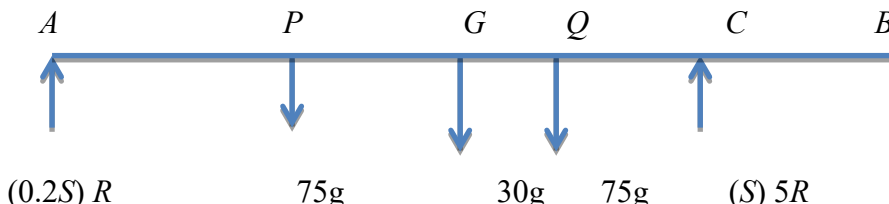
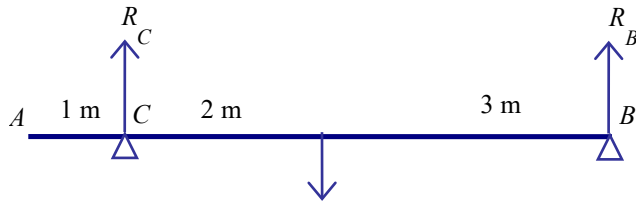
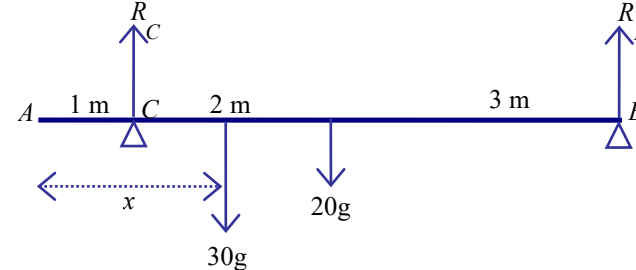


A level Mathematics Practice Paper – Moments – Mark scheme

Question	Scheme	Marks
1(a)	$M(D), \quad 8R = (80g \times 6) + (200g \times 4)$ $R = 160g, 1600, 1570$	M1 A1 A1
		(3)
1(b)	$(\uparrow), \quad 2S = 80g + 200g$ $S = 140g, 1400, 1370$	M1 A1
		(2)
1(c)	$M(B), \quad Sx + (S \times 10) = (80g \times 8) + (200g \times 6)$ $140x + 1400 = 640 + 1200$ $140x = 440$ $x = \frac{22}{7}$	M1 A2 A1
		(4)
		(9 marks)
2(a)		
	$(\uparrow) R + 5R = 75g + 30g + 75g$	M1 A2
	$M(A) \quad 75gx + 75g2x + 30g \times 3 = 5R \times 4$ $x = \frac{34}{15} = 2.3 \text{ or better}$	M1 A2 A1
	(N.B. Or another Moments Equation)	(M1 A2)
		(7)
2(b)	uniform – mass is or acts at midpoint of plank; centre of mass is at middle of plank; weight acts at the middle of the plank, centre of gravity is at midpoint rod - plank does not bend, remains straight, is inflexible, is rigid	B1 B1
		(2)
		(9 marks)

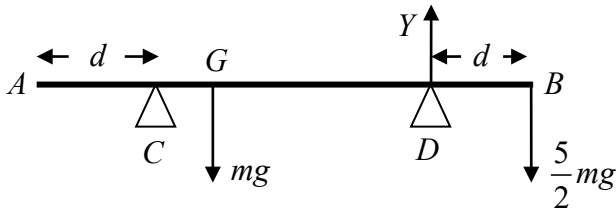
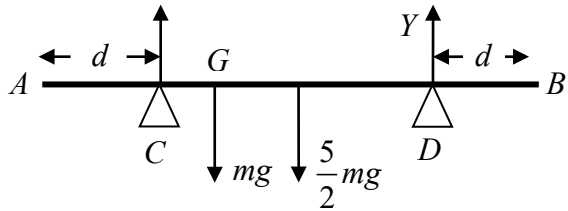
A level Mathematics Practice Paper – Moments – Mark scheme

Question	Scheme	Marks
3(a)		
	Taking moments about B: $5 \times R_C = 20g \times 3$	M1A1
	$R_C = 12g$ or $60g/5$ or 118 or 120	A1
	Resolving vertically: $R_C + R_B = 20g$	M1
	$R_B = 8g$ or 78.4 or 78	A1
		(5)
3(b)		
	Resolving vertically: $50g = R + R$	B1
	Taking moments about B:	
	$5 \times 25g = 3 \times 20g + (6 - x) \times 30g$	M1 A1 A1
	$30x = 115$	
	$x = 3.8$ or better or $23/6$ oe	A1
		(5)
		(10 marks)

A level Mathematics Practice Paper – Moments – Mark scheme

Question	Scheme	Marks
4(a)	Resolving vertically: $T + 2T (= 3T) = W$	M1A1
	Moments about A: $2W = 2T \times d$	M1A1
	Substitute and solve: $2W = 2 \frac{W}{3} d$	DM1
	$d = 3$	A1
		(6)
4(b)	Resolving vertically: $T + 4T = W + kW \quad (5T = W(1+k))$	M1A1 ft
	Moments about A: $2W + 4kW = 3 \times 4T$	M1A1 ft
	Substitute and solve: $2W + 4kW = \frac{12}{5}W(1+k)$	DM1
	$2 + 4k = \frac{12}{5} + \frac{12}{5}k$	
	$\frac{8}{5}k = \frac{2}{5}, \quad k = \frac{1}{4}$	A1
		(6)
		(12 marks)

A level Mathematics Practice Paper – Moments – Mark scheme

Question	Scheme	Marks
5(a)		
	$M(D) \quad mg \times GD = \frac{5}{2} mg \times d$	M1 A1
	$GD = \frac{5}{2} d \quad *$	DM1 A1
		(4)
5(b)		
	$M(C) \quad mg \times \frac{d}{2} + \frac{5}{2} mg \times \frac{3}{2} d = Y \times 3d$	M1 A2(1, 0)
	Leading to $Y = \frac{17}{12} mg$	DM1 A1
		(5)
		(9 marks)

A level Mathematics Practice Paper – Moments – Mark scheme

Question	Scheme	Marks
6(a)		
	EITHER $M(R), 8X + 2X = 40g \times 6 + 20g \times 4$	M1 A2
	solving for X , $X = 32g = 314$ or 310 N	M1 A1
	☐ $X + X = 40g + 20g + Mg$ (or another moments equation)	M1 A2
	solving for M , $M = 4$	M1 A1
	OR $M(P), 6X = 40g \times 2 + 20g \times 4 + Mg \times 8$	M1 A2
	solving for X , $X = 32g = 314$ or 310 N	M1 A1
	☐ $X + X = 40g + 20g + Mg$ (or another moments equation)	M1 A2
	solving for M , $M = 4$	M1 A1
		(10)
6(b)	Masses concentrated at a point or weights act at a point	B1
		(1)
		(11 marks)
7(a)	$T_A + T_C = 85g$	M1 A1
	OR $M(A), 25g \times 2.5 + 60g \times 5 = 4.5 \times T_C$	
	OR $M(C), T_A \times 4.5 + 60g \times 0.5 = 25g \times 2$	
	OR $M(B), T_A \times 5 + T_C \times 0.5 = 25g \times 2.5$	M1 A1
	OR $M(G), T_A \times 2.5 + 60g \times 2.5 = 2 \times T_C$	
	$T_A = \frac{40g}{9} = 44\text{N or } 43.6\text{N}; T_C = \frac{725g}{9} = 790\text{N or } 789\text{ N}$	A1 A1
		(6)
7(b)	$M(C), 25g \times 2 = Mg \times 0.5$	M1 A1
	$M = 100$	A1
	$T_c = 25g + 100g$ $T_c = 125g$ (1200 or 1230)N	M1 A1 B1
		(6)
		(12 marks)

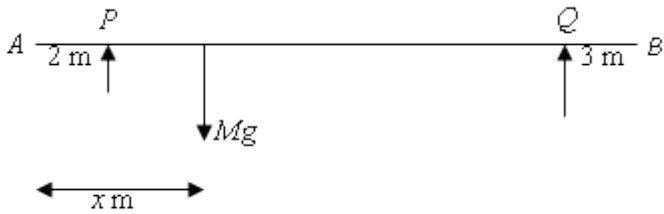
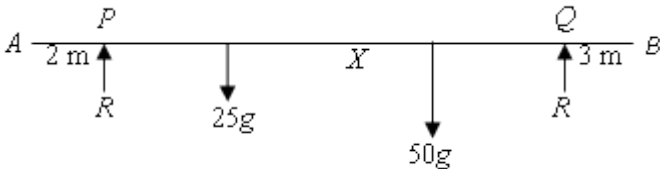
A level Mathematics Practice Paper – Moments – Mark scheme

Question	Scheme	Marks
8		
	$M(S): Mg \times 0.5 = 30g(d - 0.5)$ $M(T): Mg \times 2 = 30g(4 - d)$ dividing: $4 = \frac{(4 - d)}{(d - 0.5)} \Rightarrow$ (i) $d = 1.2$ (ii) $M = 42$	M1 A1 M1 A1 DM1 A1 A1
		(7 marks)
9(a)	Resolving vertically: $T + 2T (= 3T) = W$	M1A1
	Moments about B: $2 \times 2T = (d - 1)W$	M1A1
	Substitute and solve for d: $2 \times 2T = (d - 1)3T$	DM1
	$d = \frac{7}{3}(\text{m})$	A1
		(6)
9(b)	Moments about C: $(T_B \times 2) + (kW \times 1) = W \times \frac{2}{3}$	M1A1
	$T_B = W \frac{(2 - 3k)}{6}$ or equivalent	A1
		(3)
9(c)	solving $T_B \geq 0$ or $T_B > 0$ for k . $0 < k \leq 2/3$ or $0 < k < 2/3$ only	M1 A1
		(2)
		(11 marks)

A level Mathematics Practice Paper – Moments – Mark scheme

Question	Scheme	Marks
10(a)		
	Vertical equilibrium: $R + 2R = 50g$,	M1A1
	Moments about C: $50g \times 0.8 = (1.8 - x) \times 2 \times R$	M1A1
	$3 \times 0.8 = 3.6 - 2x$, $x = 0.6$	DM1A1
		(6)
10(b)		
	$S, 4S$	B1
	Vertical equilibrium: $S + 4S = (50 + m)g = 5S$	M1A1
	Moments about B: $50g \times 1 = 4S \times 0.4 + S \times 1.8 = 3.4S$	M1A1
	$50 \times \frac{5}{3.4} = (50 + m)$	DM1
	$m = 400/17, 24, 23.5$ or better	A1
		(7)
		(13 marks)

A level Mathematics Practice Paper – Moments – Mark scheme

Question	Scheme	Marks
11(a)		
	M(P), $50g \times 2 = Mg \times (x - 2)$	M1 A1
	M(Q), $50g \times 3 = Mg \times (12 - x)$	M1 A1
	$M = 25 \text{ (kg)}$	DM1 A1
	$x = 6 \text{ (m)}$	DM1 A1
		(8)
11(b)		
	$(\uparrow)R + R = 25g + 50g$	M1 A1 ft
	M(A), $2R + 12R = 25g \times 6 + 50g \times AX$	M1 A1 ft
	$AX = 7.5 \text{ (m)}$	DM1 A1
		(6)
		(14 marks)

A level Mathematics Practice Paper – Moments – Mark scheme

Question	Scheme	Marks
12(a)	M(A): $d \cos \theta \times 5g = 4P$	M1
		A1
	Resolving horizontally: $P \sin \theta = F$	B1
	Resolving vertically: $P \cos \theta + R = 5g$	M1
		A1
		DM1
	$R = 5g - \frac{5gd \cos^2 \theta}{4}$	A1
	$F = \frac{5gd \cos \theta \sin \theta}{4}$	A1
		(8)
12(b)	$\mu = \frac{\frac{5gd \cos \theta \sin \theta}{4}}{5g - \frac{5gd \cos^2 \theta}{4}}$	M1
	$\frac{1}{2} \left(5g - \frac{5gd \cos^2 \theta}{4} \right) = \frac{5gd \cos \theta \sin \theta}{4}$	A1
	$4 \times 169 = 120d + 144d$	M1
	$d = \frac{169}{66}$	A1
		(4)
		(12 marks)

A level Mathematics Practice Paper – Moments – Mark scheme

Question	Scheme	Marks
13(a)		
	$F = \frac{2}{3}R$ seen or implied	B1
	$M(C): 5g \times 3 \cos \alpha + F \times 7 \sin \alpha = 7 \cos \alpha \times R$	M1
		A1
		A1
	$15g \cos \alpha = R \left(7 \cos \alpha - \frac{14}{3} \sin \alpha \right)$	
	$15g \times \frac{4}{5} = R \left(7 \times \frac{4}{5} - \frac{14}{3} \times \frac{3}{5} \right) = \frac{14}{5} R$	dM1
	$R = \frac{30}{7} g = 42 \text{ (N)}$	A1
		(6)
13(b)	Resolve $\uparrow$: $T \cos \theta + R = 5g$	M1
	$R + T \sin(\beta - \alpha) = 5g$	A1
	Resolve $\leftrightarrow$: $T \sin \theta = F (= 28)$	M1
	$F \left(= \frac{2}{3} R \right) = T \cos(\beta - \alpha)$	A1
	Solve simultaneous equations for $\beta - \alpha$	
	$\tan(\beta - \alpha) = 4, \quad \beta = 50.9^\circ \quad (51^\circ)$	A1
		(5)
		(11 marks)

A level Mathematics Practice Paper – Moments – Mark scheme

Question	Scheme	Marks
14(a)		
	$R = F$	B1
	$S + Q = mg$	B1
	$Q = \frac{2}{3}R, \quad F = \frac{1}{4}S$	B1
	$Q = \frac{2}{3}R = \frac{2}{3} \times \frac{1}{4}S, \quad S + \frac{1}{6}S = mg, \quad S = \frac{6}{7}mg$	M1
		A1
		(5)
14(b)	M (A) $mg \times x \cos 60 = Q \times 2l \cos 60 + R \times 2l \sin 60$	M1
	M (B) $mg(2l - x) \cos 60 + F \times 2l \sin 60 = S \times 2l \cos 60$	A2
	M (c of m) $Sx \cos 60 = Fx \sin 60 + R(2l - x) \sin 60 + Q(2l - x) \cos 60$	
	$mgx \cos 60 = \frac{1}{6} \times \frac{6}{7}mg \times 2l \cos 60 + \frac{1}{4} \times \frac{6}{7}mg \times 2l \sin 60$	DM1
	$\frac{1}{2}x = \frac{1}{7} \times 2l \times \frac{1}{2} + \frac{3}{14} \times l\sqrt{3}$	
	$AG = x = 1.028....l \quad x = 1.03l$	A1
		(5)
		(10 marks)

A level Mathematics Practice Paper – Moments – Mark scheme

	Source paper	Question number	New spec references	Question description	New AOs
1	M1 Jan 2013	2		Moments	1.1b, 2.2a, 3.1b
2	M1 2017	3		Moments	1.1b, 2.4, 3.4
3	M1 Jan 2011	3		Moments	1.1b, 3.1b
4	M1 2014	4		Moments	1.1b, 3.1b, 3.3
5	M1 Jan 2012	4		Moments	1.1b, 3.1b
6	M1 2011	5		Moments	1.1b, 2.2a, 2.4, 3.1b
7	M1 2015	5		Moments	1.1b, 2.1, 3.1b, 3.3, 3.4
8	M1 2016	6		Moments	1.1b, 2.1, 3.1b
9	M1 2014R	6		Moments	1.1b, 2.1, 2.5, 3.1b
10	M1 2013R	8		Moments	1.1b, 3.1b
11	M1 2013	6		Moments	1.1b, 2.1, 3.1b
12	M2 2016	5		Equilibrium and moments	1.1b, 2.1, 2.2a, 3.1b
13	M2 2017	5		Moments and equilibrium	1.1b, 2.1, 2.2a, 3.3
14	M2 2014R	3		Moment of a force, equilibrium of a rigid body	1.1b, 2.1, 2.2a, 3.1b