Mechanics Year 2 exam questions - AQA

NOTE:
Please be aware that in the Year 12 collections, you will find questions from the Year 13 papers. However, these questions are intentionally included because they align with Year 12 content and topics. That's the reason why you are missing some questions here, please have a look at the Year 12 collection!
Happy studying!

Ch 20 Moments of forces

June 2022 Question 14 Paper 2

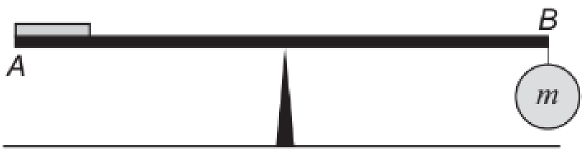
14 A £2 coin has a diameter of 28 mm and a mass of 12 grams.

A uniform rod AB of length 160 mm and a fixed load of mass m grams are used to check that a £2 coin has the correct mass.

The rod rests with its midpoint on a support.

A £2 coin is placed face down on the rod with part of its curved edge directly above A.

The fixed load is hung by a light inextensible string from a point directly below the other end of the rod at B, as shown in the diagram.



14 (a) Given that the rod is horizontal and rests in equilibrium, find m.

[3 marks]

14 (b) State an assumption you have made about the £2 coin to answer **part (a)**.

[1 mark]

ANSWER

Q	Marking instructions	AO	Marks	Typical solution
14(a)	Forms a dimensionally correct non-zero moment. For example $0.012g \times 0.066$ $0.012g \times 66$ $12g \times 66$ $160mg$	3.3	B1	$66 \times 12g = 80mg$
	Obtains a correct single equation where the only unknown is the mass. This might come from correct moments about a point other than the centre with forces correctly resolved in the vertical direction, but these equations must be combined to eliminate the force at the centre. PI by 9.9	1.1a	M1	$m = 9.9$
	Obtains 9.9 Condone $m = 0.0099kg$ OE provided units are included if m is not in grams	1.1b	A1	
	Subtotal		**3**	

Q	Marking instructions	AO	Marks	Typical solution
14(b)	States a valid assumption about the £2 coin with no contradictions or incorrect statements For example Models the coin as uniform, or weight acts through the centre or centre of mass is at the centre Do not accept ‘mass acts’ or ‘centre of mass acts’ at the centre or ‘centre of weight’ or ‘weight is at’	3.5a	E1	The coin is uniform
	Subtotal		**1**	

November 2021 Question 16 Paper 2

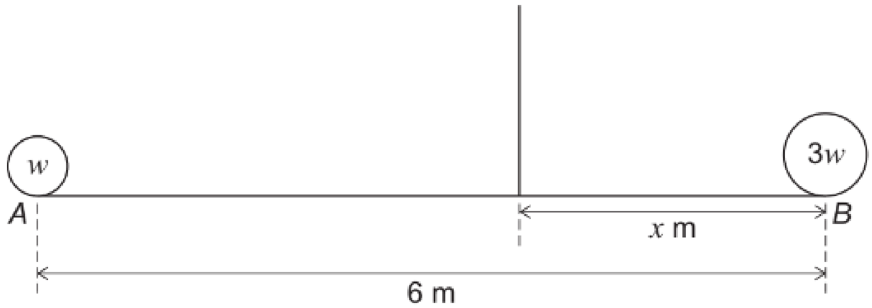
16 A straight uniform rod, AB, has length 6 m and mass 0.2 kg

A particle of weight w newtons is fixed at A.

A second particle of weight $3w$ newtons is fixed at B.

The rod is suspended by a string from a point x metres from B.

The rod rests in equilibrium with AB horizontal and the string hanging vertically as shown in the diagram below.



Show that

$$x = \frac{3w + 0.3g}{2w + 0.1g}$$

[4 marks]

ANSWER

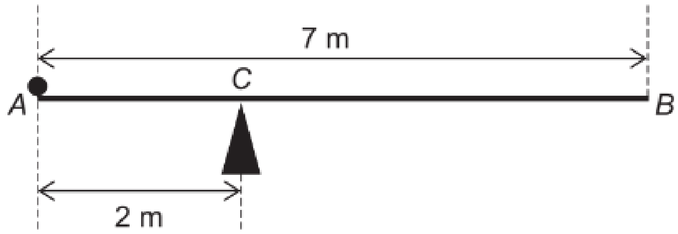
Q	Marking Instructions	AO	Marks	Typical Solution
16	Takes moments about the point of suspension to form a moments equation involving w and x with one term correctly expressed. or Takes moments about any other point to form a moments equation involving w, x and T with one term correctly expressed. If moments taken about A then $0.2g(3) + 3w(6) = T(6 - x)$ If moments taken about B then $w(6) + 0.2g(3) = Tx$	3.3	M1	Take moments about the point of suspension $3wx = (3 - x)0.2g + (6 - x)w$ $4wx + 0.2gx = 6w + 0.6g$ $2(2w + 0.1g)x = 6w + 0.6g$ $\therefore x = \dfrac{3w + 0.3g}{2w + 0.1g}$
	Forms a dimensionally correct moments equation with two terms correctly expressed	1.1a	M1	
	Forms a fully correct equation involving w, x and g only If moments taken about A or B then T = 4w +0.2g must have been substituted at this point	1.1b	A1	
	Obtains given answer showing at least the step $x(4w + 0.2g) = 6w + 0.6g$ OE or $x = \dfrac{6w + 0.6g}{4w + 0.2g}$ OE Must have fully corrected any error involving weight and mass throughout AG	2.1	R1	
	Total		**4**	

November 2020 Question 13 Paper 2

13 A uniform rod, AB, has length 7 metres and mass 4 kilograms.

The rod rests on a single fixed pivot point, C, where $AC = 2$ metres.

A particle of weight W newtons is fixed at A, as shown in the diagram.



The system is in equilibrium with the rod resting horizontally.

13 (a) Find W, giving your answer in terms of g.

[2 marks]

13 (b) Explain how you have used the fact that the rod is uniform in part **(a)**.

[1 mark]

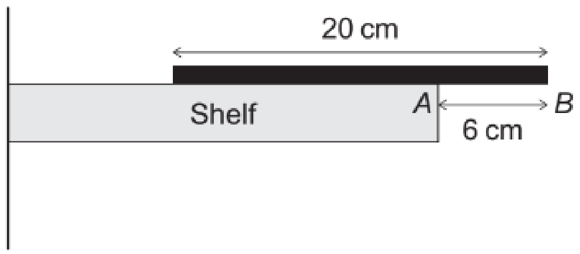
ANSWER

Q	Marking Instructions	AO	Marks	Typical Solution
13(a)	Finds a moment of a force about any point. Must have the form force x distance. Can be awarded for example for 2w, 7w, 5R, 2R Condone use of 9.8, 9.81, 10 instead of g	3.4	M1	$2W = 1.5 \times 4g$ $W = 3g$
	Obtains w= $3g$ CAO	1.1b	A1	
	Subtotal		**2**	
13(b)	Explains that the weight of the rod acts through the midpoint or the centre of mass is at the midpoint (of the rod) OE	3.5a	E1	The rod is uniform so its weight acts at the centre
	Subtotal		**1**	
	Question Total		**3**	

June 2019 Question 14 Paper 2

14 A metal rod, of mass m kilograms and length 20 cm, lies at rest on a horizontal shelf.

The end of the rod, B, extends 6 cm beyond the edge of the shelf, A, as shown in the diagram below.



14 (a) The rod is in equilibrium when an object of mass 0.28 kilograms hangs from the midpoint of AB.

Show that $m = 0.21$

[3 marks]

14 (b) The object of mass 0.28 kilograms is removed.

A number, n, of identical objects, each of mass 0.048 kg, are hung from the rod all at a distance of 1 cm from B.

Find the maximum value of n such that the rod remains horizontal.

[4 marks]

14 (c) State one assumption you have made about the rod.

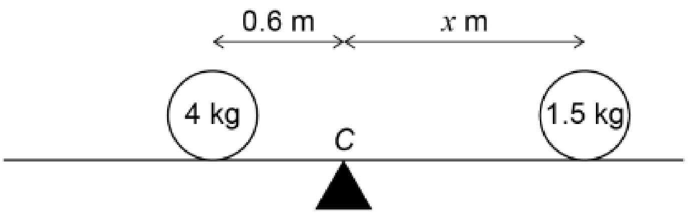
[1 mark]

ANSWER

Q	Marking Instructions	AO	Marks	Typical Solution
14(a)	Finds a moment of a force about any point. Must have the form force x distance Can be awarded for $6R$ **PI** by fully correct equation	1.1b	B1	Take moments about *A* $mg \times 0.04 = 0.28g \times 0.03$ $m = 0.21$
	Forms a fully correct moments equation using the correct model Must have included g on both sides Moments about *B* gives (in metres) $0.28g(0.03) + 0.1mg = 0.06(0.28g + mg)$	3.3	M1	
	Solves equation to show $m = 0.21$ **AG**	1.1b	A1	
14(b)	Forms a moments equation for equilibrium of rod with correct number of terms – can use m, 0.21 or their value for m from part **14(a)** **Condone omission of g throughout part 14(b)**	3.1b	M1	Take moments about *A* $0.21g \times 0.04 = 0.048g \times 0.05 \times n$ $n = 3.5$ Maximum $n = 3$
	Forms a moments equation for equilibrium of rod with term involving n correct – can use m, 0.21 or their m value from **part 14(a)** FT their incorrect m Moments about B gives $0.06R = 0.00048ng + 0.1mg$	3.4	A1F	
	Obtains a fully correct moments equation with $m = 0.21$ substituted Moments about B gives $0.06(0.21g + 0.048ng) = 0.00048ng + 0.1(0.21)g$ Must have substituted correct expression for R	1.1b	A1	
	States $n = 3$ **CSO**	1.1b	A1	
14(c)	States an assumption about the rod Accept The mass/weight of the rod acts in the middle The rod is in limiting equilibrium **OE** The rod is rigid	3.5b	E1	The rod is uniform
	Total		**8**	

June 2018 Question 11 Paper 2

11 A uniform rod, AB, has length 4 metres.
The rod is resting on a support at its midpoint C.
A particle of mass 4 kg is placed 0.6 metres to the left of C.
Another particle of mass 1.5 kg is placed x metres to the right of C, as shown.



The rod is balanced in equilibrium at C.

Find x.

Circle your answer.

[1 mark]

1.8 m   1.5 m   1.75 m   1.6 m

ANSWER

Q	Marking Instructions	AO	Marks	Typical Solution
11	Circles correct answer	AO1.1b	B1	1.6 m
	Total		**1**	