a response which is as good as might reasonably be expected of a 16-year-old GCSE candidate.

Awarding zero marks
Marks should only be awarded for valid responses and no marks should be awarded for an answer which is completely incorrect or inappropriate.

Types of mark scheme
Mark schemes for questions which require candidates to respond in extended written form are marked on the basis of levels of response which take account of the quality of written communication.

Other questions which require only short answers are marked on a point for point basis with marks awarded for each valid piece of information provided.

1 **(a)** **(i)** Velocity is a vector/velocity has a direction or the two directions are different [1]

(ii) (Average) velocity = displacement/time or v = 0/t [1]
Displacement = 0 [1] [2]

(b) **(i)** Distance = speed × time or 10 = v × 0.5 [1]
Speed = $\frac{10}{0.5}$ must be an equation for partial credit [1]
= 20 m/s [1] [3]

(ii) Average speed = $\frac{(\text{inital speed} + \text{final speed})}{2}$ [1]
= $\frac{(20 + 0)}{2}$ must be an equation for partial credit [1]
= 10 m/s [1] [3]

(c) 80 km = 80 000 m [1]
1 hr = 3600 s [1]
80 km/hr = 80 000/3600 (= 22.2) [1] [3]

22.2 × 3600
79920
79920/1000
=79.9 (80) km/h

(d) **(i)** Average speed = $\frac{\text{distance moved}}{\text{time taken}}$ [1]
= $\frac{6000}{450}$ must be an equation for partial credit [1]
= 13.3 m/s [1] [3]

(ii) 150 s to 300 s [1]
Least gradient or graph less steep [1] [2]

(e) **(i)** Height = area under the graph [1]
= $\frac{1}{2}$(4 × 10) + (8 × 10) + $\frac{1}{2}$(4 × 10) [3]
= 120 m [1] [5]

Trapezium method	Falling method
$\frac{1}{2}$(16 + 8) × 10	$\frac{1}{2}$ × base × height
= 120	= $\frac{1}{2}$ × (24 – 18) × 40
	= 120

(ii) Drop at 18 s [1]

(iii) Brakes at 22 s [1]

(iv) Acceleration = velocity change/time [1]

must be an equation for partial credit

= $\frac{(0 - -40)}{2} = \frac{40}{2}$ [1]

= 20 (m/s^2) [1] [3]

AVAILABLE MARKS

27

					AVAILABLE MARKS
2	**(a)**	**(i)**	Resultant force = 600 N [1] (Vertically) upwards [1]	[2]	
		(ii)	a = $\frac{F}{m}$ (or equivalent) must be an equation for partial credit [1] a = $\frac{600}{1500}$ [1] a = 0.4(m/s^2) [1] *Allow ecf for the force from* **(a)(i)**	[3]	
	(b)		ACM = CM [1] 6 × 20 = W_{Box} × 30 or $W_{Box} = \frac{120}{30}$ [2] = 4N [1] must be an equation for partial credit *If position used other than distance award [1] out of [4]* *The answer will be 2.25*	[4]	
	(c)	**(i)**	The extension is (directly) proportional to the force applied (accept load) [1] provided up to the limit of proportionality is not exceeded [1]	[2]	
		(ii)	2 N causes an extension of 8 cm (26 – 18) [1] 1 N causes an extension of 4 cm [1] Alternative method F = ke, (5 – 3)2 = k × 8 k = 0.25 1 N = 0.25 × e, e = 4 cm	[2]	
		(iii)	k = $\frac{F}{e}$ must be an equation for partial credit [1] k = $\frac{2}{8}$ (ecf from **(ii)** for extension) or 1/4 [1] = 0.25 [1] N/cm [1] Accept 25 N/m	[4]	
	(d)		P = $\frac{F}{A}$ or equivalent must be an equation for partial credit [1] F = 10 × 25 [1] = 250 (N) [1]	[3]	20

					AVAILABLE MARKS
3	**(a)**	Wood has the larger volume than lead or lead has a smaller volume Volume must appear in the answer	[1]		
	(b)	**(i)** Fixed (positions)	[1]		
		(ii) Vibrate (about their fixed positions)	[1]		
		(iii) Gaps/spaces/bigger distance between the particles	[1]		
		(iv) Weak or zero force between the particles bonds = forces	[1]		
	(c)	Volume = length × breadth × height or 2 × 5 × 2	[1]		
		= 20 cm^3	[1]		
		Density = $\frac{\text{mass}}{\text{volume}}$ must be an equation for partial credit	[1]		
		= $\frac{18}{20}$	[1]		
		= 0.9 g/cm^3	[1]	[5]	
	(d)	B D and F *All three correct before second mark can be gained*	[1]		
		They lie on a straight line that passes through 0,0 Same mass to volume ratio	[1]	[2]	12

AVAILABLE MARKS

4 (a) Indicative content

Methods Conduction, convection, radiation
Radiator Conduction in the metal by electrons
Room Convection in the air
Shiny foil Reflects radiant heat/radiation or is a poor absorber of radiant heat
Cavity Polystyrene/insulating foam/mineral wool/Polystyrene beads Urea formaldehyde foam. Cavity - conduction
Glazing Conduction is reduced
Concrete Carpet or wooden floor

Response	Mark
Candidates describe in detail using good spelling, punctuation and grammar at least **5** of the points shown above and the precaution is clearly stated. The form and style are of a high standard and specialist terms are used appropriately at all times.	[5]–[6]
Candidates describe in detail using good spelling, punctuation and grammar **3 or 4** of the points shown above. The form and style are of a high standard and specialist terms are used appropriately at all times.	[3]–[4]
Candidates make some reference to **1 or 2** of the main points shown above using satisfactory spelling, punctuation and grammar. The form and style are of a satisfactory standard and they have made some reference to specialist terms.	[1]–[2]
Response not worthy of credit	[0]

[6]

(b) (i) **Potential energy** in upper dam
Kinetic energy of water in pipe
Kinetic energy of rotating turbine
Electrical energy
Unwanted forms Heat and Sound [3]
[$\frac{1}{2}$] each round up

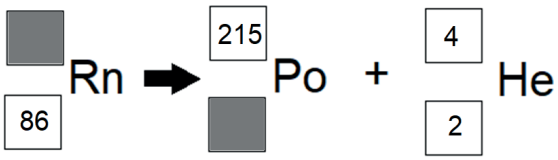
(ii) E_p = mgh must be an equation for partial credit [1]
= 1000 × 10 × 600 [1]
= 6×10^6 (J) [1] [3]

(iii) Input power = 6×10^6 W [1]
In megawatts = 6.0 MW [1] [2]
Allow ecf for energy from **(ii)**

(iv) Efficiency = $\frac{\text{useful power out}}{\text{total power in}}$ must be an equation [1]
for partial credit

= $\frac{4}{6}$ allow ecf for power in [1]

= 0.67 accept 67% [1] [3]
but not 0.67% or 67
Accept energy in place of power
Accept $\frac{\text{UOE}}{\text{TIE}}$ = efficiency

					AVAILABLE MARKS
(c)	**(i)**	20 – 15 = 5 (J)	[1]		
	(ii)	Work/energy lost = force × distance or W = F × D	[1]		
		must be an equation for partial credit			
		5 = F × 1.4 Allow ecf for work from **(i)**	[1]		
		F = 3.6 (N)	[1]	[3]	
	(iii)	$E_k = \frac{1}{2}mv^2$ must be an equation for partial credit	[1]		
		$15 = \frac{1}{2} \times 0.5 \times v^2$ Allow ecf from **(i)**	[1]		
		$v^2 = 60$ **or** $v = \sqrt{60}$	[1]		
		7.75 (m/s)	[1]	[4]	25
		Alternative $v = \sqrt{\frac{2E_k}{m}}$ [1]			
		$= \sqrt{\frac{2 \times 15}{0.5}}$ [2]			
		= 7.75 (m/s) [1]			
5	**(a)**	**(i)** 1 = metal foil or foil, but not film	[1]		
		2 = Fluorescent screen or zinc sulphide screen	[1]	[2]	
	(ii)	To avoid collision between alphas and air molecules or to avoid absorption by air		[1]	
	(iii)	The nucleus is small		[1]	
	(iv)	The nucleus is positively charged		[1]	
	(b)	**(i)** 		[4]	
	(ii)	Background is the activity with no sources present	[1]		
		It is subtracted from the measured activity	[1]	[2]	
	(iii)	2048 to 1024 to 512 to 256 = 3 half lifes	[1]		
		1 half-life = $\frac{11.4}{3}$	[1]		
		= 3.8 days	[1]	[3]	
	(iv)	An electron is removed from an atom		[1]	
	(v)	Alter DNA or causes cancer/kills cells/damages DNA		[1]	16
				Total	**100**