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INTERNATIONAL A LEVEL MATHEMATICS • MECHANICS 1

Mechanics 1

Exam Questions by Topic: Mark Scheme

Pearson Edexcel International Advanced Level (WME01/01) • Calculator allowed • Take $g = 9.8 \text{ ms}^{-2}$

Every question in the booklet, marked line by line the way an examiner marks it

Chapters (tap a chapter to jump to it)	Qs	Marks	Page	My score
1 Mathematical Models in Mechanics Not examined on its own: modelling ideas are tested within Chapters 2 to 8	—	—	Not applicable	
2 Constant Acceleration Motion graphs, the suvat formulae, vertical motion under gravity	10	82	own PDF	
3 Vectors in Mechanics Resultants, velocity and position vectors, $\mathbf{r} = \mathbf{r}_0 + \mathbf{v}t$	10	81	own PDF	
4 Dynamics of a Particle Moving in a Straight Line $F = ma$, connected particles, pulleys, lifts	10	82	own PDF	
5 Forces and Friction Resolving forces, friction, inclined planes	10	86	own PDF	
6 Momentum and Impulse Conservation of momentum, impulse	10	81	own PDF	
7 Statics of a Particle Equilibrium, limiting friction	10	82	own PDF	
8 Moments Beams and rods, tilting, non-uniform rods	10	82	3	

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How to use this mark scheme

The same marking rules Pearson examiners use for WME01.

Mark every line, not just the answer. Method marks are given for a correct method even when the final answer is wrong. If you lost marks, find the *first* line where your working differs from the scheme. That is the thing to fix.

Code	Meaning
M1	Method mark: for knowing a correct method and attempting to apply it. Small slips in the working do not lose this mark.
dM1	Dependent method mark: can only be given if the method mark before it has been given.
A1	Accuracy mark: for a correct answer or line of working. It can only be given if the method mark it depends on has been given.
B1	Independent mark: for a correct result or statement, whatever method was used.
*	The answer is given in the question. Every step must be shown, and the answer must follow from correct working (cso).
cao	Correct answer only.
cso	Correct solution only: no errors anywhere in the working.
ft	Follow through: the mark can be given for correct work using your own earlier (wrong) answer.
oe	Or equivalent: any correct equivalent form is accepted.

Accuracy after using $g = 9.8$. When $g = 9.8 \text{ ms}^{-2}$ has been substituted, the final answer must be given to 2 or 3 significant figures: more accurate answers (and fractions) lose the final A mark. Exact multiples of g are usually accepted. Using $g = 9.81$ loses accuracy marks.

Marking a sketch. Graph marks are given for the correct shape (straight lines for constant acceleration, no solid vertical lines) and for the key values marked on the axes. An equation of motion or a suvat equation must have the correct number of terms and be dimensionally correct to earn its method mark.



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Chapter 8: Moments

Mark scheme. Marks are shown on the right of each line.

Question 1

6 marks

Part	Scheme	Marks
(a)	$M(A): R_C \times 3 = 20g \times 2$ Correct equation $131 \text{ N} \left(\frac{40g}{3} \right)$	M1 A1 A1 (3)
(b)	$R_A + R_C = 20g$ (or $M(C): 3R_A = 20g \times 1$) $65.3 \text{ N} \left(\frac{20g}{3} \right)$	M1 A1 (2)
(c)	The weight acts at the midpoint, 2 m from A	B1 (1)
Total for Question 1: 6 marks		

Question 2

6 marks

Part	Scheme	Marks
(a)	$T_A + 1.5T_A = 50g$ $T_A = 20g = 196 \text{ N}$ $T_B = 30g = 294 \text{ N}$	M1 A1 A1 (3)
(b)	$M(A): 30g \times 4 = 30g \times 2 + 20g \times AC$ $AC = 3 \text{ m}$	M1 A1 (2)
(c)	The beam is rigid (it stays straight), so the distances do not change <i>Summer 2019 report: a comment about the beam remaining straight is all that is expected.</i>	B1 (1)
Total for Question 2: 6 marks		



Question 3

6 marks

Part	Scheme	Marks
(a)	Greatest m: on the point of tilting about D, so $R_C = 0$ $M(D): mg \times 1.5 = 20g \times 1$ $m = 13.3 \left(\frac{40}{3}\right)$ <i>Jan 2021 report: some assumed the reaction at the pivot is zero. It is the other support.</i>	B1 M1 A1 (3)
(b)	$M(C): R_D \times 2.5 = 20g \times 1.5 + 10g \times 4$ $R_D = 28g = 274 \text{ N}$ $R_C = 30g - 28g = 19.6 \text{ N}$	M1 A1 A1 (3)
Total for Question 3: 6 marks		

Question 4

6 marks

Part	Scheme	Marks
	Tilting about C means $R_D = 0$; tilting about D means $R_C = 0$ $M(C): 30 \times 1 = W(x - 1)$ $M(D): 50 \times 1 = W(3 - x)$ Adds (or eliminates x): $80 = 2W$ $W = 40$ $x = 1.75$ <i>The weight is W newtons: writing Wg is an accuracy error (Jan 2021 report).</i>	B1 M1 M1 M1 A1 A1 (6)
Total for Question 4: 6 marks		



Question 5

6 marks

Part	Scheme	Marks
(a)	Moments about A: $10\bar{x} = 2 \times 0 + 5 \times 1 + 3 \times 3$ Correct 1.4 m	M1 A1 A1 (3)
(b)	$10g = $ 98 N	B1 (1)
(c)	New balance point $\frac{14}{11} = 1.27$ m from A 0.127 m towards A	M1 A1 (2)
Total for Question 5: 6 marks		

Question 6

10 marks

Part	Scheme	Marks
(a)	M(A): $T_C \times 2.1 = 60g \times 1.5 + 40g \times 0.9$ $2.1T_C = 126g$ $T_C = 60g = 588 \text{ N}^*$	M1 A1 A1* (3)
(b)	$100g - 60g = $ 392 N	B1 (1)
(c)	$2.1T_C = 90g + 40gd$ with $T_C \leq 800$ $882 + 392d \leq 1680$ 2.04 m	M1 A1 A1 (3)
(d)	On the point of tilting about C: tension at A is 0 M(C): $Mg \times 0.9 = 60g \times 0.6$ M = 40 <i>Jan 2025 report: using the tension from earlier parts instead of zero at A is the common error.</i>	B1 M1 A1 (3)
Total for Question 6: 10 marks		



Question 7

10 marks

Part	Scheme	Marks
(a)	$M(C): R_D \times 3 = 30g \times 2 + 70g \times 1.5$ Correct equation $R_D = 55g = \boxed{539 \text{ N}}$ $R_C = 100g - 55g = \boxed{441 \text{ N}}$	M1 A1 A1 A1 (4)
(b)	Man near A, about to tilt about C ($R_D = 0$): $70g(1 - x) = 30g \times 2$ $x = \frac{1}{7} = 0.143$ Man near B, about to tilt about D ($R_C = 0$): $70g(x - 4) = 30g \times 1$ $x = \frac{31}{7} = 4.43$ $\boxed{0.143 \leq x \leq 4.43}$ (m from A)	M1 A1 M1 A1 A1 (5)
(c)	e.g. his weight is taken to act at one point, but his feet cover a length of the plank, so the limits are approximate	B1 (1)
Total for Question 7: 10 marks		

Question 8

11 marks

Part	Scheme	Marks
(a)	$R_C + R_D = 18g$ and $R_C = 2R_D$ $R_D = 6g, R_C = 12g$ $M(A): 12g \times 1.5 + 6g \times 5 = 18g \times x$ Correct equation $x = \frac{8}{3} = 2.67 \text{ m}$	M1 A1 M1 A1 A1 (5)
(b)	About to tilt about D: $R_C = 0$ $M(D): mg \times 1 = 18g \left(5 - \frac{8}{3}\right)$ $\boxed{42 \text{ kg}}$	B1 M1 A1 (3)
(c)	$R_C = R_E = 11.5g$ $M(A): 11.5g \times 1.5 + 11.5g \times AE = 18g \times \frac{8}{3}$ $\boxed{AE = 2.67 \text{ m}}$	B1 M1 A1 (3)
Total for Question 8: 11 marks		



Question 9

10 marks

Part	Scheme	Marks
(a)	$M(C): 30g \times 2.5 = 20g \times 0.5 + mg \times 3.5$ Correct equation $m = 18.6 \left(\frac{130}{7} \right)$	M1 A1 A1 (3)
(b)	$(30 + 20 + m)g$ 672 N (670)	M1 A1 (2)
(c)	$M(C): 30g \times 2 = 20g \times 0.5 + mg \times y$ $y = \frac{50}{m} = \frac{35}{13} = 2.69 \text{ m from } C$ Moves $3.5 - 2.69 = 0.808 \text{ m}$	M1 A1 A1 (3)
(d)	Any two: the plank is not exactly uniform; the children are not particles; the plank may bend; the pivot has a width	B2 (2)
Total for Question 9: 10 marks		



Question 10

11 marks

Part	Scheme	Marks
(a)	The bolt pulls the board down at A $M(C): F \times 1 = 40g \times 1 + 60g \times 3$ $F = 220g = \boxed{2160 \text{ N}}$ (2156) Vertically: $R_C = F + 100g$ $320g = \boxed{3140 \text{ N}}$ (3136) <i>Taking the bolt force upwards gives a negative answer; it must be interpreted as downwards.</i>	B1 M1 A1 M1 A1 (5)
(b)	$M(C): 40g + 3mg \leq 2500$ $m \leq \frac{2500/9.8 - 40}{3}$ $\boxed{71.7 \text{ kg}}$	M1 A1 A1 (3)
(c)	$M(C): 2000 = 40g(x - 1) + 60g \times 3$ $392(x - 1) = 236$ $\boxed{x = 1.60}$	M1 A1 A1 (3)
Total for Question 10: 11 marks		

