

Movement and position

Mark Scheme 3

Level	IGCSE(9-1)
Subject	Physics
Exam Board	Edexcel IGCSE
Module	Single Award (Paper 2P)
Topic	Forces and motion
Sub-Topic	Movement and position
Booklet	Mark Scheme 3

Time Allowed: 56 minutes

Score: /46

Percentage: /100

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	775%	70%	60%	55%	50%	<50%

Question number	Answer	Notes	Marks
1 (a) (i)	<p>$p = m \times v$</p> <p>(ii) statement of conservation of momentum; calculation of momentum before seen; use of correct mass for momentum after; evaluation of velocity;</p> <p>e.g. $m_1v_1 = m_2v_2$ 43.2×4.10 OR $177(.12)$ seen ($m_2=$) 45.7 ($v=$) 3.88 (m/s)</p>	<p>accept answer in words, standard symbols or rearranged</p> <p>allow in words</p> <p>3.9, 3.876</p>	<p>1</p> <p>4</p>
(b)	<p>MP1. boy and skateboard move backwards/in opposite direction to the ball;</p> <p>Either MP2. because of conservation of momentum/eq; MP3. because of Newton's 3rd law/eq;</p>	<p>total marks = 7</p>	2

Question number	Answer	Notes	Marks
2 (a)	(i) lever arm / bolt moves to the left;		1
	(ii) to return the metal bar (and lever) to the right/eq	allow pulls it back (again)	1
(b)	(i) $F_1d_1 = F_2d_2$;	accept answer in words, standard symbols or rearranged clockwise (moments) = anticlockwise (moments)	1
	(ii) substitution; rearrangement; evaluation; e.g. $110 \times 22 = 38 \times F_2$ $F_2 = \frac{110 \times 22}{38}$ 63.7 (N)	rearrangement and substitution in either order 63.684 (N) -1 for incorrect rounding	3
	(iii) any two from MP1 (since distance to A greater) moment is greater; MP2 distance to B is constant / still 110 cm; MP3 (hence) force will increase;	allow correct re-calculation with d_B	2
total marks = 8			

Question number	Answer	Notes	Marks
3 (a) (i)	momentum = mass \times velocity;	symbols and rearrangements e.g. $p = m \times v$	1
(ii)	substitution into correct equation; evaluation; e. (momentum =) 0.23×13 $= 3.0$ (kg m/s)	allow 3, 2.99	2

(b)	<p>explanation in terms of conservation of momentum OR Newton's third law</p> <p>conservation of momentum - any 3 of:</p> <p>MP1. mention of conservation of momentum;</p> <p>MP2. momentum of snowball and skater;</p> <p>MP3. (are) equal and opposite;</p> <p>MP4. because momentum initially zero;</p> <p>OR</p> <p>Newton's third law - any 3 of:</p> <p>MP1. mention of {action and reaction / Newton III law};</p> <p>MP2. forces on skater and snowball;</p> <p>MP3. (are) equal and opposite;</p> <p>MP4. idea that (magnitude of) rate of change of momentum is same for both forces;</p>	<p>allow 'her' or similar to mean the skater allow e.g. -3.0 (kg m/s)</p> <p>allow 'her' or similar to mean the skater condone 'push' for force</p> <p>if no other mark awarded, allow 'because there is no / little friction' for 1 mark</p>	3
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(c)	<p>explanation in terms of momentum OR acceleration OR pressure</p> <p>momentum - any 3 of:</p> <p>MP1. idea of increased time (of impact); MP2. same change in momentum; MP3. force is rate of change in momentum; MP4. reduces force (on knee);</p> <p>OR</p> <p>acceleration - any 3 of:</p> <p>MP1. idea of increased distance/time (to slow down); MP2. same change in velocity / speed; MP3. reduces acceleration; MP4. reduces force (on knee);</p> <p>OR</p> <p>pressure - any 3 of:</p> <p>MP1. idea of increased area (in contact with ground / knee); MP2. reduced force; MP3. pressure = force \div area; MP4. reduces pressure (on knee);</p>	<p>allow $F = \text{change in momentum} \div \text{time}$</p> <p>allow same force symbols</p>	3
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Total 9 marks

Question number	Answer	Notes	Marks																		
4 (a)	<p>Vector quantities – Force, velocity</p> <p>Scalar quantities – Distance, speed</p>	<p>Four correct ticks = 2 marks minus 1 each mistake /omission two ticks in a row is a mistake</p> <table border="1"> <thead> <tr> <th>Quantity</th> <th>Vector</th> <th>Scalar</th> </tr> </thead> <tbody> <tr> <td>distance</td> <td></td> <td>✓</td> </tr> <tr> <td>force</td> <td>✓</td> <td></td> </tr> <tr> <td>momentum</td> <td>(✓)</td> <td></td> </tr> <tr> <td>speed</td> <td></td> <td>✓</td> </tr> <tr> <td>velocity</td> <td>✓</td> <td></td> </tr> </tbody> </table>	Quantity	Vector	Scalar	distance		✓	force	✓		momentum	(✓)		speed		✓	velocity	✓		2
Quantity	Vector	Scalar																			
distance		✓																			
force	✓																				
momentum	(✓)																				
speed		✓																			
velocity	✓																				
(b) (i)	Momentum = mass x velocity;	Allow equivalent rearrangement or symbols $p = m \times v$	1																		
(b) (ii)	<p>Substitution into correct equation; Calculation; e.g. 1500 x 20 30 000 (kg m/s)</p>	<p>Allow 3×10^4 Full marks for correct answer without working (bald answer)</p>	2																		

Question number	Answer	Notes	Marks
4 (c) (i)	Substitution into correct equation; Calculation; e.g. $\frac{22500}{0.14}$ 160 000 (N)	No mark for the equation as it is given on page 2 Accept 2 or more sf, e.g. 161 000, 160 714 Full marks for bald correct answer	2
	(ii) Any three of - MP1. Longer time (of impact); MP2. Same momentum change (with or without a seatbelt); MP3. Reduces force; MP4. Passenger stays on seat / is not thrown from vehicle/eq;	Do not credit the equation as it is given on page 2 Allow slows down more gradually	3

(Total for Question 4 = 10 marks)

Question number	Answer	Notes	Marks
5 (a)	Any 2 from air bags; side impact beams/bars; crumple zones /collapsible bumpers; collapsible steering column /wheel;	Allow references to strong / laminated / safety glass ignore unqualified bumpers	2
(b) (i)	Any four from MP1. same momentum change (with or without a seatbelt); MP2. (but) time of impact increases; MP3. (which) reduces rate of momentum change; MP4. (therefore) reducing the (average) force; MP5. the seat belt stretches (during collision); MP6. (which) increases the area over which the force acts; MP7. (hence) pressure on body reduces;	Ignore • references to momentum reducing • word equation	4
(b) (ii)	A sensible suggestion; e.g. there is a higher momentum (transfer in collision) there is a larger force during impact straps have a greater area over which force acts larger area of straps reduces the pressure		1

(c)	Momentum (of car and dummy) reduces to <u>zero</u> ; OR All momentum is absorbed by the Earth;		1
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(Total for Question 5= 8 marks)

Question number	Answer	Notes	Marks
6 (a)	momentum = mass × velocity;	Allow rearrangements and standard abbreviations $p = m \times v$	1
(b)	Equation; Substitution and rearrangement; Evaluation; e.g. $m_1 \times v_1 = m_2 \times v_2$ $10\,000 \times 4.5 / 1500$ $30(\text{m/s})$	bald answer = 3 marks POT = -1	3

(Total for Question 6= 4 marks)