Rewarding Learning

General Certificate of Secondary Education
2012

Science: Physics

Unit P1
Higher Tier

[GPH12]

FRIDAY 15 JUNE, AFTERNOON

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.

						AVAILABLE MARKS
1	**(a)**	**(i)**	Output energy = 1200 J		[1]	
		(ii)	Efficiency = useful output energy/total input energy			
			= (6000 – 4800)/6000	[1]		
			= 0.2	[1]	[2]	
		(iii)	No. of kJ = 1.2 × 60 × 60 × 10	[1]		
			= 43 200 (kJ)	[1]	[2]	
			Allow ecf for output energy from **(i)**			
		(iv)	Advantage – free (after the initial cost)/renewable			
			non polluting			
			saves fossil fuels	[1]		
			Disadvantage – produces less electricity in the winter			
			output not constant			
			low efficiency			
			expensive to install	[1]	[2]	
		(v)	Install another panel	[1]		
			By named method			
			Name two alternatives			
			Reduce their present energy usage/switch off appliances			
			Connect to the mains/use gas/alternative energy source			
			Name source, e.g. wind, hydroelectric	[1]	[2]	
	(b)	**(i)**	150 N and 2.0 m	[1]		
			200 N and 1.5 m	[1]		
			300 N and 1.0 m	[1]	[3]	
		(ii)	Power = work/time give [1] if no further work	[1]		
			= 3000/30 or 300/3	[1]		
			= 100 (W)	[1]	[3]	15

2 **(i)** 80 km = 80 000 m *give [1] if no further credit possible* [1]
80km/hr = 80 000/3600 = (22.2 m/s) *This line is worth full marks* [2] [3]

(ii) Think time = distance/speed or $t = \frac{s}{v}$ or alternative [1]
= 15/22.2 *substitutions* [2]
= 0.7 s (0.68 s) (0.67 → 0.68) [1] [4]

(iii) X axis – speed and Y axis – thinking distance [1]
(Both labels needed [1]) Quantity or unit
Points plotted [2]
Best fit line through origin [1] [4]
Poor scale max penalty [–1] (No origin)
Including max use of graph

(iv) They are proportional [1]
Straight line [1]
passing through origin [1] [3]
or thinking distance doubles when speed doubles.
Thinking distance increases as speed increases award [1]

(v) Thinking distance = constant × speed [1]
constant = gradient **or** ratio of thinking distance/speed
or constant = 0.19 or TD = $\frac{\text{speed}}{5.3}$ [1] [2]

(vi) 21/4 or 5.25 [2]/ 96/4 or 75/4 – give [1] [2]
Rounded up to 6 car lengths [1] [3]

(vii) a = 6.45 F = 9675
a = 6.5 F = 9750
$s = \frac{1}{2}(u + v)t$ [1] **or** $v^2 = u^2 + 2as$ [1]
$75 = 0.5 \times 31 \times t$ or $t = 4.8$ s [1] $0 = 31.1^2 - 2a \times 75$ [2]
$a = 6.4$ [1] [4]

or $v = u + at$
$0 = 31.1 - 4.8\,a$ [1]
$a = 6.4$ (m/s^2) [1] ignore -ve sign

(viii) F = ma
= 1500 × 6.4 *allow ecf for deceleration from* **(vii)** [1]
= 9600 (N) [1] [2]

AVAILABLE MARKS

25

AVAILABLE MARKS

3 **(a)** **(i)** Momentum before a collision equals
the momentum after a collision In words accept event [1]

(ii) Momentum = mass × velocity [1]
speed not acceptable *if no further working shown*
= 1200 × 9 [1]
= 10 800 (kg m/s) [1] [3]

(iii) 10 800 = (1200 + 800) × V **or** 2000 × v
[1] [1] [1] [2]
V = 10800/2000 [1]
= 5.4 (m/s) [1] [4]

(iv) KE = $[\frac{1}{2}]$ mv^2 [1]
= $[\frac{1}{2}]$ 2000 × 5.4^2 [1]
= 29 160 (J) *Allow ecf for velocity from* **(iii)** [1] [3]

(b) **(i)** Momentum change = force × time **or** in symbols [1]
1350 = F × 0.6 *substitutions* [1]
F = 2250 (N) [1] [3]

(ii) **Indicative content**
Crumple zone collapses **or** material collapses easily or car crumples
Car stops in a longer time or in a longer distance
Momentum change = force × time **or** Energy change = force × distance
So the force is reduced
Less chance of injury to passengers

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

[6] 20

				AVAILABLE MARKS
4	**(i)**	60 g (no tolerance)	[1]	
	(ii)	Mass of liquid = 140 – 60 or equivalent – may be subsumed by 2nd line [1] ecf from **(i)** Density = 80/100 **or** equivalent [1] = 0.8 [1] Liquid = Ethanol [1] If 0.8 noted and ethanol full marks	[4]	
	(iii)	A straight line starting at 60 g [1] of lesser positive slope [1]	[2]	
	(iv)	60 cm^3 of water have a mass of 60 g [1] Total reading will be 60 + 60 = 120 g [1] *Allow ecf for mass of cylinder from* **(i)**	[2]	
	(v)	Ice molecules are further apart than water molecules *Comparison is required*	[1]	10
5	**(a)**	Position 1 – does not topple [1] clockwise moment or force acts inside wheel **or** within base [1] Position 2 – bus topples [1] anticlockwise moment or force acts outside wheel or outside base [1]	[4]	
	(b)	**Indicative content** Distance pivot to effort **greater** than that from pivot to load Since **moment = force × distance** Distance identified as **perpendicular** The **effort** can give the same/larger **moment** than load		

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

[6] 10

6 **(a)** **(i)** 12 (accept 11–13) [1]
can ignore initial point
Smooth curve *no credit for short straight lines* [1]
The graph levels at 12 [1] [3]

(ii) 132 – 12 [1]
= 120 *Allow ecf from* **(i)** (accept 118–122) [1] [2]

(b)

Fusion	Fission
5	3
6	7
1	2
4	8

[$\frac{1}{2}$] *each round down* [4]

(c) **(i)** $^{0}_{-1}\beta$ $^{60}_{28}Ni$ [1] each [4]

(ii) 120 to 60 60 to 30 30 to 15 **or** $\frac{120}{15} = 8$ [1] [1]
3 half lifes identified or $\frac{15}{3}$ $3t_{\frac{1}{2}} = 8 = 2^3$ [1] [1]
15/3 = 5 years **or** $t_{\frac{1}{2}} = \frac{15}{3}$ [1] [1] [3]
$t_{\frac{1}{2}} = 5$ [1]

(iii) Cancer treatment/sterilisation of equipment [1]
Preserving food/fertiliser development [1] [2]
Medical imaging/PET scans

(d) Plum Pudding – electrons in a sphere of positive charge to imply lack of order [1]
Rutherford-Bohr – electrons in orbit around the nucleus [1] [2]
labelled diagram acceptable

Total

AVAILABLE MARKS
20
100