CCEA GCSE PHYSICS

PHYSICS



EXAM QUESTION PACK

UNIT P1 HIGHER TIER GPH12 PAPERS

STEMUP

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Rewarding Learning

General Certificate of Secondary Education
2016

GCSE Physics

Unit 1
Higher Tier

[GPH12]

MONDAY 20 JUNE, MORNING

MARK SCHEME

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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)**	(Force which) resists/opposes motion/slows down/stop/reduces speed. Surfaces rubbing – give [0]	[1]	
	(b) **(i)**	As friction increases, acceleration decreases/doesn't increase **or** Ratio (of friction : acceleration) is not constant/negative correlation not doubling – acceptable	[1]	
	(ii)	T – F = ma F – T = ma give [1]	[2]	
	(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] or T – 6 = 60 × 5 – [1] T = 36 N [1]	[2]	
	(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] Value consistent with their graph	[3]	
	(c) **(i)**	deceleration = 12 000/800 [1] = 15 (m/s^2) ignore (–) [1]	[2]	
	(ii)	v = u + at or 0 = u – 15 × 2 ecf for deceleration from **(i)** [1] speed = 30 (m/s) [1] **or** Ft = m(v – u) or 12 000 × 2 = 800(0 – u) $u = \frac{24000}{800}$ = 30 (m/s)	[2]	20

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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

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					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]		
		dependent marking: so the force on the driver is **reduced**	[1]	[2]	
		(iii) $700 \times 10 = F \times 0.6$ [1] for each side of equation		[2]	
		$F = 7000/0.6$ [1] for each sub		[2]	
		$= 11\,667$ (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

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						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]	[2]	15
			Ruler not long enough			
			Alternative method			
			Max ACM = 250 (N cm) [1]			
			CM = 14 × 20 = 280 [1]			

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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

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Rewarding Learning

General Certificate of Secondary Education
2015

GCSE Physics

Unit 1

Higher Tier

[GPH12]

FRIDAY 12 JUNE, AFTERNOON

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						AVAILABLE MARKS
1	(a)	(i)	The ball is accelerating/getting faster/increasing speed or velocity	[1]		
			The distance or gap between the balls is increasing	[1]	[2]	
			First point needed before second mark gained			
		(ii)	(Ave) speed = distance/time	[1]		
			= 1.2/0.5	[1]		
			= 2.4 (m/s)	[1]	[3]	
			Award [1] for realising time = 0.5 s if no other working shown			
			Use of g (9.8 or 10) give [0]			
		(iii)	Ave velocity = $\frac{1}{2}$ (u + v)			
			2.4 = $\frac{1}{2}$(0 + Final speed) [1] each side	[2]		
			Final speed = 4.8 (m/s) ecf for average velocity	[1]	[3]	
			Use of g (9.8 or 10) give [0]			
		(iv)	Acc = (v – u)/t or equivalent ignore minus in –9.6	[1]		
			(4.8 – 0)/0.5 $a = \frac{u - v}{t}$ [0] if no more working	[2]		
			= 9.6 (m/s^2) ecf for final velocity ecf for time	[1]	[4]	
			Alternative approach			
			$v^2 = u^2 + 2as$ [1]	$s = \frac{1}{2}at^2$ [1]		
			$4.8^2 = 0 + 2 \times a \times 1.2$ [1] **or**	$1.2 = \frac{1}{2} \times a \times 0.5^2$ [1]		
			a = 9.6 (m/s^2)	a = 9.6 (m/s^2) [1]		
	(b)	(i)	Smooth curve		[1]	
			Points joined by short lines give [0]			
			Straight line give [0]			
			Curve does **not** have to pass through 0, 0			
		(ii)	$1200 = k \times (0.5)^2$	[1]		
			k = 1200/0.25	[1]		
			k = 4800 **Any value** 4800–5200	[1]	[3]	
			Any values taken from their curve/line are allowable			
	(c)	(i)	F = ma F = mg [0] – no further credit	[1]		
			= 1600 × 0.5 = 800 (N)	[1]	[2]	
			F = ma Then 1000 – 800 give [1]			
			= 1600 × 0.5 = 800			
		(ii)	Resultant force = 1000 – friction or			
			800 = 1000 – friction	[1]		
			Friction = 200 (N)	[1]	[2]	20
			ecf for resultant force			
			ignore minus			

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AVAILABLE MARKS

2 (a) (i) KE = $\frac{1}{2}$ mv^2 = $\frac{1}{2}$ × 1 × 15^2
[1] for the equation and [1] for subs [2]
= 112.5 (J) [1] [3]

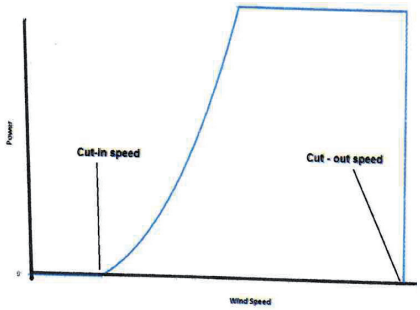
(ii) KE = $\frac{1}{2}$ × 1 × 9^2 = 40.5 [1]
Loss of KE = (112.5 – 40.5) = 72 allow ecf from **(i)** > 40.5 [1]
Rotational energy = 0.5 × 72 = 36 (J) [1] [3]

(iii) Output energy = input × 0.3 or equivalent (must include energy/power/work) [1]
= 1000 × 0.3 = 300 (J) [1] [2]

(b) (i) Maximum efficiency = 0.51 to 0.52 Ratio = 0.3 no tolerance [2]
0.505 → 0.524

(ii) It is not moving/air is still/no wind/calm/stopped [1]

(iii)



must be a + value
on speed axis
Both
Cut-In **and** Cut-Off marked [1]
Increase to constant output [1]
Abrupt cut-off [1] [3]
steeper than the increase

(c) Indicative content

1. Measure the weight lifted or known weight – Force [0]
2. Measure the (vertical) height it is raised/distance moved/distance pulled down
3. Calculate the work done = weight × distance
   or work done = weight × distance × (number of lifts)
4. Determine time for one lift or time for a number of lifts
5. Power = work done/time

Response	Mark
Candidates describe in detail using good spelling, punctuation and grammar **all 5 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 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 **one or two 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]

20

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						AVAILABLE MARKS
3	(a)	(i)	Density = mass per unit volume $D = \frac{M}{V}$ only if M and V named **or** Density = mass/volume **or** equivalent response		[1]	
		(ii)	kg/m^3 or g/cm^3 or kg/cm^3 or g/m^3		[1]	
	(b)	(i)	**Fill** bottle with water Pour water into measuring cylinder Read the volume of water/take the reading	[1] [1] [1]	[3]	
			Alternative method Fill/pour water into cylinder [1] **Fill** bottle [1] Read difference [1] } use of sand [0]			
		(ii)	Read water level in measuring cylinder Place bottle in cylinder Note difference in levels/displacement	[1] [1] [1]	[3]	
		(iii)	Subtract the volume of water from volume of bottle Subtract volume of inside from volume of bottle Volume of expt 2 – volume of expt 1		[1]	
	(c)	(i)	Density of the steam is **less** than density of water		[1]	
		(ii)	Molecules in steam are further apart Molecules in water are closer		[1]	
	(d)	(i)	Weight on Moon = 8 (N) Weight on Earth = 50 (N) Difference = 50 – 8 = 42 (N)	[1] [1] [1]	[3]	
		(ii)	Straight line from 0,0 through 1, 3.7 and extended ↑ 3.6 to 3.8		[1]	15

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AVAILABLE MARKS

4 **(a)** **(i)** Prevents passenger being thrown forward against windscreen
or similar response [1]
increases time **and reduces force/deceleration**

(ii) Airbag or crumple zone or steel cage or ABS
or stability control, or traction control [1]

(iii) Momentum = mass × velocity **or** p = mv [1]
= 48 × 15 720,000 only [1] [1]
= 720 if correct unit [1]
kg m/s or Ns given g m/s [1] [4]

(b) **(i)**

Centripetal force, F, in newtons	0.0	0.5	1.0	1.5	2.0
Speed of bung, v, in m/s	0.0	0.9	1.3	1.6	1.8
v^2 in m^2/s^2	**0.0**	**0.8**	**1.7**	2.6	**3.2**

All correct 1 decimal place only [1]

(ii) Label: v^2 in **m^2/s^2** unit is required [1]
Scale: Covering at least half axis – on both axes [1]
Plotted points ± 1 square, $\frac{1}{2}$ mark per point and round **down** [2] [4]

(iii) Straight line of fit (not point-to-point) [1]

(iv) gradient = 2.0/3.2 = 0.625 **A non-linear scale** [1]
= 0.6 ± 0.05 **on the graph** [1] [2]
values from table ok **no credit**

(v) They are the same/equal [1] 15

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5 **(a)** **(i)** P marked clearly on shoulder [1]

(ii) G clearly marked at the midpoint of the ladder – good approximation by eye – 2nd box to LHS of shoulder [1]

(iii) ACM = CM [1]
ACM = CM or $200 \times 0.5 = 80 \times d$ [1]

Alternative

$200 \times 0.5 = 80 \times (1.5 - \mathbf{X})$ give [3]
d = 1.25 m [1]
Distance from **X** = 0.25 m [1] [4]

(iv) Direction to the right/towards the end **X**/away from the window cleaner/away from pivot [1]
To create a larger turning effect/moment/larger CM [1]
to compensate/allow for the larger moment or ACM due to the ladder [1] [3]
Allow calculations for the explanation
If direction wrong – give [0]

(b) 1. Large base area/wide base
2. Heavy base
3. Low CoG
4. CoG still acts within the base
5. Not easily toppled
6. Presents a fire risk/burns
7. CoG in the centre

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

[6]

AVAILABLE MARKS

15

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						AVAILABLE MARKS
6	**(a)**	**(i)**	Proton, Neutron and Electron (3 × [1])		[3]	
		(ii)	$^{3}_{2}He$ both figures required and in correct place		[1]	
	(b)	**(i)**	Fission correct spelling		[1]	
		(ii)	**Reasons must be consistent with their choice** e.g. Yes – is a long term energy supply, would provide long term employment, employment of technical skilled persons, employment (cost arguments – give [0] efficiency [0]) during the construction process, reduces the demand for fossil fuels/conserves fossil fuel stocks/lots of energy from little fuel – reliable No CO_2 [0] But SO_2 ✓ No – produces toxic waste, terrorist attack, could increase radiation in the area, possibility of leakage/decommission costs explosion [0] potential for disaster [1] difficult to store waste products [1] radioactive waste causes cancer **or** just radioactive waste (2 x [1])		[2]	
	(c)		It will **strip**/**remove** electrons off atoms **only** removing or adding electrons [0]		[1]	
	(d)	**(i)**	Gamma – must be stated before 2nd mark possible	[1]		
			(Only) gamma will pass through the steel/alpha and beta will not pass through the steel	[1]	[2]	
			Most penetrating [0] Accept source			
		(ii)	If the steel is too thick the detector registers a reduction **or** if the steel is too thin the detector registers an increase	[1]		
			(The control unit) increases the pressure or force on the rollers/the control unit decreases the pressure or force on the rollers	[1]	[2]	
			constant reading means constant thickness so constant pressure } give [1]			
	(e)		20 cps to 5 cps is 2 half-lives	[1]		
			2 half-lives = $\underbrace{2 \times 5600}_{[1]} = \underbrace{11\ 200\ y}_{[1]}$	[2]	[3]	15
					Total	**100**

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Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2014

GCSE Physics

Unit 1

Higher Tier

[GPH12]

GPH12

THURSDAY 12 JUNE, MORNING

TIME

1 hour 30 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Write your answers in the spaces provided in this question paper.
Complete in blue or black ink only. **Do not write in pencil or with a gel pen**.
Answer **all six** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 100.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

Quality of written communication will be assessed in Question **1(a)(iii)** and Question **3(a)(v)**.

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Examiner Only	
Marks	Remark

1 **(a)** **(i)** In 2009 the sprinter Usain Bolt ran the 100 m sprint with an average speed of 10.44 m/s. Calculate the time he recorded for this race.

You are advised to show clearly how you get your answer.

Time to run 100 m = _____ s [2]

(ii) Explain why 10.44 m/s is his average speed.

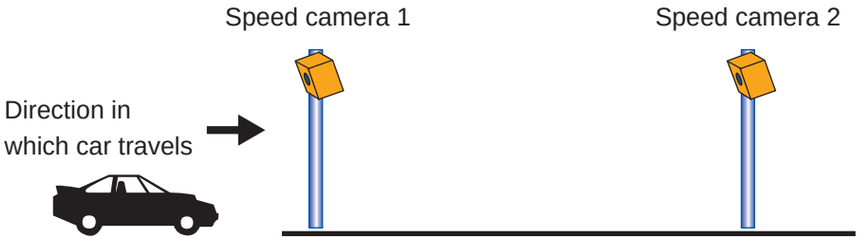
_____

_____

_____ [1]

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(iii) To detect speeding motorists speed cameras are located on the roadside. One type of speed camera measures the average speed of a motorist.
Those motorists who exceed this average speed are prosecuted.
The diagram below represents the layout of the system.



Explain carefully and in detail how this system of speed cameras measures the average speed of a car.

In this question you will be assessed on your written communication skills including the use of specialist terms.

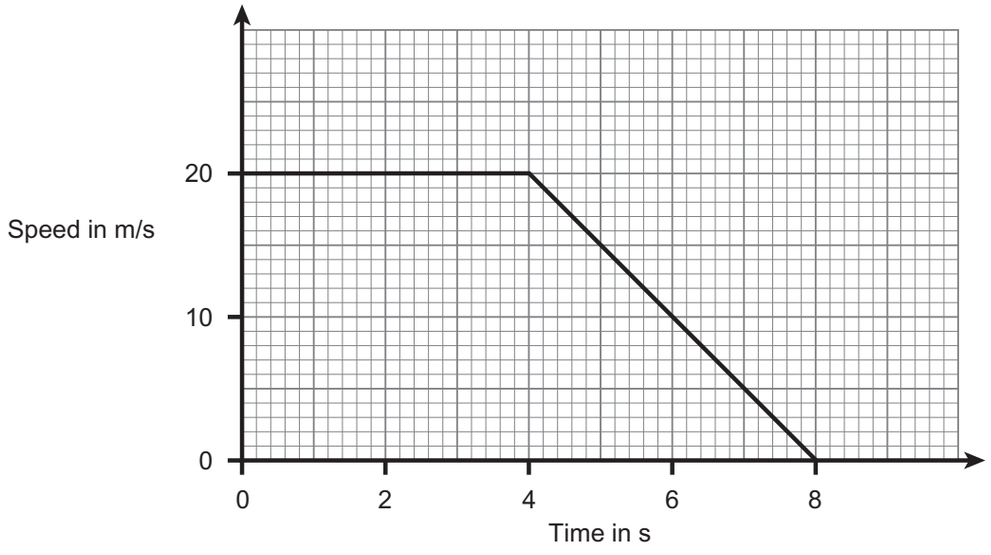
[6]

Examiner Only	
Marks	Remark

[Turn over

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(b) The speed–time graph for the motion of a car as it approaches a set of traffic lights is shown below.



(i) Using the graph calculate the distance travelled by the car during the 8 s of its motion shown in the graph.

You are advised to show clearly how you get your answer.

Distance = _____ m [4]

Examiner Only	
Marks	Remark

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(ii) Calculate the deceleration of the car after the brakes have been applied.

You are advised to show clearly how you get your answer.

Deceleration = _____ m/s^2 [2]

(iii) The car has a mass of 800 kg. Using your answer to **part (ii)** calculate the force acting on the car when the brakes are applied.

You are advised to show clearly how you get your answer.

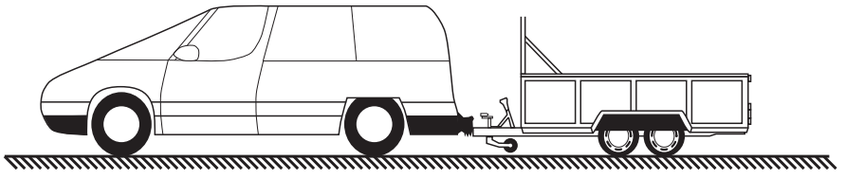
Force = _____ N [3]

Examiner Only	
Marks	Remark

[Turn over

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(iv) A car with the same mass (800 kg) is towing a trailer. This car and trailer are also travelling at 20 m/s.



The braking force remains unchanged from the value you calculated for **part (iii)**. Explain carefully why a driver should allow for a greater stopping distance when towing a trailer.

_____

_____

_____

_____ [2]

Examiner Only	
Marks	Remark
Total Question 1	

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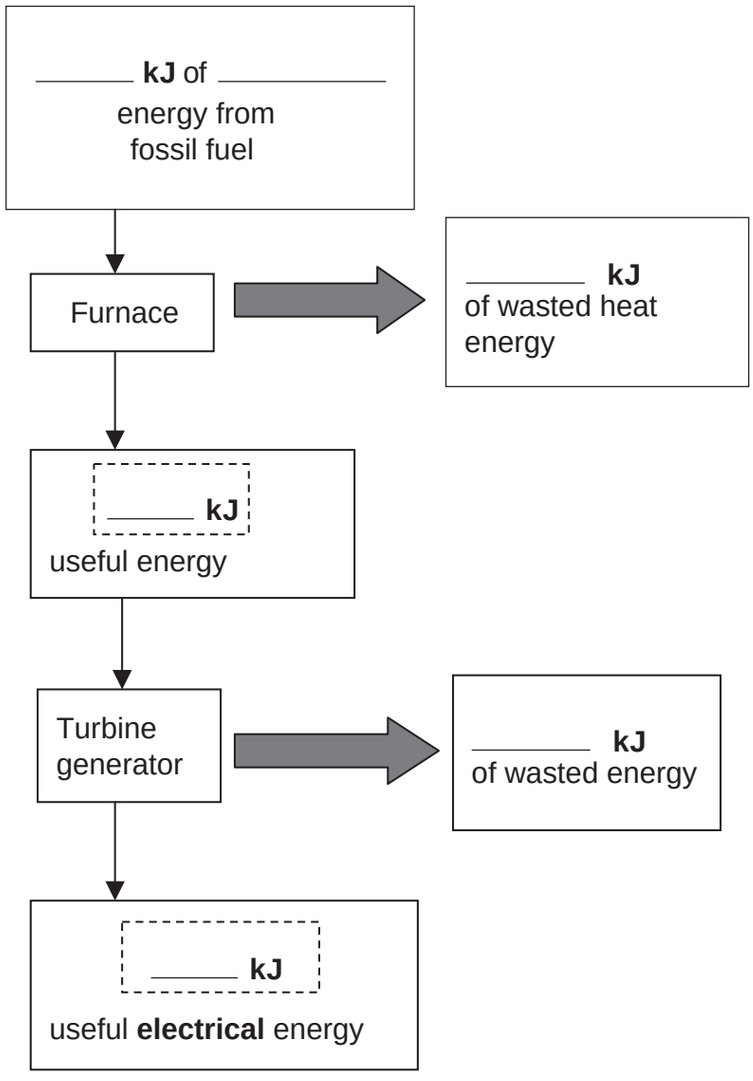
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Examiner Only	
Marks	Remark

2 **(a)** Electrical energy can be obtained by burning fossil fuels. The simplified diagram below illustrates the energy changes that take place during this process. For every 120 kJ of input energy 80 kJ are wasted as heat from the furnace. Of the remaining useful energy 16 kJ are wasted as heat and sound in the turbine. The remainder of the useful heat energy is converted to electrical energy.

(i) Complete the diagram below by adding the appropriate numbers to the boxes. You should also name the type of input energy used in this process by adding the name to the first box.



[4]

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(ii) Name and state the principle that allowed you to answer **part (a)(i)**.

_____

_____ [2]

(b) Every second a power station uses 800 MJ of input energy in the form of a fossil fuel. The efficiency of this power station is 0.35 (35%). Calculate the output electrical energy per second for this power station.

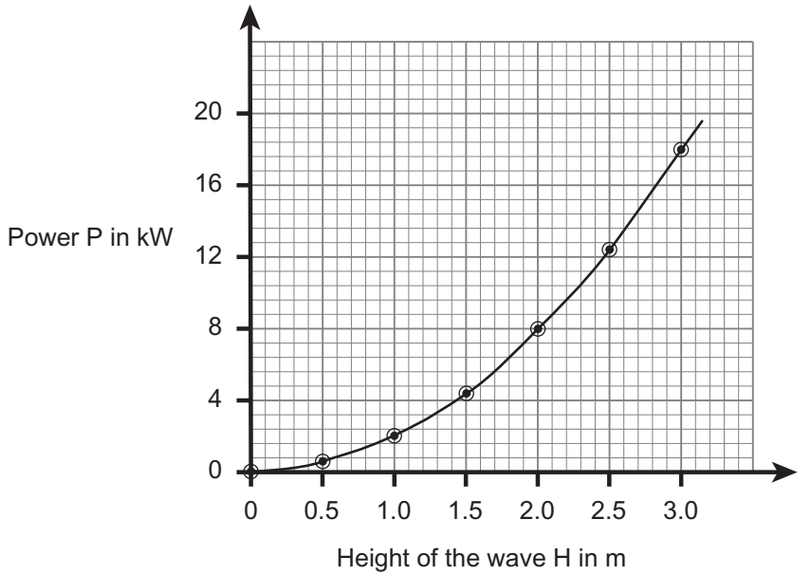
You are advised to show clearly how you get your answer.

Output electrical energy per second = _____ MJ [4]

Examiner Only	
Marks	Remark

[Turn over

(c) Many scientists are investigating the use of water waves to produce electrical energy. In one investigation the electrical power P extracted from water waves was measured when waves of different height were used. The graph below shows the results obtained from the investigation.



(i) The **power P** is directly proportional to the **square** of the **height H** of the wave. Use this information to complete, in the box below, the equation linking the power P, the height of the wave H and the constant of proportionality K.

P =

[2]

(ii) Using the equation and the graph, find the value of the constant of proportionality K.

You are advised to show clearly how you get your answer.

K = _____ [3]

Examiner Only	
Marks	Remark
Total Question 2	

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(Questions continue overleaf)

[Turn over

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Examiner Only	
Marks	Remark

3 **(a)** **(i)** The density of aluminium is 2.7 g/cm^3.
Explain, **without giving a formula**, what this means.

_____

_____ [1]

(ii) Calculate the number of cm^3 in 1 m^3.

_____ [1]

(iii) Calculate the mass in grammes of 1 m^3 of aluminium.

_____ g [1]

(iv) Calculate the density of aluminium in kg/m^3.

_____ kg/m^3 [2]

(v) You are given a block of metal as shown in the diagram below.



© CCEA

Describe how you would determine the density of the metal. In your answer you should state the measurements you would make and the calculations needed to find the density.

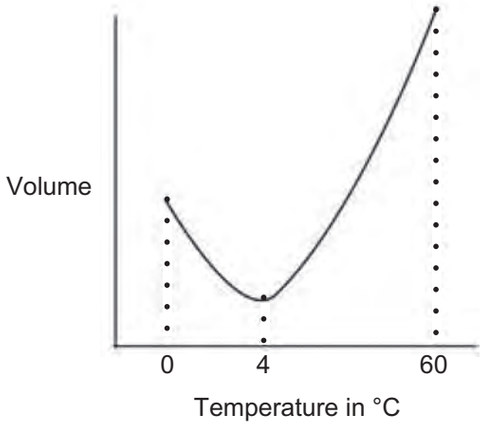
In this question you will be assessed on your written communication skills including the use of specialist science terms.

[6]

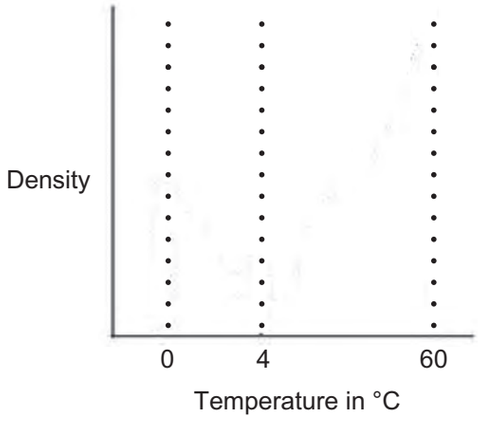
Examiner Only	
Marks	Remark

[Turn over

(b) Graph 1 shows how the volume of a **fixed mass** of water changes as it is cooled from 60 °C until it turns to ice at 0 °C.



Graph 1



Graph 2

(i) On Graph 2 draw the graph that would be found for the density changes that take place between 60 °C and 0 °C. [2]

Examiner Only	
Marks	Remark

(ii) Describe what is happening to the distance between the water molecules during the following temperature changes.

60 °C to 4 °C _____

_____

_____

4 °C to 0 °C _____

_____

_____ [2]

Examiner Only	
Marks	Remark
Total Question 3	

[Turn over

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Examiner Only	
Marks	Remark

4 **(a)** The diagram shows an athlete who is moving a hammer in a circle. The hammer is a heavy metal ball attached to a steel wire. The athlete grips the steel wire at the other end as shown below.



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(i) What name is given to the force that keeps objects moving in a circle?

_____ [1]

(ii) In what direction does this force act?

_____ [1]

(iii) In the case shown in the diagram what provides this force?

_____ [1]

(iv) The hammer moves in a circle with constant speed. Explain why it would be **incorrect** to say it moves with a constant velocity.

_____

_____

_____ [1]

(v) The table below shows some of the factors that may affect the size of the force needed to move an object in a circle. Complete the table using the terms increases, decreases or has no effect. You should assume that only one factor at a time is changing.

Factor being changed	The effect on the size of the force
The speed is increased, the mass and radius remain constant	
The radius is increased, the mass and speed remain constant	
The direction of rotation is reversed, the speed, mass and radius remain constant	

[3]

(b) Golfers when hitting a golf ball sometimes want it to go as far as possible.
They achieve this by following through. This means the golf club exerts a force on the ball for as long as possible.



© iStock / Thinkstock

(i) Write down the equation that connects the momentum change that the ball experiences, the force acting on the ball and the time for which the force acts.

_____ [1]

Examiner Only	
Marks	Remark

[Turn over

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(ii) A golfer exerts a force of 9 000 N on the golf ball for **1.2 milliseconds**.
Calculate the change in momentum of the golf ball.
(1 millisecond = 0.001 seconds)

You are advised to show clearly how you get your answer.

Change in momentum = _____ kg m/s [3]

(iii) At a particular point in its motion the golf ball of mass 0.06 kg is moving with a velocity of 50 m/s. Calculate its momentum.

You are advised to show clearly how you get your answer.

Momentum = _____ kg m/s [2]

Examiner Only	
Marks	Remark

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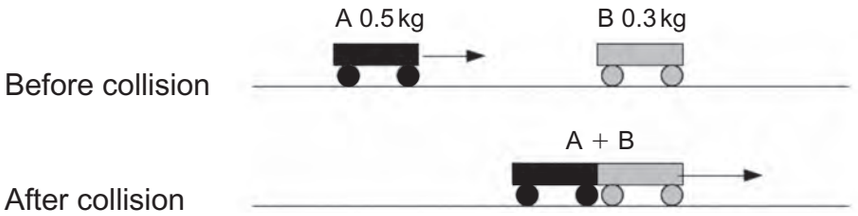
(Question 4 continues overleaf)

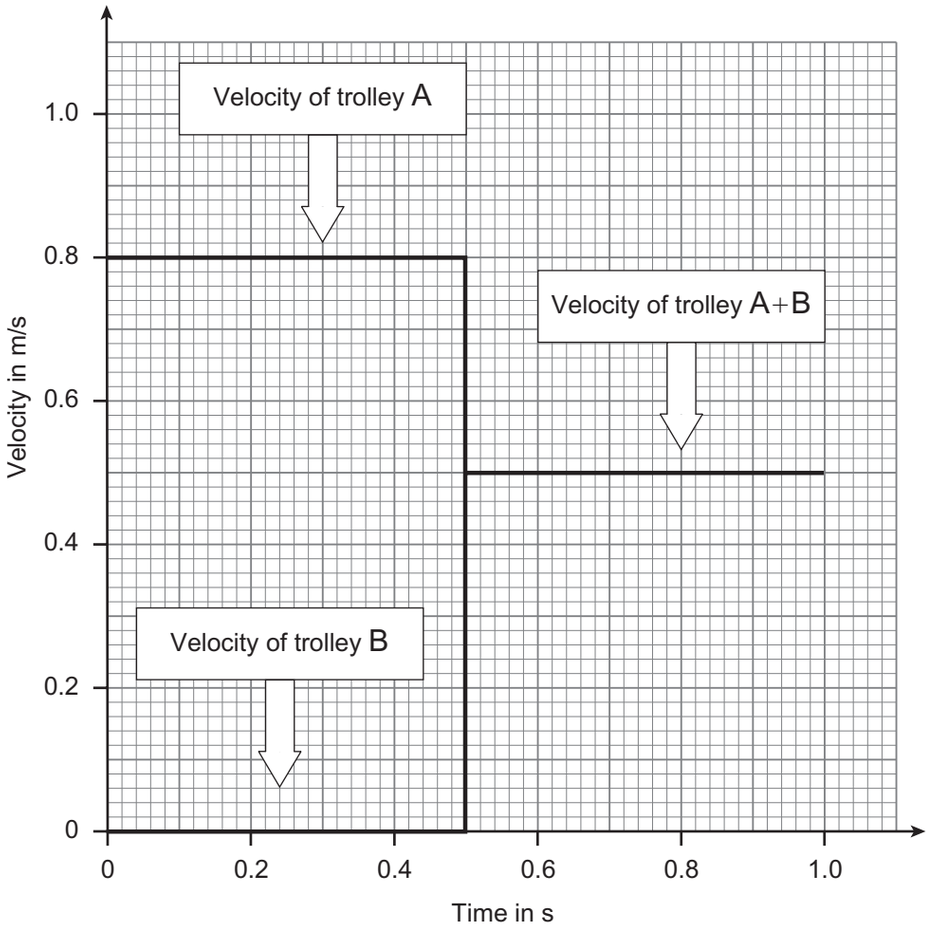
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(c) In order to investigate momentum the following experiment was carried out. Trolley A was made to travel along a horizontal surface and collide with a **stationary** trolley B. After the collision the two trolleys stick to each other and move together. The velocities of the trolleys were measured and these are shown on the graph below.

Examiner Only	
Marks	Remark





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(i) Using the data from the graph complete the table below.
Write your answers in the boxes that are **NOT** shaded

Before collision		After collision	
Velocity of trolley A			
Velocity of trolley B	0 m/s		
		Velocity of A + B	
Mass of trolley A	0.5 kg		
Mass of trolley B	0.3 kg		
		Mass of trolley A + B	0.8 kg
Momentum of trolley A			
Momentum of trolley B			
Total momentum =			
		Momentum of trolley A + B	

[6]

(ii) Explain how the results of the experiment verify the Principle of Conservation of Momentum.

_____

_____ [1]

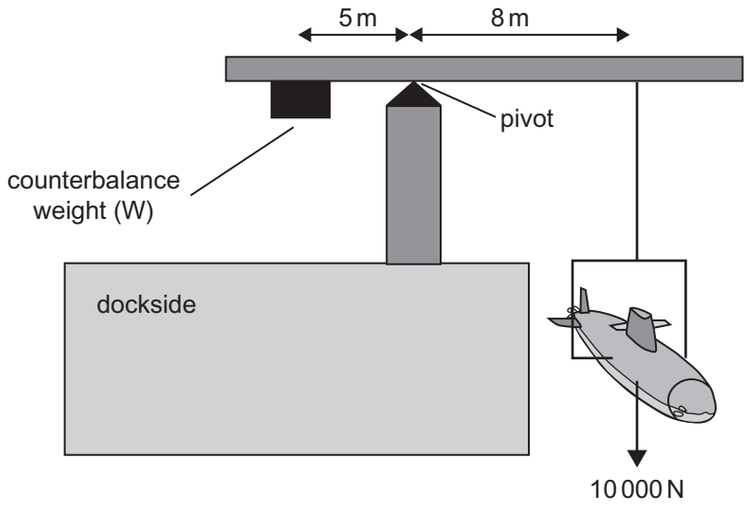
Examiner Only	
Marks	Remark
Total Question 4	

[Turn over

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5 **(a)** The diagram below represents a crane lifting a small submarine. The submarine weighs 10 000 N.

Examiner Only	
Marks	Remark



(i) Calculate the value of the counterbalance weight, W, needed to prevent the crane from toppling over.

You are advised to show clearly how you get your answer.

Counterbalance weight W = _____ [4]

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(ii) To allow the crane to lift boats of different weights out of the water, the counterbalance weight can be moved to the left or right.
If a boat heavier than 10 000 N is to be lifted by the crane, in what direction should the counterbalance weight be moved? Explain your answer.

Direction of movement is _____

Explanation

_____

_____

_____

_____ [2]

Examiner Only	
Marks	Remark

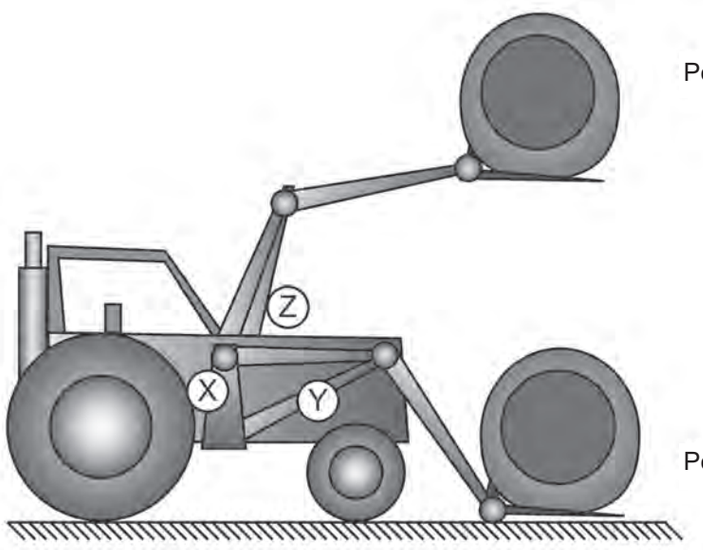
(b) (i) What is meant by the centre of gravity of an object?

_____

_____

_____ [2]

Many farmers use tractors to move large round bales as shown in the diagram below.



X is the position of the tractor's centre of gravity when it is not carrying any bale.
Y is the position of the centre of gravity when the bale is carried in the low position and Z is the position of the centre of gravity when the bale is carried in the raised position.

(ii) In which position of the bale is the tractor **least** stable? Explain your answer.

_____

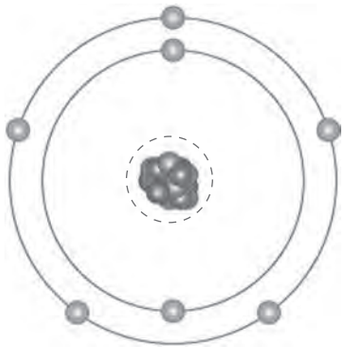
_____

_____ [2]

Examiner Only	
Marks	Remark
Total Question 5	

Examiner Only	
Marks	Remark

6 **(a)** The diagram shows the particles that make up the **atom** of an isotope of nitrogen.



© *Science Photo Library*

(i) Using information from the diagram above and your knowledge of the structure of a nucleus, complete the symbol below to show the composition of this nucleus of nitrogen.

$$^{15}_{\square}\mathrm{N}$$

[1]

(ii) What does the number 15 represent?

_____

_____ [1]

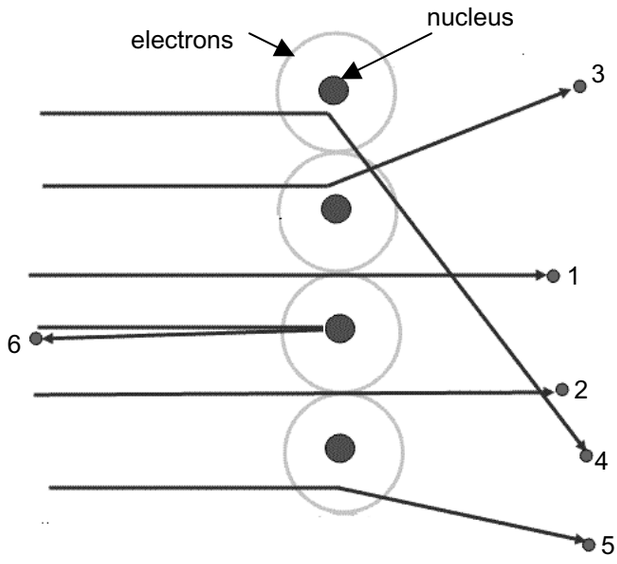
(iii) How many neutrons are to be found in this nucleus of nitrogen?

_____ [1]

[Turn over

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(b) The model of the atom shown in part **(a)** came about through observations of how alpha particles passed through a thin metal foil. Below is a simplified diagram showing the paths taken by some of the alpha particles.



Most alpha particles followed paths 1 to 5. What information **about the nucleus** of the atom did each of the paths taken by the alpha particles provide?

(i) Paths 1 and 2 _____

_____

_____ [1]

(ii) Paths 3, 4 and 5 _____

_____

_____ [1]

Examiner Only	
Marks	Remark

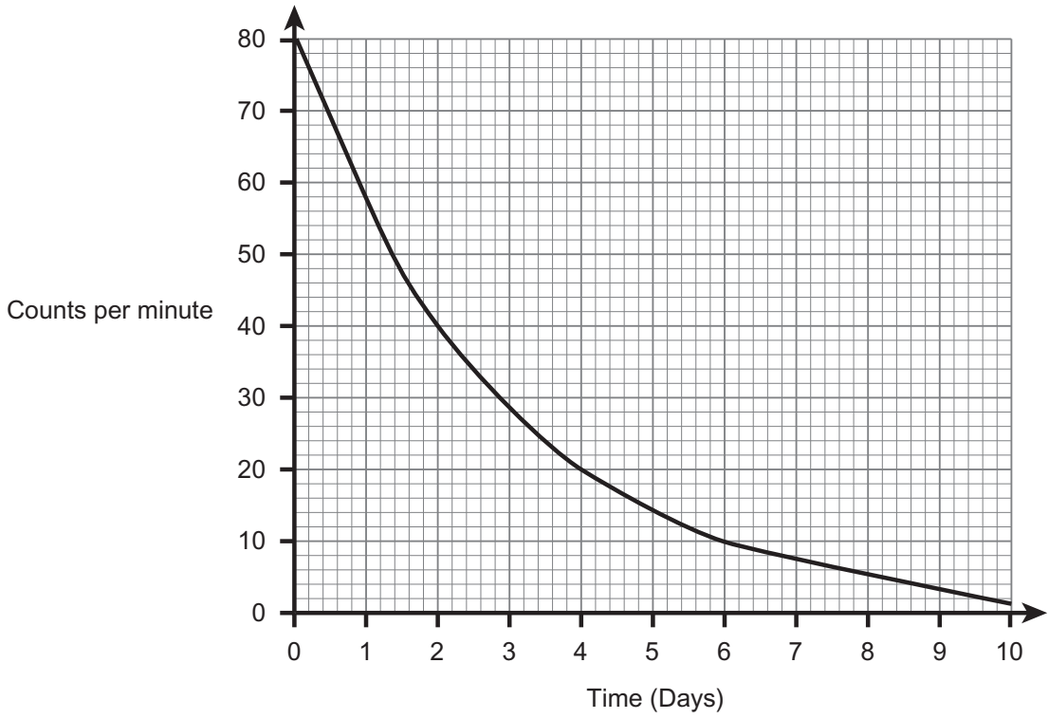
Path 6 is very different from the others. Path 6 was followed by very few of the alpha particles.

(iii) What additional piece of information about the nucleus did this observation provide?

_____

_____ [1]

(c) The graph below shows how the activity of a radioactive substance changes with time.



(i) What is the half-life of this radioactive substance?

_____ [1]

(ii) On the grid plot **three values** for the activity of another substance with a half-life of 1 day.
This substance had an initial activity of 80 counts per minute.
Draw a smooth curve through your points. [3]

Examiner Only	
Marks	Remark

[Turn over

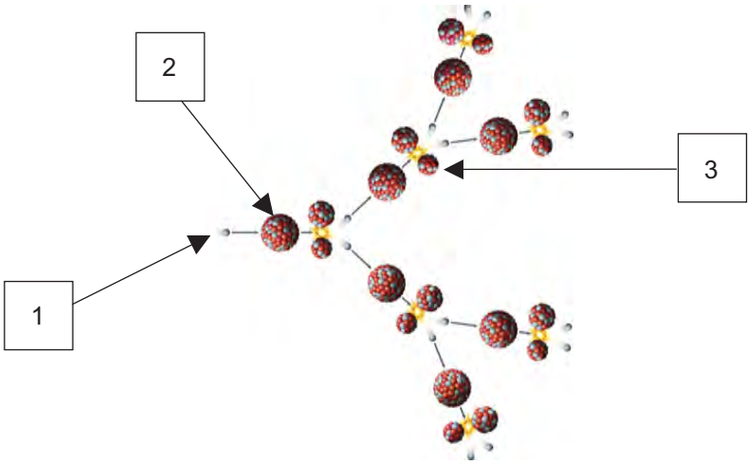
Examiner Only	
Marks	Remark

(d) The element sodium (symbol Na) has an unstable isotope which is radioactive and decays to the element magnesium (symbol Mg). Complete the decay equation below for this change.

$$\square^{24}_{\square}\mathrm{Na} \rightarrow \square^{}_{12}\mathrm{Mg} + \square^{}_{\square}\mathrm{e}$$

[4]

(e) The diagram below illustrates a nuclear reaction that results in the release of a large amount of energy.



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(i) What is the name of this nuclear process?

_____ [1]

(ii) Name the particle marked 1. _____ [1]

(iii) Particle 1 is absorbed by nucleus 2.
State what nucleus 2 is and explain how nucleus 3 is formed.

_____

_____

_____

_____ [2]

(iv) An important part of this process is the creation of a chain reaction. Describe what this is.

_____

_____

_____ [2]

THIS IS THE END OF THE QUESTION PAPER

Examiner Only	
Marks	Remark
Total Question 6	

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Question Number	**Marks**
1	
2	
3	
4	
5	
6	
Total Marks	

Examiner Number

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Rewarding Learning

General Certificate of Secondary Education
2014

GCSE Physics

Unit 1
Higher Tier

[GPH12]

THURSDAY 12 JUNE, MORNING

MARK SCHEME

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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) (i) time = 100/10.44 [1]
= 9.58 s **or** 9.6 **or** 9.5785 **not** 9.5 [1] [2]

(ii) His speed changes during the race/he has accelerated [1]

(iii) **Indicative content**
Timer starts when car passes camera 1
Timer stops when car passes camera 2
Time interval calculated/or known
Distance between cameras is known/or measured
Average speed = distance/time interval

Response	Mark
Candidates describe in detail using good spelling, punctuation and grammar **all the main points** shown above. 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 **one or two 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) Distance = area under the graph [1]
= (20 × 4) [1] + $\frac{1}{2}$(4 × 20) **or** $\frac{1}{2}$ (8 + 4) × 20 [1] [2]

= 120 (m) [1] [4]

(ii) Deceleration = slope or gradient or 20/4 ignore – sign [1]
= 5 (m/s^2) or a = $\frac{v - u}{t}$ or v = u + at [1] [2]
Do not penalise v, u confusion – 20 = 0 + 4a [1]

(iii) F = ma = 800 × 5 [1] for recall of formula [1] for substitution
= 4000 (N) **e.c.f. from (ii)** ignore +/– signs [3]

(iv) Larger mass [1] means smaller deceleration [1]
not weight or greater kinetic energy
Greater momentum [1] – longer stopping time [1] [2]
The 2nd mark only if first mark gained

20

AVAILABLE MARKS

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						AVAILABLE MARKS
2	**(a)**	**(i)**	120 kJ [$\frac{1}{2}$] of chemical [1] 80 kJ [$\frac{1}{2}$] of wasted heat 40 kJ [$\frac{1}{2}$] of useful heat $\frac{1}{2}$ marks round down 16 kJ [$\frac{1}{2}$] of wasted energy 24 kJ [1] of electrical energy		[4]	
		(ii)	Conservation of energy conversion [0]	[1]		
			Energy cannot be created or destroyed	[1]	[2]	
	(b)		Efficiency = $\frac{\text{useful output energy}}{\text{total input energy}}$ $\frac{\text{UOE}}{\text{TIE}}$ [1] for part credit	[1]		
			Work or power can be used in place of energy Output/input score [0] for part credit formula wrong **XP** even if answer correct			
			0.35 = useful output/800	[2]		
			Useful output = 800 × 0.35 = 280 (MJ) Power of 10 error give **max** [3]	[1]	[4]	
	(c)	**(i)**	$P = KH^2$ – box is the definitive answer		[2]	
		(ii)	$2.0 = K \times 1^2$ **or** $8 = K2^2$ **or** corresponding pts from graph	[2]		
			$K = 2 \pm 0.2$ **no ecf**	[1]	[3]	15
			Allow K = 2000 if P → watts i.e. $2000 = K \times 1^2$ or $8000 = K \times 2^2$			

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AVAILABLE MARKS

3 (a) (i) **1 cm^3** or a cm^3 of aluminium has a **mass** of 2.7 g Unit volume [0] [1]

(ii) Volume 1m^3 = 100 × 100 × 100 cm = 1 000 000 [1]

(iii) Mass = 2.7 × 1 000 000 = 2 700 000 ecf from **(ii)**
or 2.7 × their answer to **(ii)** [1]

(iv) $\left(D = \frac{M}{V} =\right) \frac{2700000}{1000\ [1]} = 2700$ [1] ecfs from **(ii)** and **(iii)**
or their answer to $\frac{\textbf{(iii)}}{1000}$ [2]
– no marks for $D = \frac{M}{V}$

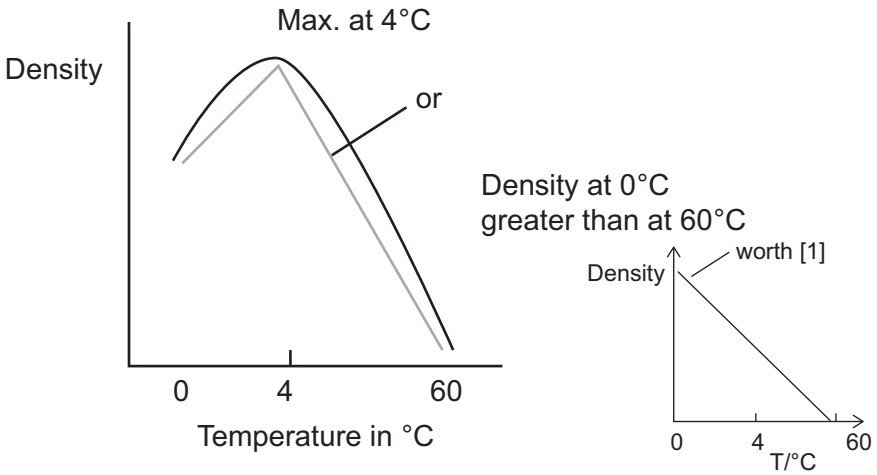
(v)

Measure length, width and depth Using a ruler/tape measure Calculate volume by l × w × d Measure the mass Using a balance/scales Density = mass/volume or $D = \frac{M}{V}$	DISPLACEMENT METHOD Initial V_1 Final V_2 } [1] Vol of object = $V_2 - V_1$ Measuring cylinder [1]	EUREKA CAN Fill to spout Collect overflow Measuring cylinder to measure volume

Response	Mark
Candidates describe in detail using good spelling, punctuation and grammar **at least 5 points** shown above. 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 3 of the main 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 **one 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]

Mark for physics, then [1] for QWC [6]

(b) (i)



Max. at 4 °C [1]
Density at 0 °C > 60 °C [1] [2]

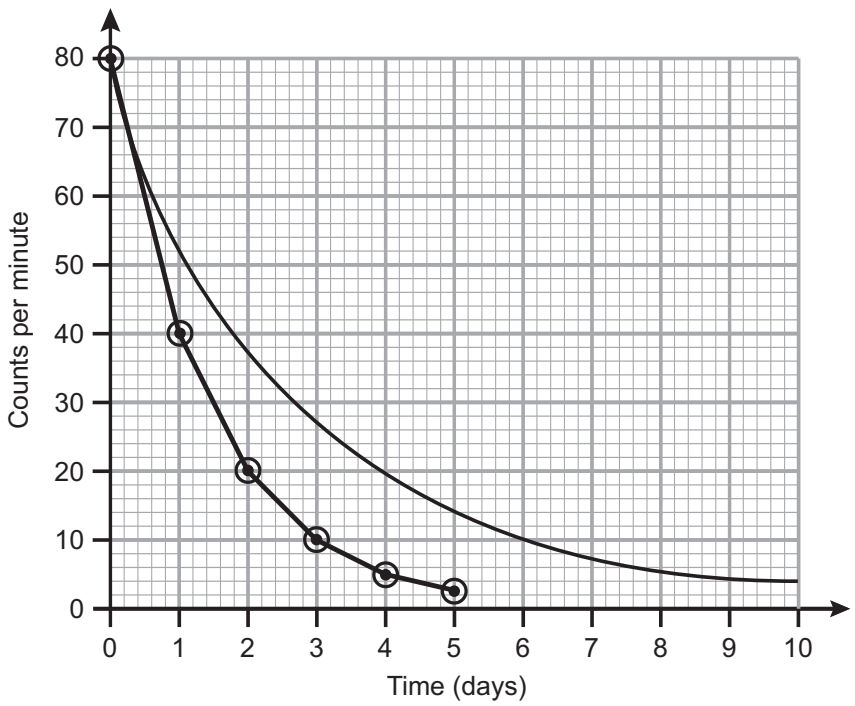
(ii) 60 to 4 distance between molecules is **decreasing** [1]
4 to 0 distance between molecules is **increasing** [1] [2]

15

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						AVAILABLE MARKS
4	**(a)**	**(i)**	Centripetal		[1]	
		(ii)	Towards the **centre** (of the circle) centre seeking inward [0] towards person [0]		[1]	
		(iii)	Tension (in the cable)		[1]	
		(iv)	The **direction** of hammer/displ. is changing **or** velocity is a vector vel = $\frac{\text{displ}}{\text{time}}$ [0]		[1]	
		(v)	Increases Decreases No effect/same	[1] [1] [1]	[3]	
	(b)	**(i)**	Momentum **change** = Force × Time or Ft = m(v – u) ΔmaΔp = Ft not F = ma	[1]		
		(ii)	9000 × 0.0012 if 9000 × 1.2 give [1] if no further work sight of 0.0012 [1] Momentum change = 10.8 (kg m/s) 9000 × 0.001 [0]	[2] [1]	[3]	
		(iii)	Momentum = mass × velocity Award equation [1] if no further work shown = 0.06 × 50 = 3 (kg m/s)	[1] [1]	[2]	
	(c)	**(i)**	Before collision Velocity of A = 0.8 Momentum of A = 0.4 Momentum of B = 0 Total momentum = 0.4 Units are not required	After collision [1] Velocity of A+B = 0.5 [1] [1] [1] [1] Momentum of A+B = 0.4 [1]	[6]	
		(ii)	Momentum before the collision equals the momentum after the collision Equilibrium of forces – **BOD**		[1]	20
5	**(a)**	**(i)**	ACM = CM only give [1] if no further work or ↺ = ↻ W × 5 = 8 x 10 000 W = 16 000 (N)	[3] [1]	[4]	
		(ii)	W moves LEFT/further away/west Creating a larger moment/turning effect **or** Compensates for increased moment/turning effect of heavier boat anti-clock – clockwise [0], to the right [0]/[2] mention increasing force give [0]	[1] [1]	[2]	
	(b)	**(i)**	**Point** **not** region/area/space where the weight/mass acts gravity acts [0]	[1] [1]	[2]	
		(ii)	Position 2 (raised) or Z Higher CoG – more likely to topple Raised CoG allow references to narrower base Allow converse, i.e. lower CoG more stable	[1] [1]	[2]	10

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					AVAILABLE MARKS
6	**(a)**	**(i)**	7	[1]	
		(ii)	Number of nucleons **or** number of protons plus neutrons Nucleon number [0] At. mass no. [0] Mention of electrons [0]	[1]	
		(iii)	8	[1]	
	(b)	**(i)**	The nucleus is small	[1]	
		(ii)	The nucleus is positively charged/same charge as α particle	[1]	
		(iii)	The nucleus is very dense/small/massive **or** the nucleus is positively charged heavier [0] much heavier [1] nucleus is larger than α particle [0]	[1]	
	(c)	**(i)**	2 (days)	[1]	
		(ii)	 Any 3 correct points [2] Tolerance $\pm \frac{1}{2}$ square Any 2 correct points [1] Any curve [1] consistent with points – must be points shown if curve reduces before 5 days [0]	[3]	
	(d)		$^{24}_{11}\text{Na} \rightarrow {}^{24}_{12}\text{Mg} + {}^{0}_{-1}\text{e}$ No ecf	[4]	
	(e)	**(i)**	(Nuclear) fission correct spelling	[1]	
		(ii)	Neutron	[1]	
		(iii)	The **uranium** nucleus (particle 2) named nucleus [1] breaks/splits [1] (into small nuclei) fragments [1] (particle 3) [1] breaks up [1] fissions [1]	[2]	
		(iv)	The neutrons released in the breakup [1] cause other (uranium) nuclei to fission [1] general description of a chain reaction [0] No ecf for wrongly named particle, e.g. α, β	[2]	20
				Total	**100**

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Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2013

Science: Physics

Unit P1

Higher Tier

[GPH12]

GPH12

THURSDAY 13 JUNE, MORNING

TIME

1 hour 30 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
You must answer the questions in the spaces provided. Do not write outside the box, around each page or on blank pages.
Complete in blue or black ink only. **Do not write with a gel pen**.
Answer **all six** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 100.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Quality of written communication will be assessed in question **3(e)**.

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Examiner Only	
Marks	Remark

1 **(a)** A boat is pulled up a slipway. It has a mass of 2000 kg and it moves at a steady speed of 3 m/s.



© olegtoka / iStock / Thinkstock

(i) Calculate the kinetic energy of the boat.

You are advised to show clearly how you get your answer.

Kinetic energy = _____ J [3]

(ii) To pull the boat 50 m up the slipway 50 000 J of work is needed.

Calculate the force needed to do this.

You are advised to show clearly how you get your answer.

Force F = _____ N [3]

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(iii) At the top of the slipway the boat has gained 30 000 J of potential energy.

Calculate the vertical height through which the boat has been raised.

You are advised to show clearly how you get your answer.

Vertical height = _____ m [3]

(iv) At the top of the slipway the boat is allowed to slide down. On its way down it **loses 2000 J** of energy in the form of heat and sound.

Calculate the speed of the boat as it enters the water at the bottom of the slipway.

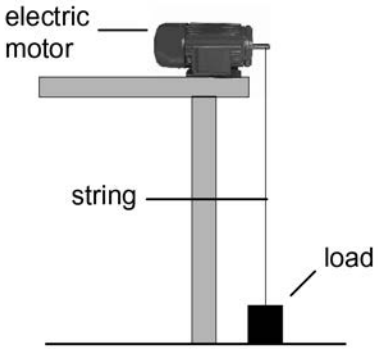
You are advised to show clearly how you get your answer.

Speed = _____ m/s [3]

Examiner Only	
Marks	Remark

[Turn over

(b) (i) To measure the output power of a small electric motor the apparatus shown opposite was set up. Describe the measurements that should be taken and the equipment used to make the measurements. State how the measurements are used to calculate the output power of the motor. Describe one step that should be taken to improve the reliability of the calculated value.



Examiner Only	
Marks	Remark

[6]

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(ii) In order to determine the efficiency of the motor what additional piece of information is needed?

_____

_____ [1]

(iii) A student calculated the efficiency of a particular motor to be 1.5 (150%). Explain why this is **incorrect**.

_____

_____ [1]

Examiner Only	
Marks	Remark
Total Question 1	

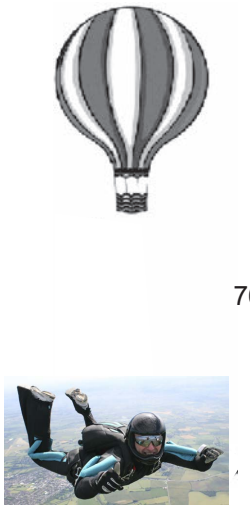
[Turn over

Examiner Only	
Marks	Remark

2 **(a)** A skydiver falls from a hot air balloon.
During the first 4 seconds she falls a distance of 76 m.

(i) Calculate her average speed during this time.

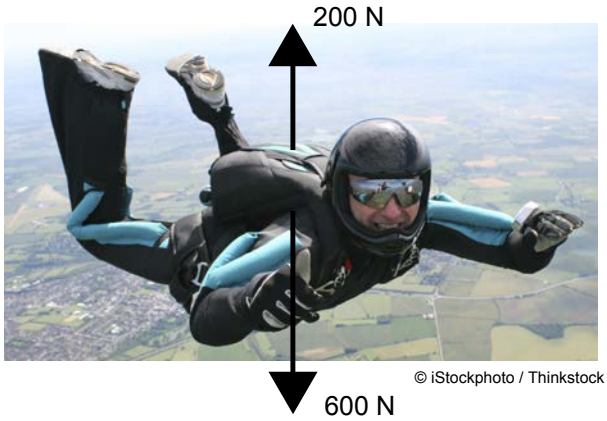
You are advised to show clearly how you get your answer.



© iStockphoto / Thinkstock

Average speed = _____ m/s [3]

(ii) The diagram below shows the two forces acting on the skydiver.
Using this information calculate the mass of the skydiver.



© iStockphoto / Thinkstock

Mass of the skydiver = _____ kg [2]

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(iii) Using your answer to part **(ii)** and information shown on the diagram calculate the acceleration of the skydiver.

You are advised to show clearly how you get your answer.

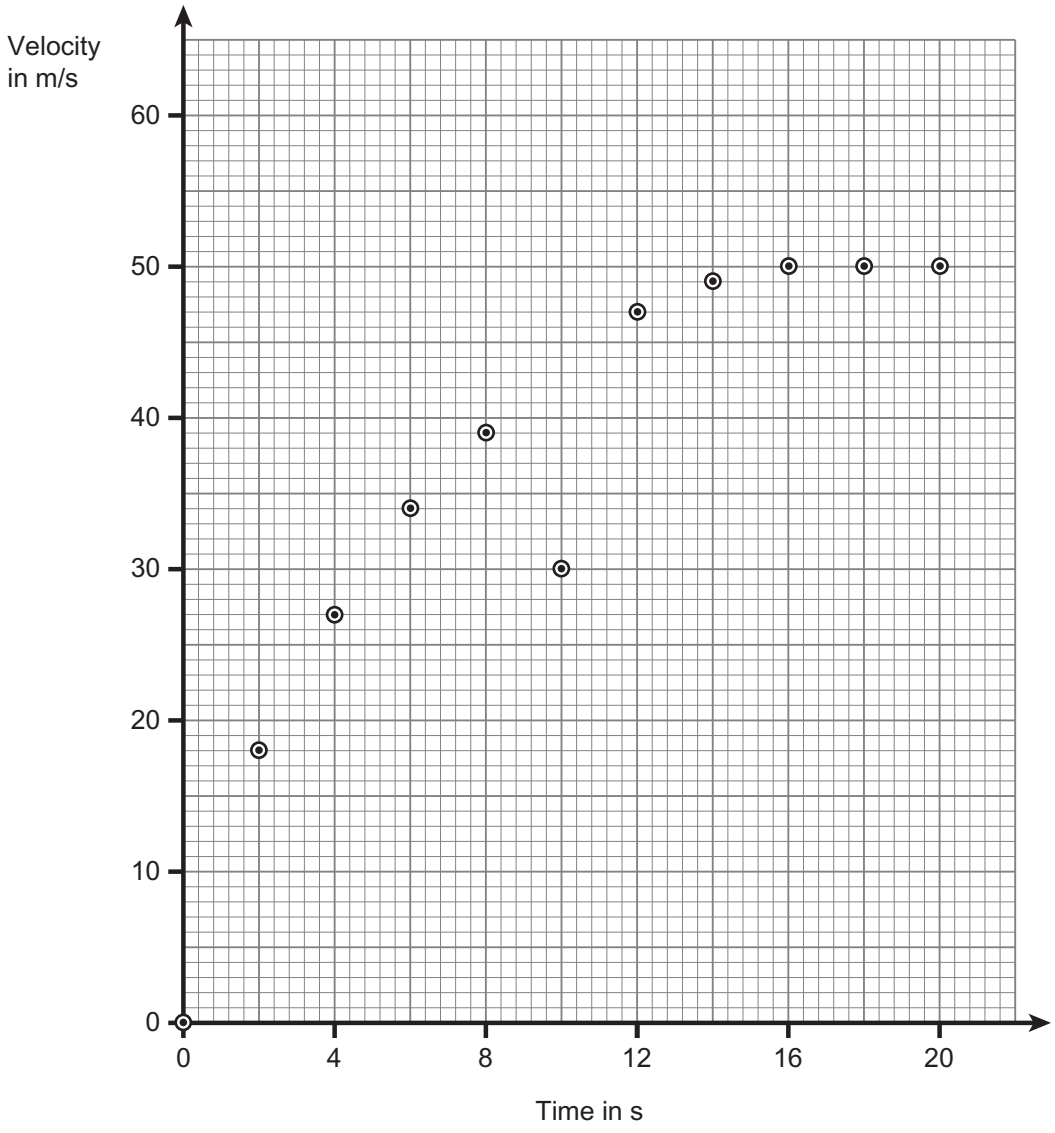
Examiner Only	
Marks	Remark

Acceleration = _____ m/s^2 [3]

[Turn over

Examiner Only	
Marks	Remark

(b) The downward velocity of the skydiver is measured at intervals from the moment she begins to fall. The results are shown in the graph below.



(i) Circle the measurement plotted on the graph that appears to be in error. [1]

(ii) Draw the curve of best fit through the points. [1]

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(iii) Calculate the skydiver's acceleration during the first 2 seconds of her fall.

Acceleration = _____ m/s^2 [2]

(iv) How does this graph show that the acceleration of the skydiver is decreasing?

_____

_____ [2]

(v) At what time did the acceleration of the skydiver become zero?

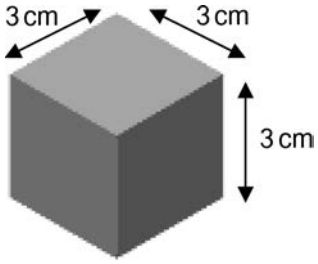
_____ [1]

Examiner Only	
Marks	Remark
Total Question 2	

[Turn over

Examiner Only	
Marks	Remark

3 **(a)** A metal **cube** has each side of length 3.0 cm and a mass of 240.3 grams.



Calculate the density of the metal.

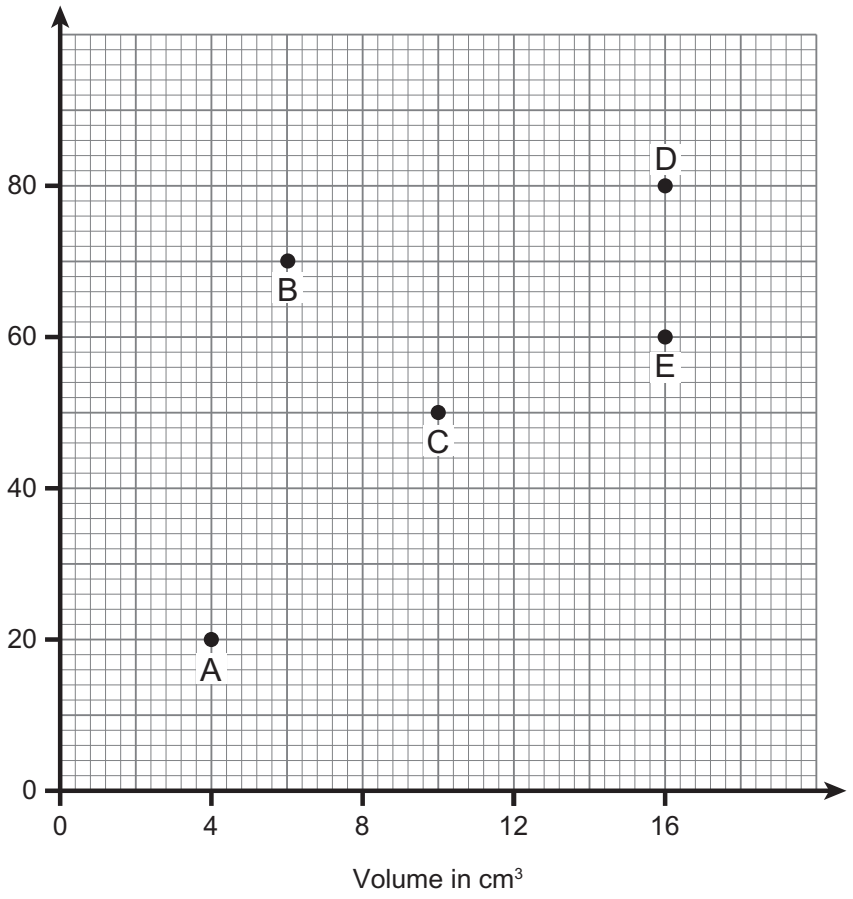
You are advised to show clearly how you get your answer.

Density = _____ g/cm^3 [4]

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Examiner Only	
Marks	Remark

(b) The mass and volume of five blocks were measured.
The values were then plotted on the grid shown below.
The letters correspond to each of the five blocks.



Which blocks are made of the same material?
Explain your answer **carefully**.

Blocks _____

Explanation _____

_____

_____

_____ [4]

[Turn over

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(c) Describe briefly what happens to the molecules in a solid when it changes into a liquid.

Examiner Only	
Marks	Remark

_____

_____

_____ [2]

(d) A volume of 500 cm^3 of water has a mass of 500 g.
Pat was given a quantity of salt and told to add enough of the salt to the water to increase the density of water to 1.1 g/cm^3.
Calculate the mass of salt needed.
Assume that adding salt does not change the volume of the water.

You are advised to show clearly how you get your answer.

Mass of salt = _____ g [4]

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(e) Mary has a necklace which she believes to be gold.
To find if it is made of gold she decides to measure the density of the metal from which it is made.
Describe, in detail, what she needs to do to measure the density of the metal used to make the necklace.

In your description you should state one precaution she should take to ensure that the density she obtains is as accurate as possible.

In this question you will be assessed on your written communication skills including the use of specialist science terms.

[6]

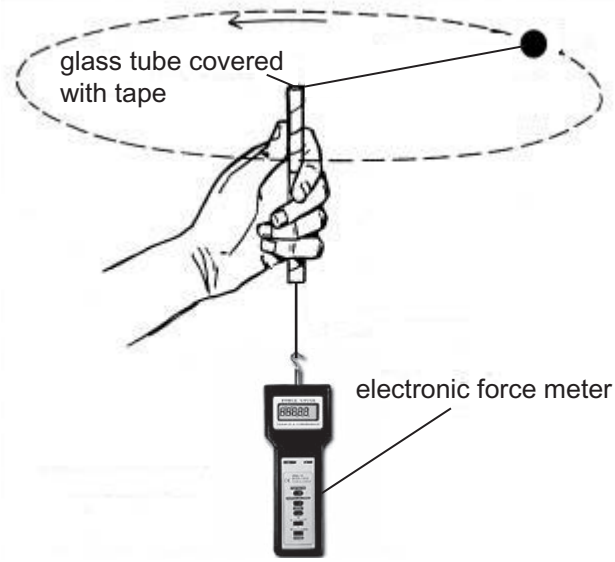
Examiner Only	
Marks	Remark
Total Question 3	

[Turn over

Examiner Only	
Marks	Remark

4 **(a)** To investigate circular motion pupils used the apparatus shown in the diagram.
An object is attached to a length of string the other end of which is attached to an electronic force meter.

The object is then whirled in a circle until it is moving with a constant speed. The time to complete one revolution is found and the reading on the force meter is noted. The speed is then changed and again the reading on the force meter and the time to complete one revolution is noted. This is carried out a number of times.



Source: http://www.eeprocess.com/Extech/instrument/images/products/451-499/475040.jpg
www.tealighthouse.org/science/images/hsphy_ucm_fig1.jpg

(i) During the investigation the radius of the circle is kept constant. Give another factor that affects the size of the centripetal force which should be kept constant during this investigation.

_____ [1]

(ii) The table below shows some of the results collected during the investigation.

Speed of the object in m/s	Reading on the force meter in N
9	32
6.4	16
4.5	8
3.2	4

Do the values in the table above show that the reading on the force meter is proportional to the speed of the object?
Explain your answer.

_____

_____

_____ [2]

Examiner Only	
Marks	Remark

[Turn over

Examiner Only	
Marks	Remark

(b) During a test of car safety a car of mass 1500 kg moving with a velocity of 20 m/s collides with a wall and comes to rest.



Source: http://static.howstuffworks.com/gif/car-testing1.jpg

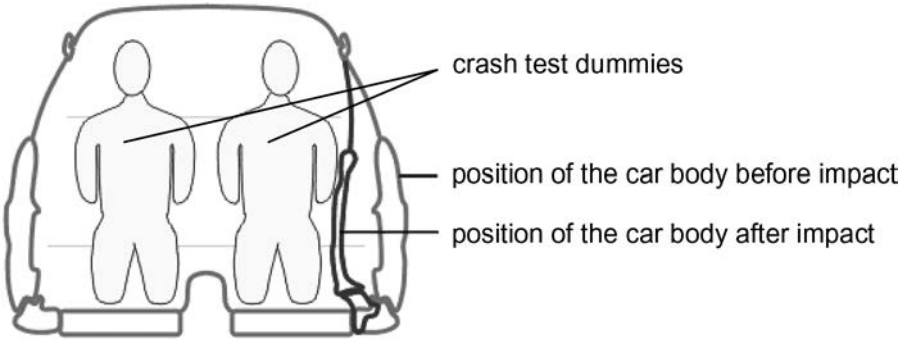
(i) The crash lasts for 0.12 s. Calculate the average force exerted on the car during this crash.

You are advised to show clearly how you get your answer.

Average force = _____ N [3]

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Many car makers design their cars with side impact crumple zones. The diagram below shows the position of the side of a car before and after impact.



Source: http://www.bbc.co.uk/schools/gcsebitesize/science/images/ph_forces08.gif

(ii) Explain, **fully**, how this design of the car reduces the possibility of serious injury to the occupants of the car.
In your answer you may refer to the equation you have used to answer part **(b)(i)**.

_____

_____

_____

_____

_____

_____

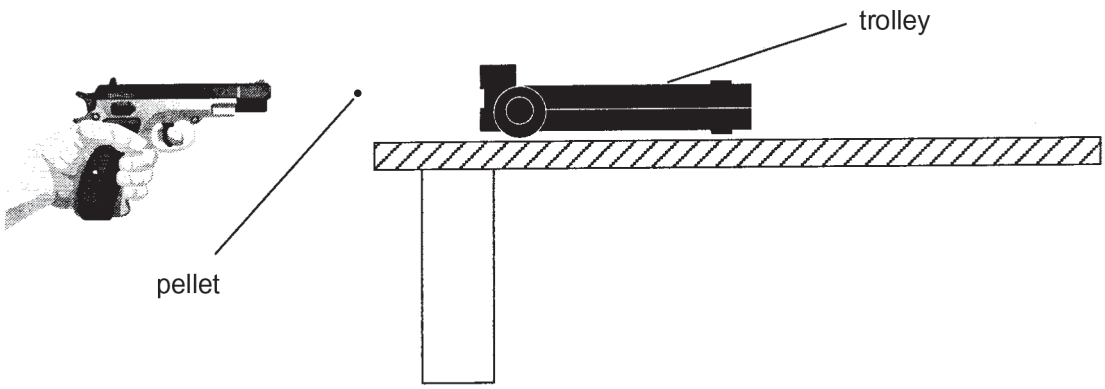
_____ [3]

Examiner Only	
Marks	Remark

[Turn over

Examiner Only	
Marks	Remark

(c) The apparatus shown below can be used to measure the velocity of a pellet from an air pistol. The pellet is fired at a stationary trolley and is embedded in the trolley.



The table shows the measurements taken during this experiment.

Mass of the pellet	3 g
Mass of the trolley	150 g
Velocity of trolley after collision	20 cm/s

(i) Calculate, in g cm/s, the momentum of the trolley **with** the embedded pellet.

You are advised to show clearly how you get your answer.

Momentum = _____ g cm/s [3]

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(ii) Using the Principle of Conservation of Momentum calculate the velocity of the pellet as it strikes the trolley.

You are advised to show clearly how you get your answer.

Speed = _____ cm/s [3]

Examiner Only	
Marks	Remark
Total Question 4	

[Turn over

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5 (a) (i) State the Principle of Moments.

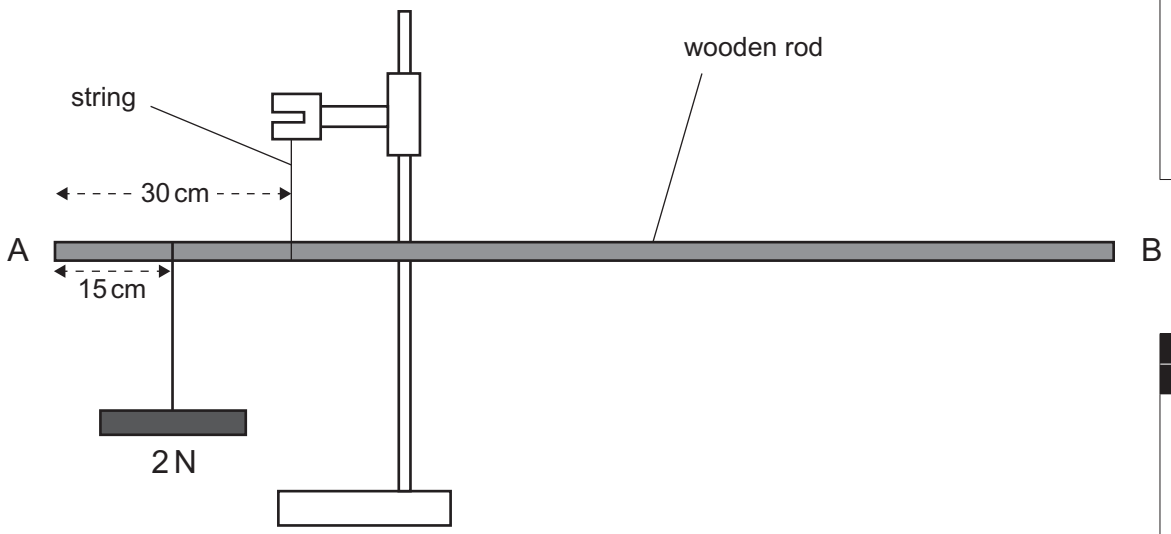
Examiner Only	
Marks	Remark

_____

_____

_____ [2]

To find the weight of a uniform length of wood Michael sets up the apparatus shown below.



The wooden rod has a length of 1.4 m and is suspended from a stand by a length of string attached 30 cm from the end A.
He moves the 2 N weight until the wooden rod is balanced horizontally.
The **2 N weight is 15 cm from the end A** when this happens.

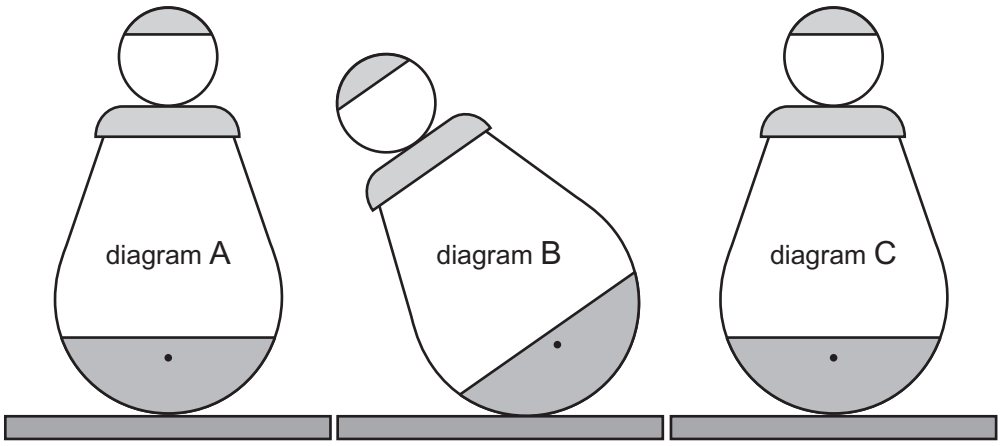
(ii) Use the Principle of Moments to find the weight of the wooden rod.

You are advised to show clearly how you get your answer.

Examiner Only	
Marks	Remark

Weight = _____ N [3]

(b) The diagram below shows a toy. In diagram A it is shown at rest. When it is moved to one side (diagram B) and released it returns to the upright position as shown in diagram C. The dot shows the centre of gravity.



(i) On diagram A mark, **carefully**, the pivot with an X. [1]

(ii) On diagram B mark where the weight of the toy acts and the direction in which it acts. [1]

(iii) Explain carefully why the toy returns to the upright position when it is released.

_____

_____

_____

_____

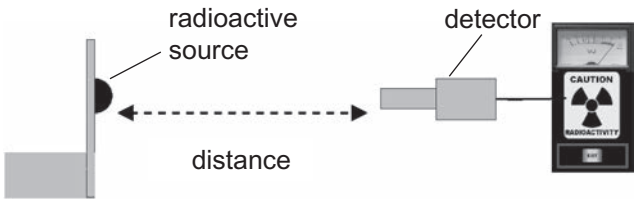
_____ [3]

Examiner Only	
Marks	Remark
Total Question 5	

[Turn over

Examiner Only	
Marks	Remark

6 **(a)** A radioactive source is placed in front of a detector. The detector measures the amount of radiation reaching it through the air from the radioactive source.



The readings on the detector are recorded for various distances.
The readings from the detector were then corrected for **background activity**.

(i) What is background activity?

_____

_____ [1]

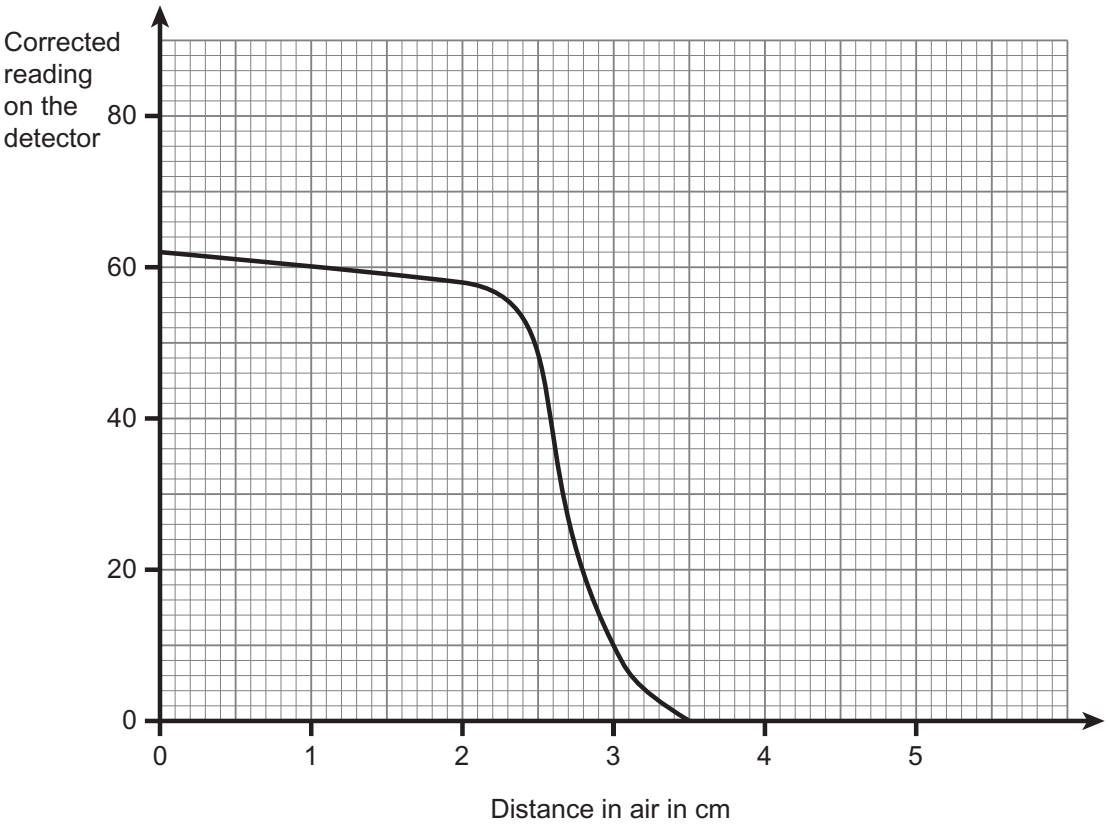
(ii) How are the measurements corrected for background activity?

_____

_____ [1]

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The corrected measurements are plotted on a graph and a smooth curve drawn through them as shown below.



(iii) Using the graph obtain a value for the range of this radiation in air. Explain how you arrived at your answer.

Range = _____

_____

_____ [2]

(iv) What radiation is being emitted by the radioactive source? Explain your answer.

_____

_____

_____ [2]

Examiner Only	
Marks	Remark

[Turn over

(v) When the radiation from the radioactive sources passes through the air it causes ionisation. What is ionisation?

_____

_____

_____ [1]

(vi) Those who work with radioactive materials take a number of precautions to reduce the risks associated with such materials. A radioactive substance in the form of a powder can be especially dangerous to work with. Explain why this is.

_____

_____

_____

_____

_____ [2]

Examiner Only	
Marks	Remark

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(Question 6 continues overleaf)

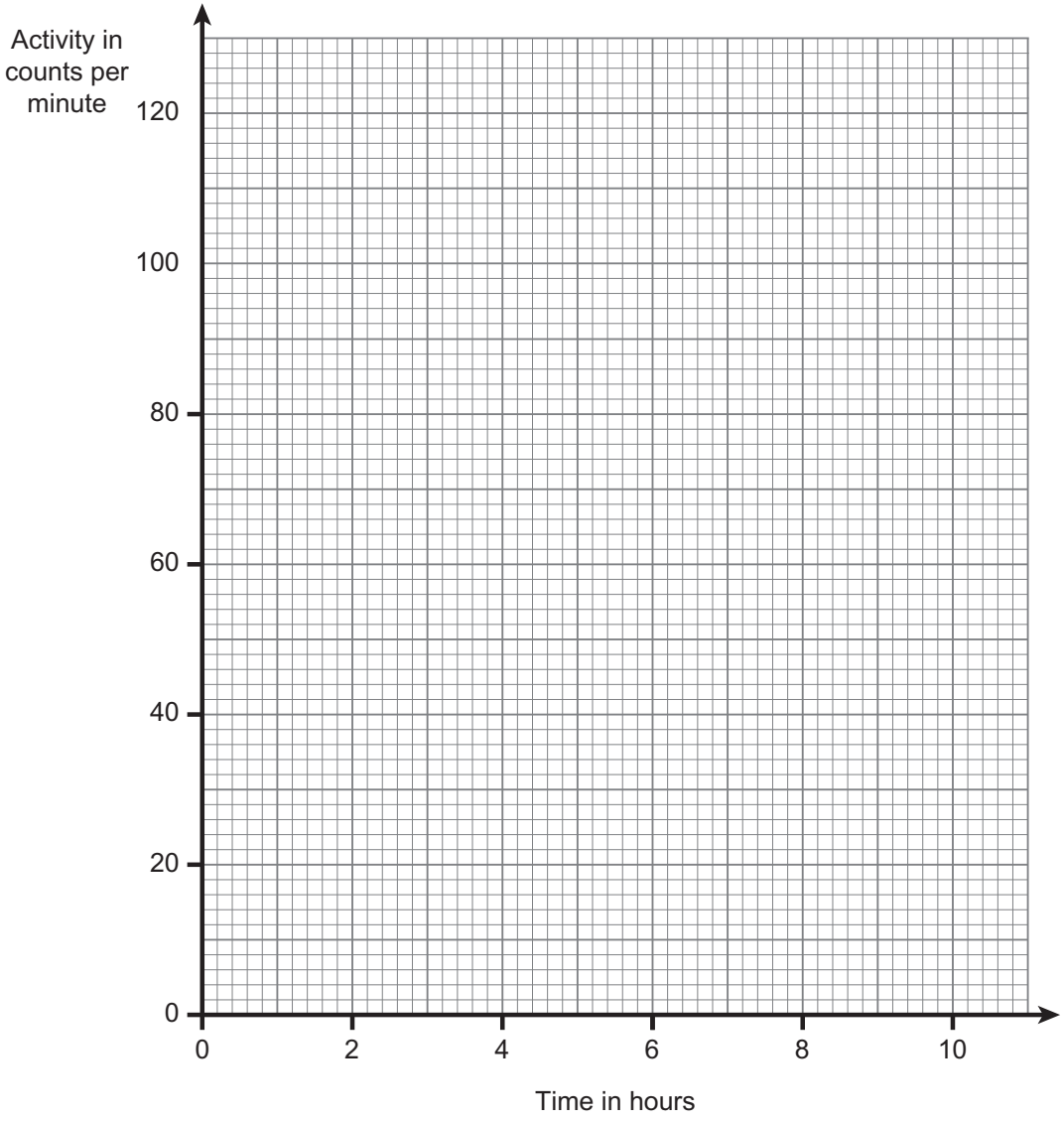
[Turn over

(b) In an experiment to measure the half-life of a radioactive source, the activity of the source is measured at regular intervals. The results obtained are shown below.

Activity in counts per minute	118	68	41	23	12	8
Time in hours	0	2	4	6	8	10

(i) Using the grid below plot a graph of activity (y-axis) against time (x-axis). [2]

(ii) Draw the curve of best fit through the points. [1]



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Marks	Remark

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(iii) Explain the meaning of the term half-life.

_____

_____

_____ [1]

(iv) Using the graph you have plotted and the curve you have drawn, obtain the half-life of the radioactive source.

Half-life = _____ hours [1]

Measurements of activity from a radioactive source are variable even when the measuring equipment is working properly.

(v) Give a reason why measurements of activity are variable.

_____

_____ [1]

(c) Nuclear fission and nuclear fusion are two nuclear reactions that are important sources of energy.

(i) Which one is already being used in the large scale generation of electrical energy?

_____ [1]

(ii) Name one nuclear fuel that is used in nuclear power stations.

_____ [1]

Examiner Only	
Marks	Remark

[Turn over

(iii) State one environmental advantage of using nuclear energy to generate electrical energy.

_____

_____ [1]

(iv) The other nuclear reaction is the source of the Sun's energy but it has not yet been possible to use this reaction for the large-scale generation of electricity. What **two** important advantages would result if this nuclear reaction were used for the generation of electricity?

1. _____

_____

2. _____

_____ [2]

Examiner Only	
Marks	Remark
Total Question 6	

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Question Number	**Marks**
1	
2	
3	
4	
5	
6	
Total Marks	

Examiner Number

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Rewarding Learning

General Certificate of Secondary Education
2013

Science: Physics

Unit P1
Higher Tier

[GPH12]

THURSDAY 13 JUNE, MORNING

MARK SCHEME

STEMUP.CO.UK

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.

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						AVAILABLE MARKS
1	(a)	(i)	$KE = \frac{1}{2}mv^2$	[1]		
			$= \frac{1}{2} \times 2000 \times 3^2$	[1]		
			$= 9000$ (J)	[1]	[3]	
		(ii)	Work = Force × distance	[1]		
			$50\,000 = F \times 50$	[1]		
			$F = 1000$ (N)	[1]	[3]	
		(iii)	PE = mgh **or** W = Fd	[1]		
			$30\,000 = 2000 \times 10 \times h$ $30\,000 = 20\,000d$	[1]		
			$h = 1.5$ (m) $d = 1.5$ (m)	[1]	[3]	
		(iv)	$\frac{1}{2}mv^2 = 28\,000$ **or** sight of 28 000 (not for the formula but knowing KE = 28 000 J)	[1]		
			$v^2 = 28$	[1]		
			v = 5.3 (m/s) **or** 5.29 **or** 5 **accept 5 → 5.3**	[1]	[3]	
	(b)	(i)	**Indicative content**			
			Measure the weight or known weight or mass – balance/ newtonmeter	[1]		
			Two markers – measure distance between them – use metre rule or from floor to table/motor	[1]		
			Time how long weight takes to move between markers/to lift load – using stopclock W = Fd **or** mgh [1]	[1]		
			Power = weight × vertical distance/time **or** P = w/t [1]	[2]		
			Repeat take average **or** ensure load moves at constant speed	[1]	[6]	
			Do **not** credit length of string if unqualified			
		(ii)	Information needed – input energy **or** power **or** work **or** wasted energy **or** power **or** work		[1]	
			Do **not** credit wasted heat			
		(iii)	Some of the input energy is wasted **or** Efficiency cannot be greater than 1 or 100% **or** Efficiency must be ⩽ 1		[1]	20

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						AVAILABLE MARKS
2	**(a)**	**(i)**	(Average) speed = distance/time **or** $s = \frac{d}{t}$	[1]		
			= 76/4	[1]		
			= 19 (m/s)	[1]	[3]	
		(ii)	600 = m × 10	[1]		
			m = 60 (kg)	[1]	[2]	
		(iii)	F = m a	$S = (ut) + \frac{1}{2}at^2$	[1]	
			600 – 200 = 60 a	$76 = \frac{1}{2} \times a \times 4^2$	[1]	
			$a = 400/60 = 6.7$ (m/s^2)	$a = 9.5$ (m/s^2)	[1]	[3]
			Allow ecf from **(ii)** for the mass			
			v = u + at No marks for eqn alone 38 = 0 + 4a [2]/[3]			
			a = 9.5 (m/s^2)			
	(b)	**(i)**	Error is time = 10 s and velocity = 30			
			or point indicated on grid		[1]	
		(ii)	Smooth curve drawn		[1]	
			No marks for short straight lines			
		(iii)	Acceleration = 18/2 **or** $a = \frac{v - u}{t}$ (**not** v = u + at)	[1]		
			= 9 (m/s^2)	[1]	[2]	
		(iv)	The gradient = the acceleration [1]			
			gradient is decreasing – give [2]		[2]	
			The gradient is changing – give [1]			
			or graph levels off or plateaus			
		(v)	15s to 16s		[1]	15

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AVAILABLE MARKS

3 **(a)** Volume = (3 × 3 × 3) = **27** (cm^3) $D = \frac{M}{V}$ **or** in words [0]
The mark is for this ⟵ [1]
Density = 240.3/27 [2]
= 8.9 (g/cm^3) [1] [4]

(b) A C D If any wrong max is [1]/[4], if any missing max is [3]/[4] [2]
two blocks give [1], *more than 3 give* [0]

They have the same density [1]
because ratio M/V the same for each
or supported by calculations [1]
or they are on same straight line **that passes through 0,0** [4]
Essential

(c) (Heat gives) atoms/molecules gain kinetic energy/move more freely
or move/faster **or** increases the amount of vibration/amplitude [1]
Eventually the bonds are overcome [1] [2]

(d) Mass of 500 cm^3 of salty water = 1.1 × 500 = 550 g [2]
Mass of salt = 550 – 500 [1]
= 50 (g) [1] [4]

Alternative method
difference in density = 0.1 [2]
mass = 500 × 0 [1]
= 50 (g) [1]

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(e) Indicative content

1. Use a balance to find the mass/**or** weigh on a balance
2. Place water in measuring cylinder (and record volume)
   Use of a beaker [0]
3. Place pendant in the water; the change of volume is volume of necklace
   Point 3 could be described as read new volume and subtract volume readings
4. Use formula D = M/V
5. Precaution – avoid splashing **or** repeat and average
   or ensure it is completely covered
   or read to bottom of meniscus

Eureka can method:
fill can
add necklace
collect and measure volume } [2]

Response	**Mark**
Candidates describe in detail using good spelling, punctuation and grammar **all 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 three 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]

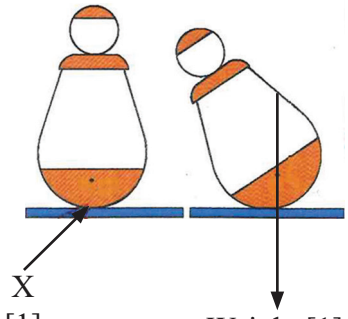
AVAILABLE MARKS

20

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						AVAILABLE MARKS
4	**(a)**	**(i)**	The mass (of the object) or weight	[1]		
		(ii)	**No** [1], if they were proportional the ratios would be equal 9/32 = 0.28 and 6.4/16 = 0.4 any 2 calculations 4.5/8 = 0.56 and 3.2/4 = 0.8	[1] [2]		
	(b)	**(i)**	Force × time = momentum change F × 0.12 = 1500 × 20 F = 250 000 (N)	[1] [1] [1]	[3]	
			Alternative $a = \frac{v - u}{t} = \frac{20}{0.12} = 167$ F = ma = 1500 × 167 = 250 000			
		(ii)	The crumple zone **increases the time** This means that the force on the car/passengers is reduced	[2] [1]	[3]	
	(c)	**(i)**	Momentum = mass × velocity = (150 + 3) × 20 = 3060 (g cm/s) [1] [1] [1]		[3]	
		(ii)	Momentum before = momentum after 3 × v = 3060 e.c.f. for momentum from **(i)** into **(ii)** v = 1020 (cm/s)	[1] [1] [1]	[3]	15

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						AVAILABLE MARKS
5	**(a)**	**(i)**	When an object is in equilibrium/balanced	[1]		
			the clockwise moment = anticlockwise moment	[1]	[2]	
		(ii)	$2 \times 15 = W \times 40$ [1] [1]	Either gets [1], but equal to needed for both marks	[2]	
			W = 0.75 (N)	[1]	[3]	
	(b)	**(i)** and **(ii)**	 X [1] Weight [1] Must pass through CoG as shown		[2]	
		(iii)	The weight has a moment **or** weight/CoG outside base	[2]		
			clockwise moment **or** so returns to original position	[1]	[3]	10

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						AVAILABLE MARKS
6	(a)	(i)	Activity/radiation from surroundings/walls/rocks/people **or** naturally occurring		[1]	
		(ii)	Subtract		[1]	
		(iii)	3.5 (cm)	[1]		
			Measurements fall to zero	[1]	[2]	
		(iv)	Alpha	[1]		
			Short range **or** travels a few cms in air	[1]	[2]	
		(v)	The removal/addition of an electron to an atom		[1]	
		(vi)	Powder can be breathed in/swallowed/air borne	[1]		
			The above for 1 mark, the 2nd mark for any of the following:			
			• very close to tissues			
			• not stopped by the skin/damages the lungs			
			• difficult to remove	[1]	[2]	
	(b)	(i)	5/6 points correctly plotted give [2]		[2]	
			3/4 points correctly plotted give [1]			
		(ii)	Draw smooth curve		[1]	
			Straight lines give [0]			
		(iii)	The time for the activity/count rate to fall to half (the initial value)		[1]	
		(iv)	Value consistent with their **curve** **2.5 ± 0.2 hr**		[1]	
		(v)	Radioactivity is a **spontaneous/unpredictable/random** process and measurements can vary		[1]	
	(c)	(i)	Fission		[1]	
		(ii)	Uranium/plutonium		[1]	
		(iii)	Low carbon dioxide/sulfur dioxide **or** no contribution to global warming **or** less fossil fuels being used		[1]	
		(iv)	**Less** radioactive waste products	[1]		
			↑ Essential			
			– do **not** accept No radioactive waste			
			Abundant fuel (water)	[1]	[2]	20
			Greenhouse gases – give [0]			
					Total	**100**

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New Specification

Rewarding Learning

Centre Number

71	

Candidate Number

General Certificate of Secondary Education
2012

Science: Physics

Unit P1

Higher Tier

[GPH12]

GPH12

FRIDAY 15 JUNE, AFTERNOON

TIME

1 hour 30 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Write your answers in the spaces provided in this question paper.
Answer **all six** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 100.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Quality of written communication will be assessed in Questions **3(b)(ii)** and **5(b)**.

For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
Total Marks	

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Examiner Only	
Marks	Remark

1 **(a)** The diagram shows a solar panel. This is made up of a number of photocells.
The photocells produce electricity directly from sunlight.
Solar panels are placed on the roof of a house.



© Zoonar / Thinkstock

On a cloudless summer day the solar energy shining on the panel every second is 6000 J. Of this amount 4800 J are reflected, the rest is converted to electricity.

(i) Calculate the output electrical energy every second from the solar panel.
You are advised to show clearly how you get your answer.

Output electrical energy = _____ J [1]

(ii) Calculate the efficiency of the solar panel.
You are advised to show clearly how you get your answer.

Efficiency = _____ [2]

(iii) On a certain summer day the panel generated electricity for 10 hours.
Calculate the number of kilojoules generated on this day by the solar panel.
You are advised to show clearly how you get your answer.

Number of kJ = _____ [2]

(iv) State **one** advantage and **one** disadvantage of the use of the solar panel.

Advantage _____

_____

_____

Disadvantage _____

_____

_____ [2]

(v) A family of four would use on average 54 000 kJ of electrical energy per day.
State **two** things they could do to make up the difference between what the solar panel produces and what they need.

_____

_____

_____

_____

_____ [2]

Examiner Only

Marks	Remark

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Examiner Only	
Marks	Remark

(b) The diagram shows weightlifting equipment found in most gyms.



© Polka Dot / Thinkstock

(i) When using the equipment John wants to do 300 J of work in each lift. He can vary the weight from 100 N to 500 N in steps of 50 N. He can also vary the distance he lifts the weights from 1.0 m to 2.0 m in steps of 0.5 m. State **three** weights and the corresponding distances that John can use to achieve this.

1. weight = _____ N distance = _____ m

2. weight = _____ N distance = _____ m

3. weight = _____ N distance = _____ m

[3]

(ii) John repeats the exercise. He does 10 complete lifts in a time of 30 seconds.
Calculate the power John produces during this time.
You are advised to show clearly how you get your answer.

Power = _____ W [3]

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Examiner Only	
Marks	Remark

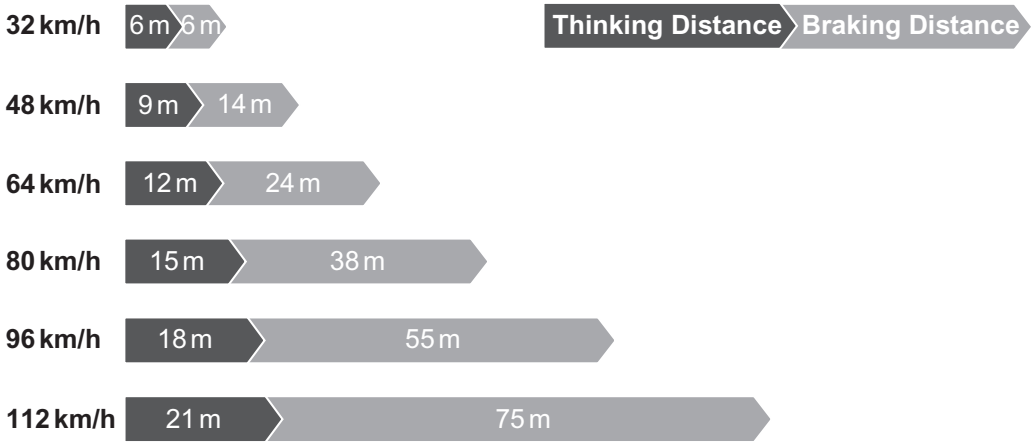
2 Speed limits in the Republic of Ireland are given in km/h.

(i) Show clearly that a speed of 80 km/h is equal to a speed of 22.2 m/s.
(Hint: 1 hour = 3600 seconds)

[3]

The **stopping distance** of a car is the **thinking distance** added to **the braking distance**. The thinking distance is the distance the car travels at constant speed before the driver reacts (reaction time) to a hazard on the road and applies the brakes. The braking distance is the distance the car travels from where the brakes were first applied to where the car stops.

The chart below shows the results of a study of stopping distance by an alert driver, on a dry day using a car with good tyres and brakes.



km/h means kilometres per hour

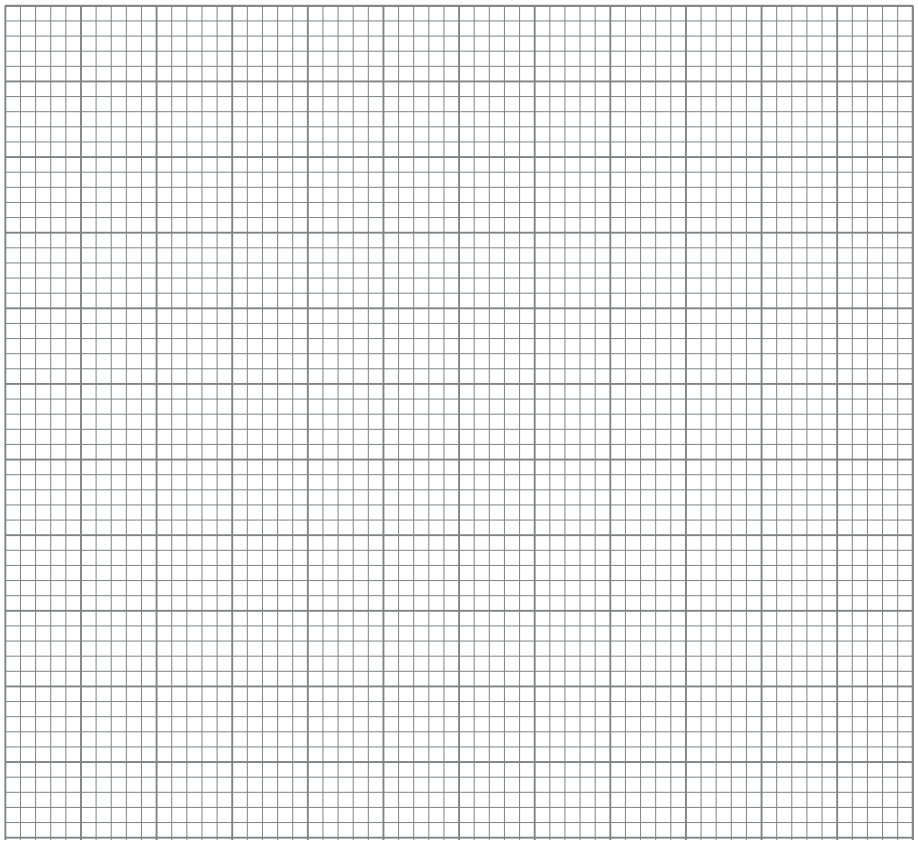
(ii) Using the data from the chart that applies to a speed of 80 km/h calculate the thinking time (reaction time) of the driver.
You are advised to show clearly how you get your answer.

Thinking time = _____ s [4]

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The **thinking distance** is the distance the car travels before the driver reacts (reaction time) to a hazard on the road and applies the brakes.

(iii) On the grid below plot a graph of thinking distance in m (*y*-axis) against the speed in km/h (*x*-axis).



[4]

(iv) What conclusion can you come to about the relationship between the thinking distance and the speed of the car?
Explain your answer.

_____

_____

_____ [3]

(v) Write down an equation which allows you to calculate the thinking distance for a particular speed in km/h.

[2]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

(vi) The speed of two cars following each other on a motorway is 112 km/h.
Should the car in front suddenly brake it is advisable for the following car to leave a gap. The average length of a car is 4 m. Use the data from the chart to calculate the size of the required gap.
Give your answer in complete car lengths.

Required gap = _____ car lengths [3]

(vii) A car travelling at 112 km/h is equivalent to a speed of 31.1 m/s.
Using the braking distance given in the chart calculate the deceleration of the car.
You are advised to show clearly how you get your answer.

Deceleration = _____ m/s^2 [4]

(viii) The car in part **(vii)** has a mass of 1500 kg.
Calculate the required braking force to bring the car to rest in this distance.
You are advised to show clearly how you get your answer.

Braking force = _____ N [2]

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(Questions continue overleaf)

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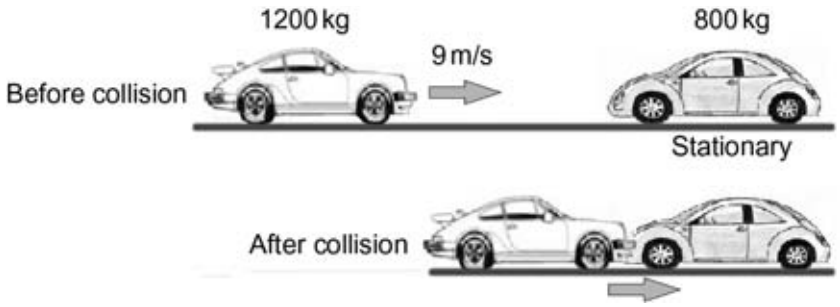
Examiner Only	
Marks	Remark

3 (a) (i) State the Principle of Conservation of Momentum as it applies to collisions.

_____

_____ [1]

A car of mass 1200 kg is travelling with a velocity of 9 m/s when it collides head-on with a stationary car of mass 800 kg. The two cars stick together as a result of the collision.



(ii) Calculate the momentum of the 1200 kg car immediately before the collision.
You are advised to show clearly how you get your answer.

Momentum = _____ kg m/s [3]

(iii) Calculate the velocity of the two cars after collision.
Remember the two cars are stuck together after the collision.
You are advised to show clearly how you get your answer.

Velocity of the combined cars after collision = _____ m/s [4]

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(iv) Calculate the kinetic energy of the combined cars after the collision.
You are advised to show clearly how you get your answer.

Kinetic energy = _____ J [3]

(b) The Transport Research Laboratory carries out research as to how to reduce the danger to drivers and passengers in road accidents.

(i) In one experiment, a car with a momentum of 1350 kg m/s collides head on with a brick wall. The car comes to rest in 0.6 s.
Calculate the average size of the force exerted on the car by the wall.
You are advised to show clearly how you get your answer.

Force on the car = _____ N [3]

Examiner Only

Marks	Remark

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Examiner Only	
Marks	Remark

(ii) Many modern cars are fitted with crumple zones. The diagram below shows what happens when a modern car crashes.



© Hemera / Thinkstock

Explain, **carefully**, how a crumple zone makes it safer for the people inside the car when it is brought to a stop during a collision.
In this question you will be assessed on your written communication skills including the use of specialist science terms.

[6]

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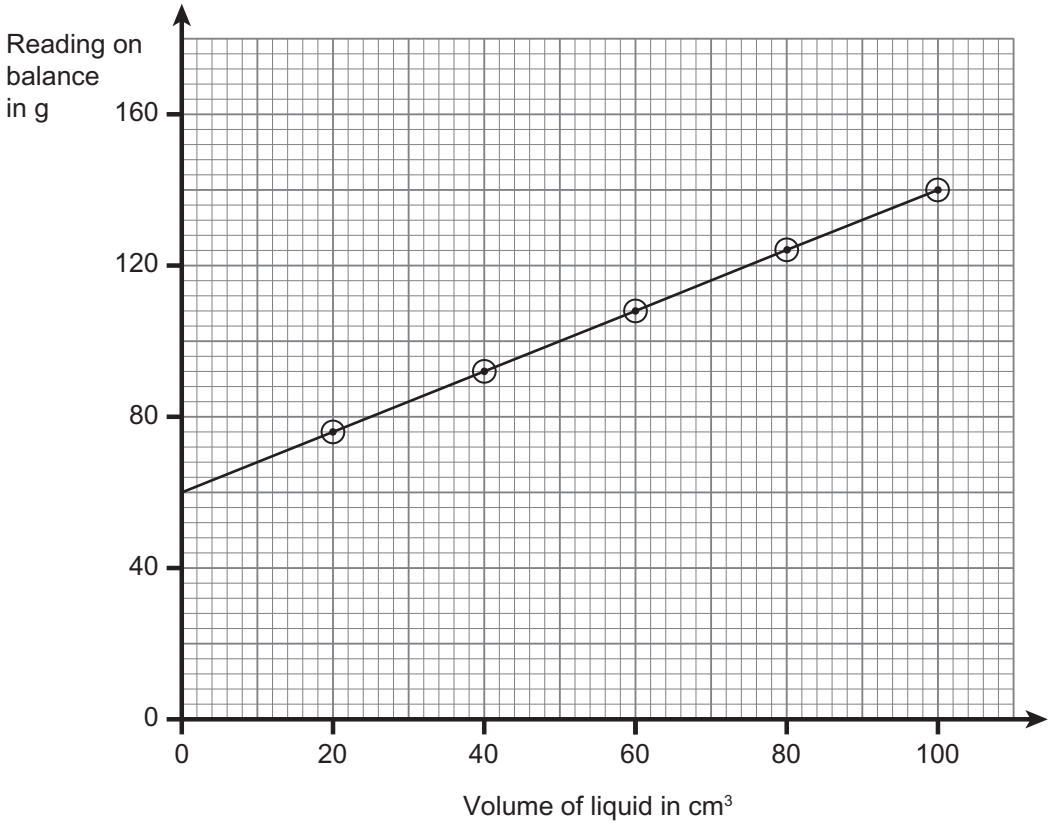
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Examiner Only	
Marks	Remark

4 Linda is given a measuring cylinder and an electronic balance. She places the empty measuring cylinder on the electronic balance and adds different volumes of liquid. Each time she measures the volume of the liquid she also records the reading on the electronic balance.
She plots her results as a graph as shown below.



© *iStockphoto / Thinkstock*



(i) What is the mass of the empty measuring cylinder?

_____ g [1]

The table shows four different liquids and their densities.

Liquid	Density in g/cm^3
Petrol	0.7
Castor Oil	0.9
Water	1.0
Ethanol	0.8

(ii) Using the data from the graph and your answer to part **(i)** identify the liquid Linda used.
You **must** show clearly how you get your answer.

Liquid = _____ [4]

(iii) She repeats the same procedure using the **same** measuring cylinder but using a **liquid of lower density** than the first liquid.
On the grid draw the straight line she would expect to obtain. [2]

(iv) Water has a density of 1.0 g/cm^3. Calculate the reading Linda would obtain if she had placed 60 cm^3 of water in the measuring cylinder and placed it on the electronic balance.

Reading = _____ g [2]

(v) Ice has a density of 0.9 g/cm^3 and water has density of 1.0 g/cm^3.
What does this tell you about the spacing of the molecules in the two states?

_____

_____

_____ [1]

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Marks	Remark

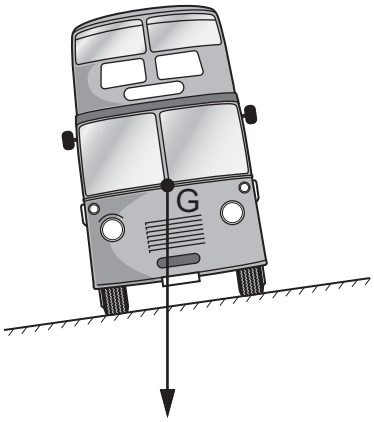
Examiner Only	
Marks	Remark

5 **(a)** The photograph shows how the stability of a double decker bus is tested. The angle of the platform is gradually increased until the bus topples.

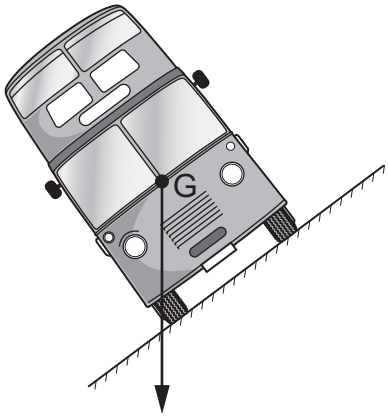
"Image of bus undergoing stability test"

The diagram below shows a bus in two positions.
The centre of gravity of the bus is marked with a G.

position 1



position 2



For each position describe **and** explain what happens to the bus.

Position 1 _____

_____

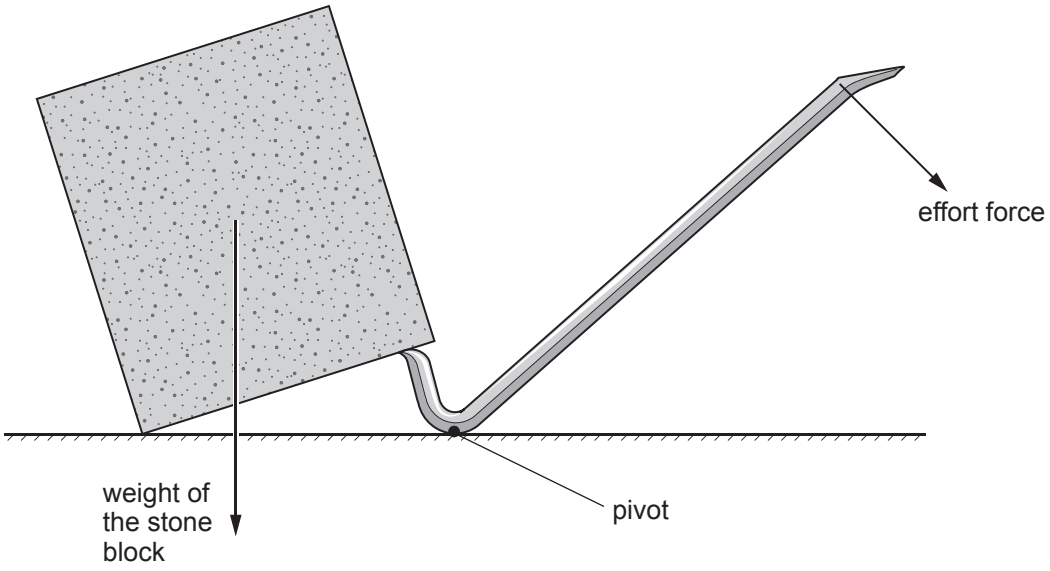
_____

Position 2 _____

_____

_____ [4]

(b) The diagram shows a long pole being used as a lever to raise a heavy stone block.



The stone block weighs much more than the force the man uses to raise it. Explain carefully how the lever allows him to raise the stone block.

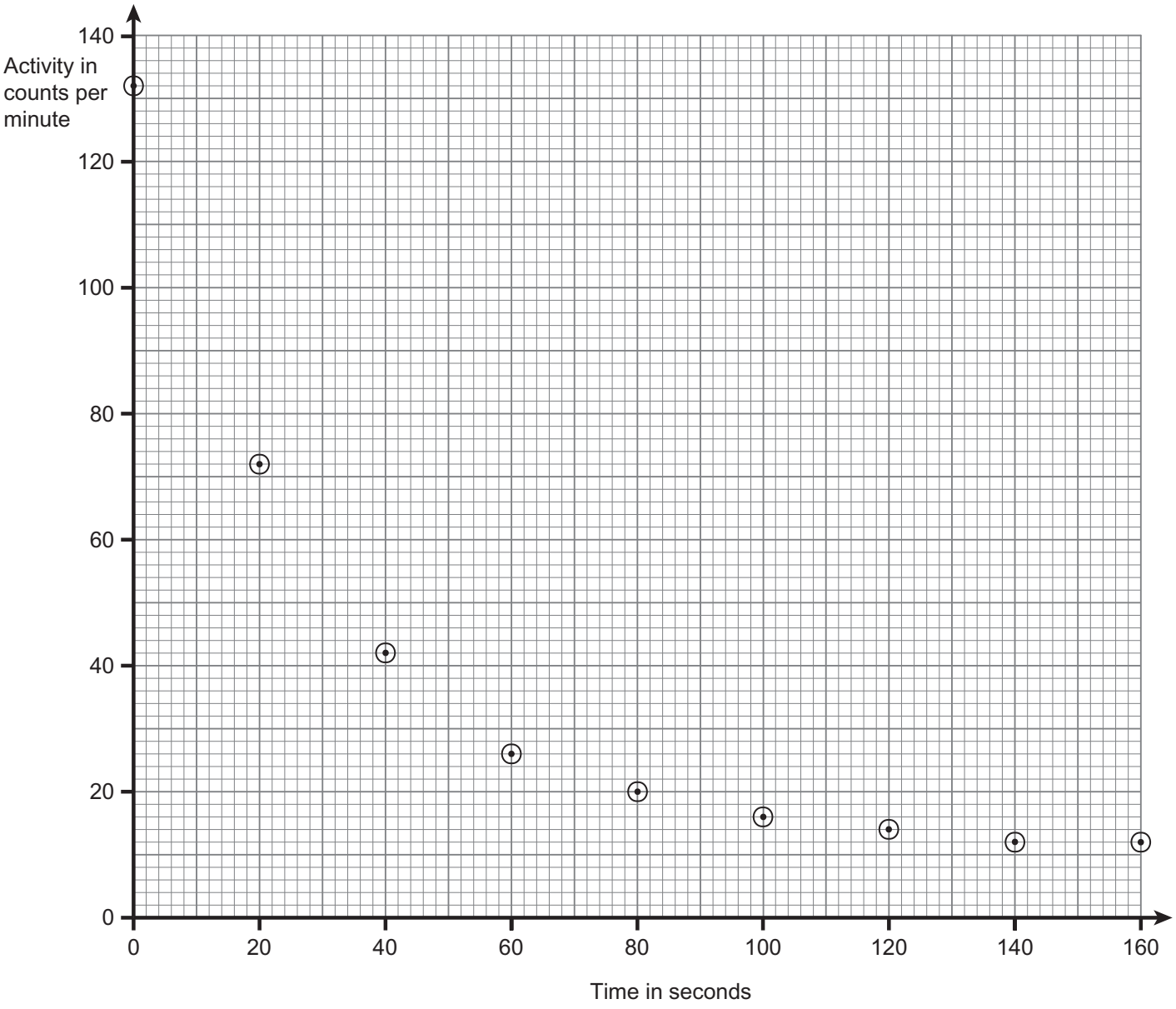
In this question you will be assessed on your written communication skills including the use of specialist science terms.

[6]

Examiner Only

Marks	Remark

6 **(a)** When measuring the half-life of a radioactive substance, measurements of the activity were taken every 20 seconds.
These measurements are shown plotted on the grid below.



(i) Complete the graph by drawing the best fit curve. Use it to find the background activity.
Explain how you arrive at your answer.

Background activity = _____ counts per minute

_____

_____ [3]

Examiner Only	
Marks	Remark

(ii) Using your value for the background activity, determine the activity due **only** to the radioactive substance at the **start of the experiment**.

Activity = _____ counts per minute [2]

(b) Fission and fusion are nuclear reactions, which release large amounts of energy. The table below is intended to show a number of significant differences between the two reactions. Complete the table using the list of phrases/words below.

1. building of larger nuclei from small nuclei
2. the splitting of large nuclei
3. nuclear power station
4. requires very high temperatures to start
5. the sun
6. hydrogen
7. uranium
8. will start at room temperature

Write the number corresponding to the statement in the appropriate box in the table below.

Nuclear Reaction	Fusion	Fission
Where the process can be found happening		
Fuel used		
Description of the reaction		
Conditions required to start		

[4]

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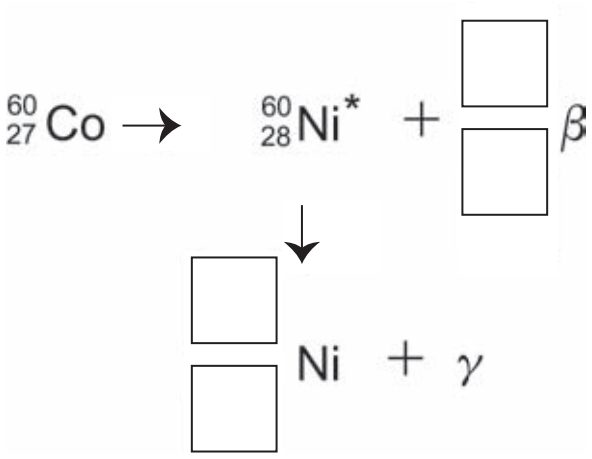
Marks	Remark

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Examiner Only	
Marks	Remark

(c) Cobalt-60 is a beta emitter which decays to nickel.
The nickel produced is a gamma emitter.

(i) Complete the decay equation below for the complete decay process by writing the correct values in the boxes.



[4]

After 15 years the measured activity of a cobalt-60 source is found to have fallen from 120 counts per minute to 15 counts per minute.

(ii) What is the half-life of cobalt-60?
You are advised to show clearly how you get your answer.

Half-life = _____ years [3]

(iii) State two possible uses of gamma radiation.

_____

_____

_____

_____ [2]

(d) Describe how the electrons are arranged in the “Plum Pudding” model of the atom and the present Rutherford-Bohr model.

_____

_____

_____

_____ [2]

Examiner Only	
Marks	Remark

THIS IS THE END OF THE QUESTION PAPER

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112130

New Specification

Rewarding Learning

General Certificate of Secondary Education
2012

Science: Physics

Unit P1
Higher Tier

[GPH12]

FRIDAY 15 JUNE, AFTERNOON

MARK SCHEME

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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.

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						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

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					AVAILABLE MARKS
2	**(i)**	80 km = 80 000 m *give [1] if no further credit possible* 80km/hr = 80 000/3600 = (22.2 m/s) *This line is worth full marks*	[1] [2]	[3]	
	(ii)	Think time = distance/speed or $t = \frac{s}{v}$ or alternative = 15/22.2 *substitutions* = 0.7 s (0.68 s) (0.67 → 0.68)	[1] [2] [1]	[4]	
	(iii)	X axis – speed and Y axis – thinking distance *(Both labels needed [1])* Quantity or unit Points plotted Best fit line through origin Poor scale max penalty [–1] (No origin) Including max use of graph	[1] [2] [1]	[4]	
	(iv)	They are proportional Straight line passing through origin or thinking distance doubles when speed doubles. *Thinking distance increases as speed increases award [1]*	[1] [1] [1]	[3]	
	(v)	Thinking distance = constant × speed constant = gradient **or** ratio of thinking distance/speed **or** constant = 0.19 or TD = $\frac{\text{speed}}{5.3}$	[1] [1]	[2]	
	(vi)	21/4 or 5.25 [2]/ 96/4 or 75/4 – give [1] Rounded up to 6 car lengths	[2] [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 × 31 × t or t = 4.8 s [1] $0 = 31.1^2 - 2a \times 75$ [2] a = 6.4 [1] **or** v = u + at 0 = 31.1 – 4.8 a a = 6.4 (m/s^2) [1] [1] ignore -ve sign		[4]	
	(viii)	F = ma = 1500 × 6.4 *allow ecf for deceleration from* **(vii)** = 9600 (N)	[1] [1]	[2]	25

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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

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				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

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						AVAILABLE MARKS
6	**(a)**	**(i)**	12 (accept 11–13) can ignore initial point	[1]		
			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: 5, 6, 1, 4 — Fission: 3, 7, 2, 8				
			[½] *each round down*		[4]	
	(c)	**(i)**	${}^{0}_{-1}\beta$ ${}^{60}_{28}\mathrm{Ni}$ [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 labelled diagram acceptable		[1]	[2]	
						20
				Total		**100**