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 ($\pm$ 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

AVAILABLE MARKS

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
Wind [1] power can be intermittent or unreliable
} oil more reliable (than)(wind) [2]

Oil can produce a lot of energy (high energy density)
Wind produces little energy (low energy density)
Oil responds quickly to demand
} oil provides more energy (than wind) [2]

Non-renewable example – coal/gas/nuclear
Renewable example – tidal/wave/solar/biomass/HEP geothermal
} must be 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 × 10 × 12 [1]
= 52 800 (J) [1] [3]

(ii) $KE_{bottom} = \frac{1}{2}\ mv^2$ [1]
$= \frac{1}{2} \times 440 \times 16^2$ [1]
= 56320 [1] [3]

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

Alternative method
$v^2 = u^2 + 2as$ or $16^2 = u^2 + 2 \times 10 \times 12$ [1]
$256 = u^2 + 240$ or $u^2 = 256 – 240$ [1]
= 4 (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 (kJ) – sight of [1]
wasted energy = 500 – 400 = 100 (kJ) [1] [3]

20

					AVAILABLE MARKS
3	**(i)**	$V = l \times b \times h$ or $= 1.5 \times 0.3 \times 0.4 = 0.18$	[1]		
		mass = density × 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 × 10 = 200	[1]		
		Total weight = 200 + 1800 = 2000 (N)	[1]		
		Minimum force = 2 × 2000 = 4000 (N)	[1]	[4]	
		Mass of water aquarium = 180 + 20 = 200 kg [2]			
		Total weight = 200 × 10 = 2000 N [1]			
		Total mass = 400 kg [3]			
	(iii)	NA Glass Water		[2]	
		All three correct give [2], one correct give [1]			10
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 × time **or** $Ft = m(v–u)$ **or** $Ft = \Delta p$ or equivalent		[1]	
		(ii) dependent marking: The time (for the (momentum change) is **longer**/crash lasts longer	[1]		
		so the force on the driver is **reduced**	[1]	[2]	
		(iii) 700 × 10 = F × 0.6 [1] for each side of equation		[2]	
		F = 7000/0.6 [1] for each sub		[2]	
		= 11667 (N) or 11 700(N)	[1]	[5]	
		Failure to convert milliseconds to seconds max [4]			
		Alternative method			
		$v = u + at$ [1]			
		$0 = 10 + a \times 0.6$ [1] Rounding			
		$a = \frac{10}{0.6} = 16.67$ [1] give 11 620–11 700			
		$(F = ma) = 700 \times 16.67$ [1]			
		= 11 667 or 11 700 [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]	15

						AVAILABLE MARKS
5	**(a)**	**(i)**	(ACM) = 20 × 1.5 = 30 (N m) [1] (CM) = 30 × 0.8 = 24 (N m) [1]		[2]	
		(ii)	Anticlockwise No ecf from **(i)** or counterclockwise		[1]	
		(iii)	Extra (clockwise) moment = 6 (N m) 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]		[3]	
			Alternative Method 1.5 × 20 = 0.8 × F (m) **or** 30 = 0.8 F 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 [1] Above the previous position [1]		[2]	
	(c)	**(i)**	Taking values from graph, e.g. 20 = k × 5 [1] k = 20/5 = 4 [1] Unit for k = cm/N [1]		[3]	
		(ii)	Suitable calculation d = 14 × 4 = 56 [1] Maximum distance from pivot must be less than 50 cm [1] Ruler not long enough		[2]	15
			Alternative method Max ACM = 250 (N cm) [1] CM = 14 × 20 = 280 [1]			

6 (a) Indicative content:

1 Proton mass 1 charge + or +1
2 Neutron mass 1 charge 0
3 Electron mass = 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]

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) $^{23}_{11}Na$ 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

AVAILABLE MARKS

20

100