

**AS UNIT 1 – Motion, Energy and Matter****MARK SCHEME****GENERAL INSTRUCTIONS**

The mark scheme should be applied precisely and no departure made from it.

Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark (except for the extended response questions).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

Marking rules

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

Extended response question

A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with both the content statements and the communication statement.

Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao = correct answer only

ecf = error carried forward

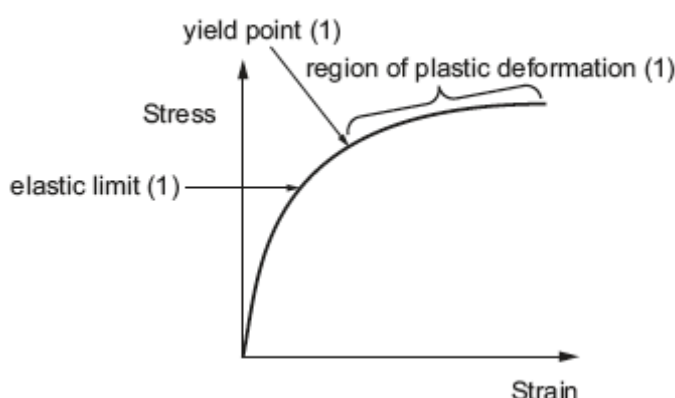
bod = benefit of doubt

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
1	(a)			Force unit: $\text{kg m s}^{-2}$ (1) $v^2$ unit: $\text{m}^2\text{s}^{-2}$ <b>or</b> $(\text{m s}^{-1})^2$ (1) Clear algebra (1)	1 1	1		3	1	
	(b)	(i)		Resultant force = 0 (1) Due to frictional force (1)		1	1	2		2
		(ii)		$\frac{1}{\text{gradient}}$ attempted (1) Correct substitution, e.g. $\frac{3.0 - 0.5}{3.0}$ (1) $m = 0.8[3]$ kg <b>unit mark</b> (1)			3	3	3	3
	(c)	(i)		A = contact force of surface on body [accept <u>normal</u> reaction] (1) B = gravitational force of Earth on body (1) [accept: weight / $mg$ ]	2			2		
		(ii)		Gravitation force of body (mass) (1) on Earth (1)	1	1		2		
				<b>Question 1 total</b>	<b>5</b>	<b>3</b>	<b>4</b>	<b>12</b>	<b>4</b>	<b>5</b>

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)			Use of $\cos 70^\circ$ (1) $2T \cos 70^\circ = 800$ (1) [ $\rightarrow T = 1\,170$ N]		2		2	2	
	(b)	(i)		Area under graph attempted <b>or</b> $\frac{1}{2}Fx$ <b>or</b> $\frac{1}{2}kx^2$ (1) 240 [J] (1)	1	1		2	2	
		(ii)		Initial energy stored in bow converted entirely to $E_k$ of arrow (1) Use of $\frac{1}{2}mv^2$ (1) Manipulation leading to $v = 98$ [m s <sup>-1</sup> ] shown (1)	1	1		3	2	
	(c)			Greater [initial] force [or equiv] required to pull the Turkish bow string [through a given distance] (1) [or more work / energy needed] Greater area under the Turkish bow curve (1) [leading to] more [elastic] potential energy stored (1) Arrows will leave Turkish bow with a greater speed / velocity (1) [accept converse arguments] <b>[Alternative to 2<sup>nd</sup> marking point:</b> linking to 1 <sup>st</sup> marking point because gradient of graph greater for Turkish bow]			4	4		
				<b>Question 2 total</b>	<b>2</b>	<b>5</b>	<b>4</b>	<b>11</b>	<b>6</b>	<b>0</b>

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
3	(a)	(i)	Distance = area (or implied) (1) Shaded area = $\frac{1}{2}tv$ (1) $v = at$ and clear substitution (1)	1 1	1		3	2	
		(ii)	Line starts linearly and gradient decreases			1	1		
	(b)	(i)	2.2 [s]		1		1		
		(ii)	Valid substitution into $v = u + at$ (e.g. $0 = u - g \times 1.1$ or $2u = 2.2g$ etc) (1) Or any other valid kinematic equation ( <b>ecf</b> on $t$ from (i)) Correct algebra / manipulation (1) $u = 10.8 \text{ [m s}^{-1}\text{]}$ (1)	1	1 1		3	3	
		(iii)	Correct substitution into $x = ut + \frac{1}{2}at^2$ (i.e. $x = 10.8 \times 0.3 - \frac{1}{2} \times 9.81 \times 0.3^2$ ) ( <b>ecf</b> on $10.8 \text{ m s}^{-1}$ ) (1) $x = 2.8 \text{ [m]}$ (1)	1	1		2	2	
	(c)		Weight acting downwards always (1) Forces labelled correctly (1) Air resistance opposing motion (1) At top, no air resistance (1)	1 1	1 1		4		
			<b>Question 3 total</b>	<b>6</b>	<b>7</b>	<b>1</b>	<b>14</b>	<b>7</b>	<b>0</b>

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
4	(a)	(i)	Point where entire <b>weight</b> of the body acts	1			1		
		(ii)	$0.2 \times (49.6 - 4) = \text{test tube} \times 38.4$ <b>or</b> $0.2 \times (45.6) = (0.2375 + \text{ball}) \times 24.5$ (1) test tube = 0.2375 [N] (1) ball bearing = 0.1347 [N] (1) $F = mg$ used (1)	1	1 1		4	4	4
	(b)		Calculating volume = $\frac{4}{3}\pi r^3$ ( $1.77 \times 10^{-6} \text{ m}^3$ ) (1) Density = 7790 – 7950 [ $\text{kg m}^{-3}$ ] (1) 7797 (using 13.8 g) <b>or</b> 7909 (using 14 g) so therefore iron ( <b>ecf</b> ) (1) Correct comment regarding closeness of answers e.g. within the limits of experimental error (1)			4	4	2	4
			<b>Question 4 total</b>	<b>3</b>	<b>2</b>	<b>4</b>	<b>9</b>	<b>6</b>	<b>8</b>

Question			Marking details	Marks available						
				AO1	AO2	AO3	Total	Maths	Prac	
5	(a)		<p>Curve: elastic (straight) and inelastic regions shown (1)</p> 							
	(b)		<p><b>Bonds</b>            B1 – Extra stress at DE.            B2 – DE breaks.            B3 – BE forms.            B4 – Extra stress at HG.            B5 – HG breaks.            B6 – HD forms.            B7 – Dislocation moves towards the right.</p> <p><b>Foreign atoms</b>            F1 – Foreign atoms fixed.            F2 – Dislocations cannot move.</p>							

## GCE AS and A LEVEL PHYSICS Specimen Assessment Materials 120

			<p><b>5-6 marks</b> At least 5 of B1 – B7. At least 1 of F1 and F2.</p> <p>There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured.</p> <p><b>3-4 marks</b> Expect 3 – 4 of B1 – B7. Either F1 or F2.</p> <p>There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure.</p> <p><b>1-2 marks</b> Expect 1 – 2 of B1 – B7.</p> <p>There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure.</p> <p><b>0 marks</b> No attempt made or no response worthy of credit.</p>	2	4		6		
	(c)	(i)	Stress = $1.9 \times 10^8 \text{ [N m}^{-2}\text{]}$		1		1	1	1
		(ii)	Max stress = $2.2 \times 10^8 \text{ [N m}^{-2}\text{]}$ (1) Min stress = $1.6 \times 10^8 \text{ [N m}^{-2}\text{]}$ (1)		2		2	2	2
	(d)		Benefit – testing over a wider range (1) Risk – large force is a hazard (whiplash) which could lead to injury (1)			2	2		2
			<b>Question 5 total</b>	<b>6</b>	<b>7</b>	<b>2</b>	<b>15</b>	<b>3</b>	<b>5</b>



Question			Marking details	Marks available						
				AO1	AO2	AO3	Total	Maths	Prac	
6	(a)		$\lambda_{\max} = 950 [\pm 50] \text{ [nm] [or by implication] (1)}$ $T = \frac{2.90 \times 10^{-3}}{950 \times 10^{-9}} \text{ (1) [ecf on } \lambda_{\max}]$ $= 3050 \text{ [K] (1)}$		1					
	(b)	(i)	Spectral intensity [far] greater at 700 nm [than at 400 nm]		1		1			
		(ii)	Infra-red	1			1			
		(iii)	Use of $\lambda_{\max} = \frac{W}{T}$ (1) $\lambda_{\max} = 550 \text{ nm [accept } 500 - 600 \text{ nm] (1)}$ $T = 5300 \text{ [K] (1)}$ <b>[ecf from <math>\lambda_{\max}</math> but only if <math>\lambda_{\max}</math> is between 400 and 700 nm]</b>	1						
	(c)		Knowledge of meaning of symbols in $P = \sigma AT^4$ demonstrated (1) $A = 4\pi \times (1.01 \times 10^8 \text{ m})^2 = 1.28 \times 10^{17} \text{ [m}^2\text{] (1)}$ $P = 6.3 \times 10^{23} \text{ W unit mark (1) [ecf on } T \text{ from (a)]}$ [1 mark lost if answer adrift by a factor of $\pi$ or $2^n$ , or if the answer to (b)(iii) used instead of 3000 K] Accept other alternatives e.g. finding $P$ from $A$ and $T$ or finding $A$ from $P$ and $T$	1						
			<b>Question 6 total</b>	<b>3</b>	<b>7</b>	<b>1</b>	<b>11</b>	<b>9</b>	<b>0</b>	

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
7	(a)	(i)	Correct lepton numbers used i.e. $e^-$ : +1 $e^+$ : -1 $\gamma$ : 0 (1) Correct application of conservation law (1)	1	1		2		
		(ii)	Electromagnetic : $\gamma$ involvement <b>(both needed for the mark)</b>	1			1		
	(b)		$\pi^-$ (1) <u>because either</u> charge of x = -e [accept -1] and x must be a hadron / can't be a lepton <b>or</b> u number = $0 - 1 = -1$ , d number = $0 - (-1) = 1$ or equivalent (1)		2		2		
	(c)	(i)	$e^+$ or positron		1		1		
		(ii)	Weak	1			1		
	(d)		$\pi^-$ [accept $\mu$ or $\tau$ ] $\rightarrow e^- + \nu_{\bar{e}}$ (accept $\nu$ ) [In fact, $\pi^- \rightarrow \mu^- + \nu_{\mu}$ much more likely]		1		1		
			<b>Question 7 total</b>	<b>3</b>	<b>5</b>	<b>0</b>	<b>8</b>	<b>0</b>	<b>0</b>

**AS UNIT 1: Motion, Energy and Matter - SUMMARY OF ASSESSMENT OBJECTIVES**

<b>Question</b>	<b>AO1</b>	<b>AO2</b>	<b>AO3</b>	<b>TOTAL MARK</b>	<b>MATHS</b>	<b>PRAC</b>
1	5	3	4	12	4	5
2	2	5	4	11	6	0
3	6	7	1	14	7	0
4	3	2	4	9	6	8
5	6	7	2	15	3	5
6	3	7	1	11	9	0
7	3	5	0	8	0	0
<b>TOTAL</b>	<b>28</b>	<b>36</b>	<b>16</b>	<b>80</b>	<b>35</b>	<b>18</b>