



Rewarding Learning

**General Certificate of Secondary Education
2016**

GCSE Physics

Unit 1
Higher Tier

[GPH12]

MONDAY 20 JUNE, 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 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) (Force which) resists/opposes motion/slows down/stop/reduces speed. [1]
Surfaces rubbing – give [0]
- (b) (i) As friction increases, acceleration decreases/doesn't increase
or
Ratio (of friction : acceleration) is not constant/negative correlation [1]
not doubling – acceptable
- (ii) $T - F = ma$ [2]
 $F - T = ma$ give [1]
- (iii) Label: Friction (force)/N (or equivalent) or F/N [1]
Scale: to cover at least half of grid/if scale too large [0] [1]
Points: 5 points [$\frac{1}{2}$] each round DOWN (± 1 div) [2]
Straight line of best fit RULED through THEIR points [1]
Line of best fit touches both axes [1] [6]
- (iv) 0.58 to 0.62 (m/s^2) [1]
- (v) From graph max friction = 35 to 37 N when acceleration = 0 [1]
So max forward force = 35 to 37 (N) [1] [2]
or $T - 6 = 60 \times 5 - [1]$ $T = 36$ N [1]
- (vi) Gradient = rise/run (or equivalent) (must be an equation) $\frac{\text{rise}}{\text{run}}$ only [0] [1]
 $= (18 - 12)/(0.3 - 0.4)$ or equivalent [1]
 $= (-)60$ (kg) [1] [3]
Value consistent with their graph
- (c) (i) deceleration = $12000/800$ [1]
 $= 15$ (m/s^2) ignore (-) [1] [2]
- (ii) $v = u + at$ or $0 = u - 15 \times 2$ ecf for deceleration from (i) [1]
speed = 30 (m/s) [1] [2]
or
 $Ft = m(v - u)$ or $12000 \times 2 = 800(0 - u)$
- $u = \frac{24000}{800} = 30$ (m/s)

AVAILABLE
MARKS

20

2 (a) **Indicative content:**

A non-renewable energy resource will run out/(accept formed over millions of years) has a limited supply
 A renewable energy source has limitless supply/will not run out/can be replaced in a lifetime/accept replenished
 Accept reference to lifetime
 Re-used not acceptable as the meaning of renewable

Oil [1] is always available to produce energy/is reliable } oil more reliable (than)(wind) [2]
 Wind [1] power can be intermittent or unreliable }
 Oil can produce a lot of energy (high energy density) } oil provides more energy (than wind) [2]
 Wind produces little energy (low energy density) }
 Oil responds quickly to demand }
 Non-renewable example – coal/gas/nuclear }
 Renewable example – tidal/wave/solar/biomass/HEP } must be geothermal } named

Response	Mark
Candidates describe in detail using good SPG at least 5 points shown opposite. 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 SPG at least 3 points shown opposite. The form and style are of a high standard and specialist terms are used appropriately on some occasions.	[3]–[4]
Candidates make some reference to one of the points shown opposite using good SPG. The form and style are of a satisfactory standard but there is limited use of specialist terms.	[1]–[2]
Response not worthy of credit.	[0]

[6]

(b) (i) $GPE = mgh$ [1]
 $= 440 \times 10 \times 12$ [1]
 $= 52\,800 \text{ (J)}$ [1] [3]

(ii) $KE_{\text{bottom}} = \frac{1}{2} mv^2$ [1]
 $= \frac{1}{2} \times 440 \times 16^2$ [1]
 $= 56\,320$ [1] [3]

(iii) $KE_{\text{top}} = KE_{\text{bottom}} - PE = 3520$ ← or sight of [1]
 Allow ecf for KE and GPE from (i) and (ii) [1]
 $\frac{1}{2}mv^2 = 3520 \quad v = \sqrt{(2 \times 3520/440)}$ [1]
 $v = 4 \text{ (m/s)}$ [1] [3]
 Allow ecf from (i) for GPE and from (ii) for KE_{bottom}

Alternative method
 $v^2 = u^2 + 2as \quad \text{or} \quad 16^2 = u^2 + 2 \times 10 \times 12$ [1]
 $256 = u^2 + 240 \quad \text{or} \quad u^2 = 256 - 240$ [1]
 $= 4 \text{ (m/s)}$ [1]

(c) (i) Heat and Sound (any order [1] each) accept thermal [2]

(ii) Total input energy = useful energy/efficiency or equivalent [1]
 $= 400/0.8 = 500 \text{ (kJ)}$ – sight of [1]
 wasted energy = $500 - 400 = 100 \text{ (kJ)}$ [1] [3]

				AVAILABLE MARKS	
3	(i)	$V = l \times b \times h$ or $= 1.5 \times 0.3 \times 0.4 = 0.18$	[1]		
		mass = density \times volume or $M = D \times V$ or equivalent	[1]		
		$= 1000 \times 0.18$	[1]		
		$= 180$ (kg)	[1]	[4]	
	(ii)	Weight of water = 1800 (N) Allow ecf for mass from (i)	[1]		
		Weight of aquarium = $20 \times 10 = 200$	[1]		
		Total weight = $200 + 1800 = 2000$ (N)	[1]		
		Minimum force = $2 \times 2000 = 4000$ (N)	[1]	[4]	
		Mass of water aquarium = $180 + 20 = 200$ kg [2]			
		Total weight = $200 \times 10 = 2000$ N [1]			
(iii)	NA				
	Glass Water All three correct give [2], one correct give [1]		[2]		
4	(a) (i)	Centripetal		[1]	
		(ii)	Friction – required for the 2nd mark	[1]	
			Between tyres and the road	[1]	[2]
	(iii)	(Labelled) arrow (V) to the right		[1]	
	(b) (i)	Momentum change (Δ mom) = force \times time or $Ft = m(v-u)$ or $Ft = \Delta p$ or equivalent			[1]
		(ii)	dependent marking		
			$\left\{ \begin{array}{l} \text{The time (for the (momentum change) is} \\ \text{longer/crash lasts longer} \\ \text{so the force on the driver is reduced} \end{array} \right.$	[1]	
				[1]	[2]
		(iii)	$700 \times 10 = F \times 0.6$ [1] for each side of equation $F = 7000/0.6$ [1] for each sub $= 11667$ (N) or 11700 (N) Failure to convert milliseconds to seconds max [4]	[2] [2] [1]	[5]
	Alternative method				
	$v = u + at$ [1]				
	$0 = 10 + a \times 0.6$ [1]	Rounding			
	$a = \frac{10}{0.6} = 16.67$ [1]	give 11620–11700			
	$(F = ma) = 700 \times 16.67$ [1] $= 11667$ or 11700 [1]				
(iv)	The (required) centripetal force decreases (as speed decreases)		[1]		
(v)	(Radius should be) increased/larger		[1]		
(vi)	The (required) centripetal force decreases (as the radius of the bend increases)		[1]		
				10	
				15	

			AVAILABLE MARKS		
5	(a) (i)	(ACM) = $20 \times 1.5 = 30$ (Nm)	[1]		
		(CM) = $30 \times 0.8 = 24$ (Nm)	[1]		[2]
		(ii) Anticlockwise No ecf from (i) or counterclockwise			[1]
	(iii)	Extra (clockwise) moment = 6(Nm) or $30 - 24 = 6$ allow ecf from (i)	[1]		
		Extra force = $6/0.8 = 7.5$ (N)	[1]		
		Place on B or on 30 N	[1]		
	Alternative Method				
	$1.5 \times 20 = 0.8 \times F$ (m)				
	or				
	$30 = 0.8F$				
$F = 37.5$ [1]					
extra $37.5 - 30 = 7.5$ (N) [1]					
on B or 30 N [1]					
(b)	(i)	Point [1] where the gravity/weight [1] of the object acts (appears)/mass is concentrated		[2]	
		(ii) To right of previous position but to left of pivot Above the previous position	[1] [1]	[2]	
(c)	(i)	Taking values from graph, e.g. $20 = k \times 5$	[1]		
		$k = 20/5 = 4$ Unit for k = cm/N	[1] [1]		[3]
(ii)	(i)	Suitable calculation $d = 14 \times 4 = 56$	[1]		
		Maximum distance from pivot must be less than 50 cm Ruler not long enough	[1]		[2]
Alternative method					
Max ACM = 250 (N cm) [1]					
CM = $14 \times 20 = 280$ [1]					

15

6 (a) **Indicative content:**

- 1 Proton mass 1 charge + or +1
 2 Neutron mass 1 charge 0 $\frac{1}{1837}$
 3 Electron mass = $\frac{1}{1836}$ or $\frac{1}{1837}$ charge – or –1
 4 Protons and neutrons in the nucleus
 5 Electrons **orbit** the nucleus electrons in shell [0]
 6 Same number of protons and electrons – same no. of + or –s if charge correctly identified earlier
 Correct diagram with all details correct max [4]

Mass issues
 $\frac{1}{2000}$ – [0]
 or 0 – [0]

AVAILABLE MARKS

Response	Mark
Candidates describe in detail using good spelling, punctuation and grammar 5 points in the Indicative Content. 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 at least three of the points in the Indicative Content. The form and style are of a high standard and specialist terms are used appropriately most of the time.	[3]–[4]
Candidates describe in detail using good spelling, punctuation and grammar at least one of the points in the Indicative Content. 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) 1 = alpha particle emitter/source radioactive source [0] [1]
 2 = (thin) metal foil/gold alpha particle [0] [1]
 3 = (alpha particle) detector/ZnS screen/fluorescent screen sensor/counter telescope/microscope/GM tube [0] [1] [3]
- (ii) Detector moved (to various angles) [1]
 Number of (alpha) particles detected/counted/recorded [1] [2]
- (iii) the atom is **empty space/mostly space/nucleus** is small [1]
- (iv) (more) **massive** [1] (than particles) and positive [1] [2]
- (c) ${}_{11}^{23}\text{Na}$ order must be correct [2]
- (d) (i) Radiation emitted by walls/rocks/people/atmosphere/all sources removed/naturally occurring/always around us/cosmic rays [1]
- (ii) Correcting for background gives 80 56 40 28 20 – [1]
 Evidence such as 80 and 40 or 56 and 28 – [1]
 with no further working give [1] [3]
 Half-life – [1]

Total

20

100