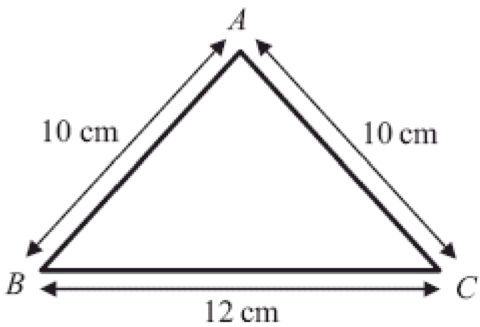
1.



A triangular frame is formed by cutting a uniform rod into 3 pieces which are then joined to form a triangle *ABC*, where *AB* = *AC* = 10 cm and *BC* = 12 cm, as shown in the diagram above.

(a) Find the distance of the centre of mass of the frame from *BC*.

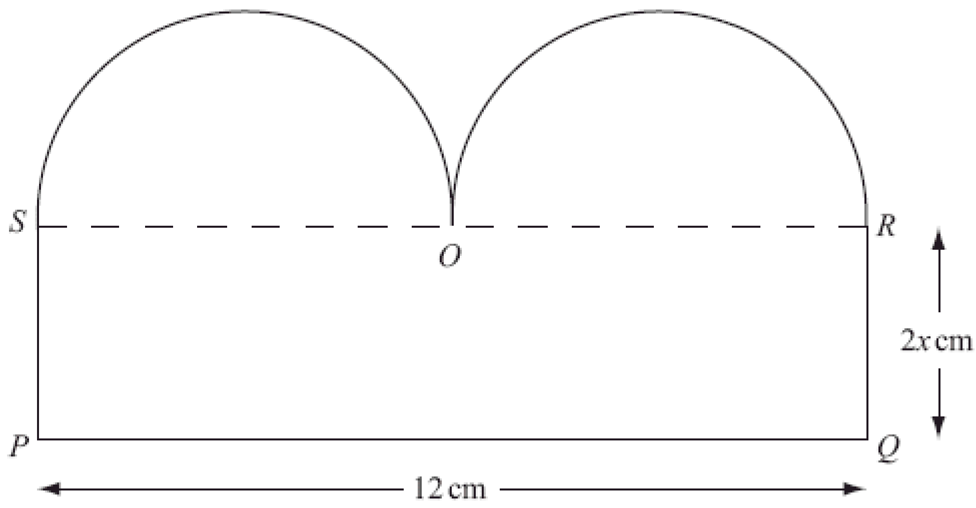
(5)

The frame has total mass *M*. A particle of mass *M* is attached to the frame at the mid-point of *BC*. The frame is then freely suspended from *B* and hangs in equilibrium.

(b) Find the size of the angle between *BC* and the vertical.

(4)
(Total 9 marks)

2. [*The centre of mass of a semi-circular lamina of radius r is* $\frac{4r}{3\pi}$ *from the centre*]



A template T consists of a uniform plane lamina $PQROS$, as shown in the diagram above. The lamina is bounded by two semicircles, with diameters SO and OR, and by the sides SP, PQ and QR of the rectangle $PQRS$. The point O is the mid-point of SR, PQ = 12 cm and QR = $2x$ cm.

(a) Show that the centre of mass of T is a distance $\frac{4|2x^2 - 3|}{8x + 3\pi}$ cm from SR.

(7)

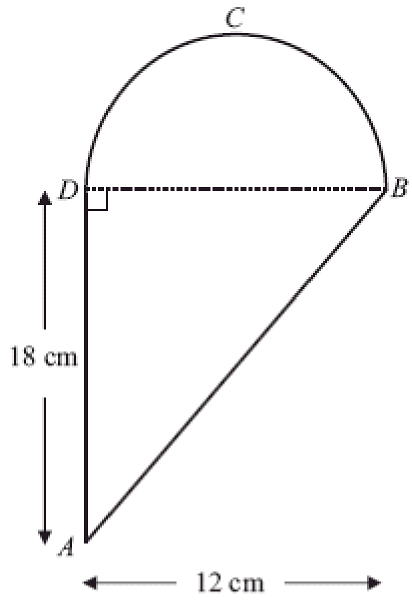
The template T is freely suspended from the point P and hangs in equilibrium.

Given that $x = 2$ and that θ is the angle that PQ makes with the horizontal,

(b) show that $\tan\theta = \frac{48 + 9\pi}{22 + 6\pi}$.

(4)
(Total 11 marks)

3.



A uniform lamina *ABCD* is made by joining a uniform triangular lamina *ABD* to a uniform semi-circular lamina *DBC*, of the same material, along the edge *BD*, as shown in the diagram above. Triangle *ABD* is right-angled at *D* and *AD* = 18 cm. The semi-circle has diameter *BD* and *BD* = 12 cm.

(a) Show that, to 3 significant figures, the distance of the centre of mass of the lamina *ABCD* from *AD* is 4.69 cm.

(4)

Given that the centre of mass of a uniform semicircular lamina, radius *r*, is at a distance $\frac{4r}{3\pi}$ from the centre of the bounding diameter,

(b) find, in cm to 3 significant figures, the distance of the centre of mass of the lamina *ABCD* from *BD*.

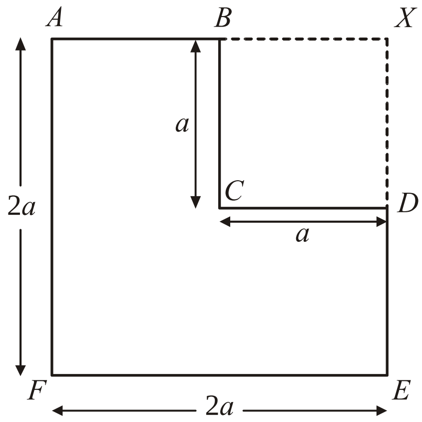
(4)

The lamina is freely suspended from *B* and hangs in equilibrium.

(c) Find, to the nearest degree, the angle which *BD* makes with the vertical.

(4)
(Total 12 marks)

4.



A uniform lamina *ABCDEF* is formed by taking a uniform sheet of card in the form of a square *AXEF*, of side $2a$, and removing the square *BXDC* of side a, where *B* and *D* are the mid-points of *AX* and *XE* respectively, as shown in the diagram above.

(a) Find the distance of the centre of mass of the lamina from *AF*.

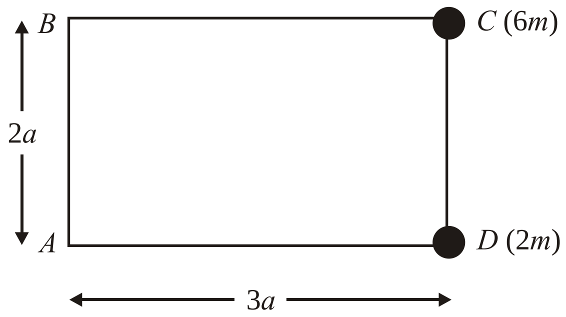
(4)

The lamina is freely suspended from *A* and hangs in equilibrium.

(b) Find, in degrees to one decimal place, the angle which *AF* makes with the vertical.

(4)
(Total 8 marks)

5.



The figure above shows four uniform rods joined to form a rigid rectangular framework *ABCD*, where $AB = CD = 2a$, and $BC = AD = 3a$. Each rod has mass m. Particles, of mass $6m$ and $2m$, are attached to the framework at points *C* and *D* respectively.

(a) Find the distance of the centre of mass of the loaded framework from

(i) *AB*,

(ii) *AD*.

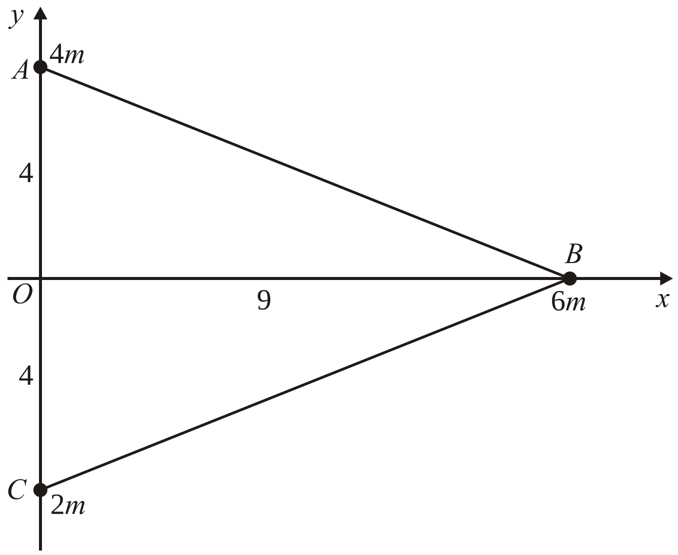
(7)

The loaded framework is freely suspended from *B* and hangs in equilibrium.

(b) Find the angle which *BC* makes with the vertical.

(3)
(Total 10 marks)

6.



The figure above shows a triangular lamina *ABC*. The coordinates of *A, B* and *C* are (0, 4) (9, 0) and (0, –4) respectively. Particles of mass 4*m*, 6*m* and 2*m* are attached at *A*, *B* and *C* respectively.

(a) Calculate the coordinates of the centre of mass of the three particles, *without the lamina.*

(4)

The lamina *ABC* is uniform and of mass *km*. The centre of mass of the combined system consisting of the three particles and the lamina has coordinates (4, λ).

(b) Show that $k = 6$.

(3)

(c) Calculate the value of λ.

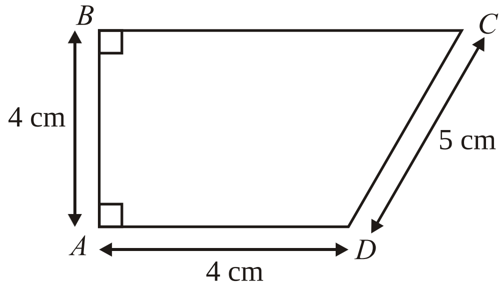
(2)

The combined system is freely suspended from *O* and hangs at rest.

(d) Calculate, in degrees to one decimal place, the angle between *AC* and the vertical.

(3)
(Total 12 marks)

7.



A thin uniform wire, of total length 20 cm, is bent to form a frame. The frame is in the shape of a trapezium *ABCD*, where *AB* = *AD* = 4 cm, *CD* = 5 cm and *AB* is perpendicular to *BC* and *AD*, as shown in the diagram.

(a) Find the distance of the centre of mass of the frame from *AB*.

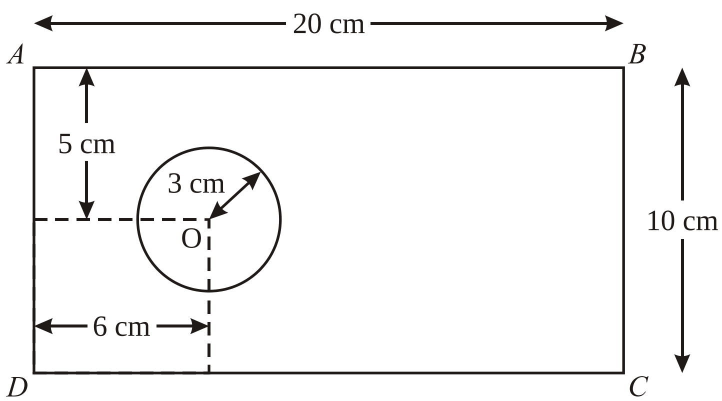
(5)

The frame has mass *M*. A particle of mass *kM* is attached to the frame at *C*. When the frame is freely suspended from the mid-point of *BC*, the frame hangs in equilibrium with *BC* horizontal.

(b) Find the value of *k*.

(3)
(Total 8 marks)

8.



This diagram shows a metal plate that is made by removing a circle of centre O and radius 3 cm from a uniform rectangular lamina $ABCD$, where AB = 20 cm and BC = 10 cm. The point O is 5 cm from both AB and CD and is 6 cm from AD.

(a) Calculate, to 3 significant figures, the distance of the centre of mass of the plate from AD.

(5)

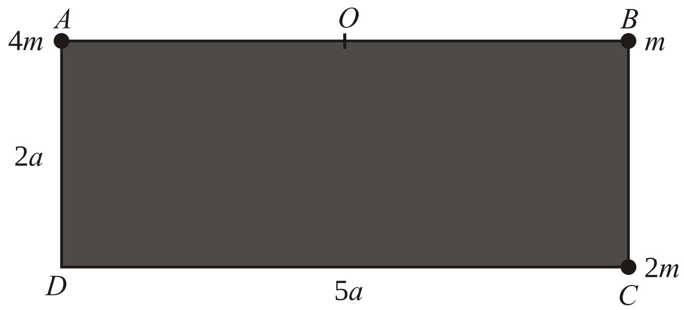
The plate is freely suspended from A and hangs in equilibrium.

(b) Calculate, to the nearest degree, the angle between AB and the vertical.

(3)

(Total 8 marks)

9.



A loaded plate L is modelled as a uniform rectangular lamina $ABCD$ and three particles. The sides CD and AD of the lamina have lengths $5a$ and $2a$ respectively and the mass of the lamina is $3m$. The three particles have mass $4m$, m and $2m$ and are attached at the points A, B and C respectively, as shown in the diagram above.

(a) Show that the distance of the centre of mass of L from AD is $2.25a$.

(3)

(b) Find the distance of the centre of mass of L from AB.

(2)

The point O is the mid-point of AB. The loaded plate L is freely suspended from O and hangs at rest under gravity.

(c) Find, to the nearest degree, the size of the angle that AB makes with the horizontal.

(3)

A horizontal force of magnitude P is applied at C in the direction CD. The loaded plate L remains suspended from O and rests in equilibrium with AB horizontal and C vertically below B.

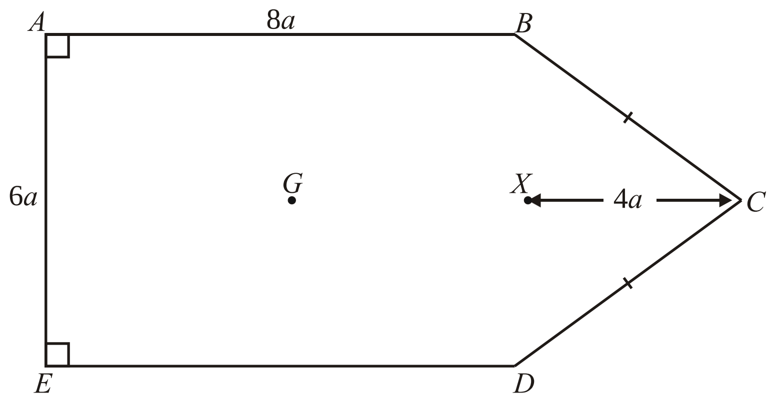
(d) Show that $P = \frac{5}{4}mg$.

(4)

(e) Find the magnitude of the force on L at O.

(4)
(Total 16 marks)

10.



The diagram above shows a uniform lamina *ABCDE* such that *ABDE* is a rectangle, $BC = CD$, $AB = 8a$ and $AE = 6a$. The point *X* is the mid-point of *BD* and $XC = 4a$. The centre of mass of the lamina is at *G*.

(a) Show that $GX = \frac{44}{15}a$.

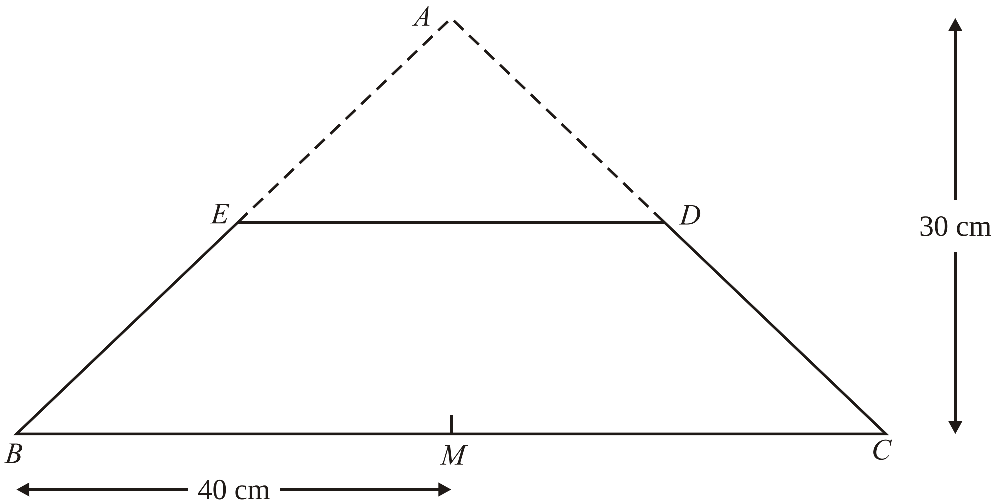
(6)

The mass of the lamina is *M*. A particle of mass λM is attached to the lamina at *C*. The lamina is suspended from *B* and hangs freely under gravity with *AB* horizontal.

(b) Find the value of λ.

(3)
(Total 9 marks)

11.



A uniform plane lamina is in the shape of an isosceles triangle *ABC*, where *AB* = *AC*. The mid-point of *BC* is *M*, *AM* = 30 cm and *BM* = 40 cm. The mid-points of *AC* and *AB* are *D* and *E* respectively. The triangular portion *ADE* is removed leaving a uniform plane lamina *BCDE* as shown in the diagram above.

(a) Show that the centre of mass of the lamina *BCDE* is $6\frac{2}{3}$ cm from *BC*.

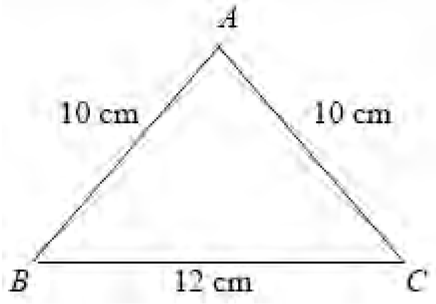
(6)

The lamina *BCDE* is freely suspended from *D* and hangs in equilibrium.

(b) Find, in degrees to one decimal place, the angle which *DE* makes with the vertical.

(3)
(Total 9 marks)

1. (a)



	AB	AC	BC	frame	
mass ratio	10	10	12	32	B1
dist. from BC	4	4	0	$\bar{x}$	B1

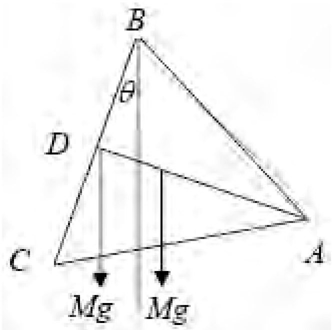
Moments about BC:

$$10 \times 4 + 10 \times 4 + 0 = 32\bar{x}$$ M1 A1

$$\bar{x} = \frac{80}{32}$$

$$\bar{x} = 2\tfrac{1}{2} \quad (2.5)$$ A1 5

(b)



Moments about B:

$$Mg \times 6\sin\theta = Mg \times \left(\bar{x}\cos\theta - 6\sin\theta\right)$$ M1 A1 A1

$$12\sin\theta = \bar{x}\cos\theta$$

$$\tan\theta = \frac{\bar{x}}{12}$$

θ = 11.768..... = 11.8° A1 4

Alternative method :

C of M of loaded frame at distance $\frac{1}{2}\bar{x}$ from D along DA B1

$$\tan\theta = \frac{\frac{1}{2}\bar{x}}{6}$$ M1 A1

θ = 11.768..... = 11.8° A1

[9]

2. (a)

	Rectangle	Semicircles		Template, T	
	$24x$	4.5π	4.5π	$24x + 9\pi$	B2
	x	$\frac{4\times3}{3\pi}$	$\frac{4\times3}{3\pi}$	$\bar{x}$	B2

$24x^2 - 4.5\pi \times \left(\frac{4\times3}{3\pi}\right) - 4.5\pi \times \left(\frac{4\times3}{3\pi}\right) = (24x + 9\pi)\ \bar{x}$ M1 A1

distance = $|\bar{x}| = \frac{4|2x^2-3|}{(8x+3\pi)}$ ** A1 7

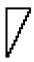
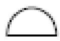
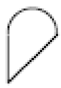
(b) When $x = 2$, $|\bar{x}| = \frac{20}{16+3\pi}$ B1

$\tan\theta = \frac{6}{4-|\bar{x}|} = \frac{6}{4-\frac{20}{16+3\pi}}$ M1 A1

$= \frac{48+9\pi}{22+6\pi}$. A1 4

[11]

3. (a)

				B1
MR	108	18π	$108 + 18\pi$	
x_1 (→) from AD	4	6	$\bar{x}$	B1
y_i (↓) from BD	6	$-\frac{8}{\pi}$	$\bar{y}$	

AD(→): $108(4) + 18\pi\ (6) = (108 + 18\pi)\ \bar{x}$ M1

$\bar{x} = \frac{432+108\pi}{108+18\pi} = 4.68731... = \underline{4.69}\ (\text{cm})\ (3\text{sf})$ **AG** A1 4

(b)

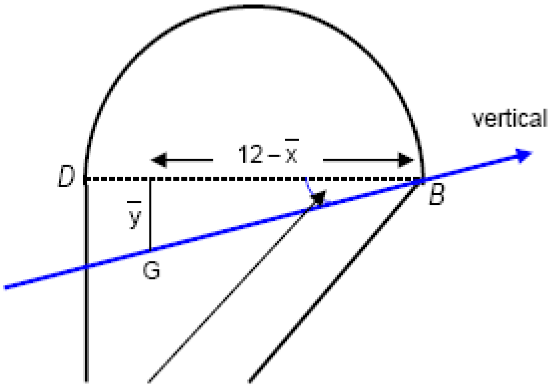
y_i (↓) from BD	6	$-\frac{8}{\pi}$	$\bar{y}$	B1 oe

$BD(\downarrow): 108(6) + 18\pi(-\frac{8}{\pi}) = (108+18\pi)\bar{y}$ M1

A1ft

$\bar{y} = \dfrac{504}{108 + 18\pi} = 3.06292... = 3.06\text{(cm)}\,\text{(3sf)}$ A1 4

(c)



θ = required angle

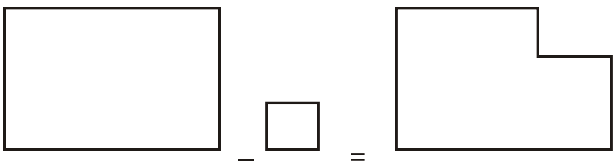
$\tan\theta = \dfrac{\bar{y}}{12 - 4.68731..}$ dM1

$= \dfrac{3.06392..}{12 - 4.68731..}$ A1

θ = 22.72641... = 23 (nearest degree) A1 4

[12]

4.



(a) M(AF) $4a^2.a - a^2.3a/2 = 3a^2.\bar{x}$ M1A2,1,0

$\bar{x} = \underline{5a/6}$ A1 4

(b) Symmetry $\Rightarrow$ $\bar{y}$ = 5a/6, or work from the top to get 7a/6 B1ft

$\tan q = \dfrac{5a/6}{2a - 5a/6}$ $\left(\dfrac{\bar{x}}{2a - \bar{y}}\right)$ M1A1ft

$q \approx \underline{35.5°}$ A1 4

M1 Taking moments about AF or a parallel axis, with mass proportional to area. Could be using a difference of two square pieces, as above, but will often use the sum of a rectangle and a square to make the L shape. Need correct number of terms but condone sign errors for M1.

A1 A1 all correct

A1 A0 At most one error

A1 5a/6, (accept 0.83a or better)

Condone consistent lack of a's for the first three marks.

NB: Treating is as rods rather than as a lamina is M0

B1ft $\bar{x} = \bar{y}$ = their 5a/6, or $\bar{y}$ = distance from AB = 2a – their 5a/6. Could be implied by the working. Can be awarded for a clear statement of value in (a).

M1 Correct triangle identified and use of tan $\frac{2a - 5a/6}{5a/6}$ is OK for M1.

Several candidates appear to be getting 45° without identifying a correct angle. This is M0 unless it clearly follows correctly from a previous error.

A1ft Tanα expression correct for their 5a/6 and their $\bar{y}$

A1 35.5 (Q asks for 1 d.p.)

NB: Must suspend from point A. Any other point is not a misread.

[8]

5. (a) Total mass = 12m (used) M1

(i) M(AB): $m.3a/2 + m.3a/2 + m.3a + 6m.3a + 2m.3a = 12m.x$ indep M1 A1

$\Rightarrow x = \frac{5}{2}a$ A1

(ii) M(AD): $m.a + m.a + m.2a + 6m.2a = 12m.y$ indep M1 A1

$y = \frac{4}{3}a$ A1 7

(b) $\tan\alpha = \frac{2a - 4a/3}{5a/2}$ M1 A1 f.t

$\Rightarrow \alpha \approx 14.9°$ A1cao 3

[10]

6. (a) $12m\bar{x} = 6m \times 9$ M1

$\bar{x} = 4\frac{1}{2}$ A1

$12m\bar{y} = 16m - 8m$ M1

$\bar{y} = \frac{2}{3}$ A1 4

(b) $(12 + k)\,m \times 4 = 12m \times\ 4\tfrac{1}{2}\ + km \times 3$ ft their $\bar{x}$ M1 A1ft

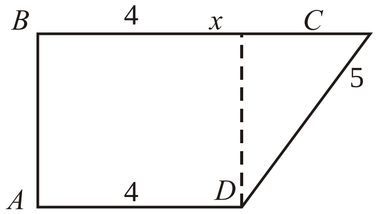
$k = 6$ A1 3

(c) $18m \times \lambda = 12m \times\ \tfrac{2}{3}$, $\Rightarrow$ $\lambda = \tfrac{4}{9}$ M1A1 2

(d) $\tan\theta = \dfrac{4}{4/9}$, $\Rightarrow$ $\theta \approx 83.7°$ ft their λ , cao M1 A1ft A1 3

[12]

7. (a)

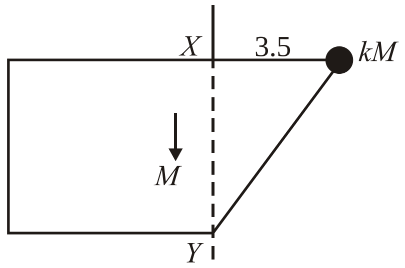


(x = 3)

M(*AB*): $7 \times 3.5 + 5 \times 5.5 + 4 \times 2 = 20 \times\ \bar{x}$ M1 A2,1,0

$\Rightarrow 20\bar{x}\ = 24.5 + 27.5 + 8 = 60 \Rightarrow\ \bar{x}\ = 3$ cm dep M1A1 5

(b)



M(*XY*):

$M \times (3.5 - 3) = kM \times 3.5$ M1 A1ft

$\Rightarrow k = \dfrac{1}{7}$. A1 3

[8]

8. (a)

	circle	rectangle	plate	
Mass ratios	9π	200;	$200 - 9\pi$	B1; B1ft
Centres of mass	6	10	$\bar{x}$	B1

$9\pi \times 6 + (200 \times 9\pi)\bar{x} = 200 \times 10$ M1

$\bar{x} \approx 10.7$ (cm) A1 5

cao

(b) $\tan\theta = \frac{5}{10.7}$ M1 A1ft

ft their $\bar{x}$

$\theta \approx 25°$ A1 3

[8]

cao

9. (a) AD: $10m\bar{x} = 3m\frac{5a}{2} + 3m \times 5a$ M1 A1

$\bar{x} = 2.25a$ * A1 3

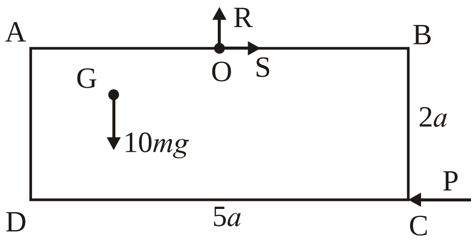
(b) AB: $10m\bar{y} = 2m \times 2a + 3m \times a$ M1

$\bar{y} = 0.7a$ A1 2

(c) $\tan\theta = \frac{2.5a - \bar{x}}{\bar{y}}$ M1 A1 f.t.

$\theta = 20°$ (nearest degree) A1 3

(d)



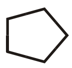
M(0), $10mg \times \dfrac{a}{4} = P \times 2a$	M1 A1 A1
(**OR**: $4mg \times \dfrac{5a}{2} - 3\,mg \times \dfrac{5a}{2} = \mathrm{P} \times 2a$)	
$P = \dfrac{5mg}{4}$ * (exact)	A1 4

(e)

$S = \dfrac{5mg}{4}$; $R = 10mg$	B1; B1
$F = \sqrt{S^2 + R^2} = \dfrac{5mg\sqrt{65}}{4}$ (10.1 mg)	M1 A1 4

[16]

10. (a)

				
MR	$48a^2$	$12a^2$	$60a^2$	B1, B1 ft
CM	$4a$	$(-)\dfrac{1}{3} \times 4a$	$\bar{x}$	B1

$48a^2 \times 4a - 12a^2 \times \dfrac{4}{3}a = 60\bar{x}$	M1 A1
Solving to $\bar{x} = \dfrac{44}{15}a$ (*)	A1 6

(b)

$\lambda M \times 4a = M \times \dfrac{44}{15}a$	M1 A1
$\lambda = \dfrac{11}{15}$	A1 3

[9]

11. (a)

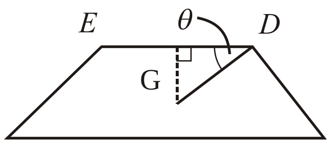
	ABC	*ADE*	*BCDE*
Relative mass	4	1	3
Distance of centre of mass from *BC*	10	20	$\bar{y}$

(–1 each error or omission) B3

$(4 \times 10) - (1 \times 20) = 3\bar{y}$ M1 A1

$6\frac{2}{3} = \dfrac{20}{3} = \bar{y}$ (T) A1 6

(b) $\tan\theta = \dfrac{15 - \bar{y}}{20}$ M1



$= \dfrac{15 - \frac{20}{3}}{20} = \dfrac{5}{12}$ A1

$\theta = 22.6°$ (1 d.p.) A1 3

[9]

1. Some candidates struggled with this question. Despite the question being explained clearly with reference to rods it was not uncommon to see the triangle treated as a lamina. Another common error was to treat the rods as being of equal mass.

The geometry of the symmetrical triangular figure was appreciated by nearly all candidates with the height of the triangle correctly calculated as 8 cm, although it was disappointing to find several candidates not recognising the 3-4-5 triangle and engaging in more work than expected to find the height of the triangle.

For part (a) those candidates who answered the question as set and worked with three rods had little difficulty in producing a relevant moments equation and arriving at the correct result. However it was disappointing to find a significant number of candidates treating the triangle as a lamina, and they were happy simply to write down the answer as $\frac{8}{3}$ cm.

For part (b) most candidates could either write down or calculate the distance of the new centre of mass from *BC* and proceed to find the required angle. 3 out of 4 marks were available for those who had treated the shape as a lamina. A number of candidates ignored the extra particle added to the framework and answered their own question. Very few students used the method of taking moments about *B* to find the angle.

2. (a) The method was understood by most candidates and there was no problem in forming a moments equation for the centre of mass. Common errors included simplifying $\frac{4\times 3}{3\pi}$ to 4π rather than $\frac{4}{\pi}$, using the area of a circle rather than a semicircle, and the use of 6 for the radius of the semicircle. From a correct table, accuracy marks were often lost in the moments equation because of a sign error. In general, those candidates who set out the masses and distances in a table tended to make fewer errors.
Many candidates made it more difficult to obtain the given answer by taking their measurements from *PQ* and attempting to subtract their result from $2x$, although this was often successfully completed. One advantage of this approach was that they were less likely to make a sign error in their moments equation.
Candidates very rarely justified the modulus sign at all, with most candidates simply writing the final answer after their last line of working. Students who had a negative coefficient for the x^2 term in the numerator were more likely to deal with this.

(b) The fact that the answer was given did guide some candidates to the correct result, indicating that they clearly appreciated the 'show that' nature of the question. Most candidates substituted $x = 2$ correctly into the given result and went on to find the tangent of an angle. Many candidates did identify the correct triangle although some went to great lengths to find the distance of the centre of mass from *SP* as an expression in x, not realising that it could be found by symmetry. Furthermore, they often did not then realise that their expression cancelled to 6.
Many of those who made progress with this part found the angle to the vertical, with quite a few unconvincingly converting to the given result or simply leaving it as the reciprocal.

3. The majority of candidates applied the correct mechanical principles to solve this problem. Most were able to find the relative masses and the centres of mass of the semi-circle and the triangle and obtain a correct moments equation. Many candidates did not show sufficient working to demonstrate that their equation led to the given result in part (a).

In part (b) the most common error was to fail to realise that the two centres of mass were on opposite sides of the line *BD* and they hence had a sign error in their expression. Those who decided to take moments about a line through *A*, perpendicular to *AD* avoided this problem.

Candidates were generally able to use the given result to find the centre of mass of the semicircle, although it was quite common to see it written incorrectly as 8π.

A clear diagram tended to lead candidates to identify the correct angle in part (c) and the correct ethod for finding it.

4. In part (a) the first stage of this question requires the candidate to divide the given lamina into appropriate sections. There are several options, large square minus small square, three small squares, a rectangle plus a square, or even dividing the shape into three right angled triangles. Most errors in finding the distance of the centre of mass from *AF* were due to sign errors in setting up the moments equation, errors in finding the distance from *AF* of centres of mass of the constituent parts, or equations which were dimensionally incorrect (usually missing *a*'s). Some candidates saw the object as a collection of connected rods despite its being described as a lamina formed from a sheet of card.

Part (b) Although some candidates used the symmetry of the figure to determine the distance of the centre of mass from *FE* (or *AX*), many repeated the working from part (a). Some candidates did not appear to realise that they needed to find the distance of the centre of mass from one of the horizontal lines, or they simply assumed that it was *a.* Many candidates did not draw diagrams, making it difficult to determine exactly what they were trying to do. A few diagrams suggested that candidates did not understand what would happen if the lamina were suspended from *A*. It was expected that candidates would use the right angled triangle with $\frac{5}{6}a$ and $\frac{7}{6}a$, but it is possible to find the distances of the centre of mass from *A* and *F* and use the cosine rule, as some candidates attempted to demonstrate.

5. This question was well answered by many candidates and the method in part (a) was well known. Some, however, used "*m*" as mass per unit length for the framework, or counted the masses of the particles more than once in an attempt to consider each rod separately. Common sense often failed to prevail, with the mass of the whole system sometimes appearing as different values in the two equations. Most were able to attempt part (b), but many failed to use $(2a - y)$ in their ratio. The very few who decided to use sine instead of tangent were usually successful.

6. In part (a) many saw intuitively that $\bar{x} = 4.5$ because of the distribution of the masses. Some made life more difficult by taking moments about different axes – especially to find the *y*-coordinate. Many completed the second part easily, but weaker candidates tried to find the area of the triangle and somehow got the required answer by devious means thereafter. A worrying number thought that 6×9 was 36. A small minority failed to complete this part through not knowing the position of the centre of mass of a triangular lamina . Part (c) was usually completely correct or else they had absolutely no idea. In the final part there were the usual problems of identifying the angle correctly with some attempting to find sine or cosine, using Pythagoras or the cosine rule.

7. Many treated the framework as a lamina and lost several marks in the first part, although most knew the correct method. Of those who correctly treated the problem as a framework, a few tried to use three sides of a square and two sides of a triangle and made errors locating the appropriate centres of mass. Many candidates wasted time finding the distance of the centre of mass from BC. In part (b) there were some good solutions but many were unable to deal correctly with the introduction of M into the question.

8. This question was also well done. A few added the masses of the circle and rectangle, rather than subtract them, and a few errors of sign in the moments equation were seen. Some candidates ignored the obvious symmetry of the diagram and took moments to find the distance of the centre of mass from *AB* and this, besides being unnecessary work, caused further difficulties if the distance found was incorrect. When an accuracy is specified in a question, the candidate is expected to give their answer to that accuracy to gain full marks.

9. Many candidates found the paper too long and relatively few attempts at this question went beyond part (c) and the majority of candidates scored less than half marks. The method for (a) and (b) was well known and there were many correct solutions. The principal error was failure to include the mass of the lamina, producing equations which were missing a term, and divisions by $7m$ instead of $10m$. Some candidates tried to include the lamina by using its area $10a^2$ instead of its given mass. Marks were often lost unnecessarily in part (c) by candidates, who knew exactly what to do, doing it carelessly.

The required angle was found probably less frequently than its complement and those who found the correct answer often failed to round it to the nearest degree. Huge numbers of candidates lost easy marks by not making it clear that they knew the basic method. Re-drawing the diagram to show the centre of mass below the point of suspension is a far less popular option than it used to be. It is therefore essential that candidates indicate that the line they draw through *G* represents the vertical.

It is difficult to know the extent to which (d) and (e) were omitted due to difficulties rather than lack of time but good attempts were rare. Of those who tried (d) a significant proportion were attempting to answer a different question about attaching an extra particle at *C*. Some of those who attempted moments took them about points other than *O* but failed to realise that the unknown force at *O* would contribute.

Far too many attempted to arrive at the printed answer of $1.25mg$ by number juggling, concocting any old equation which looked half-way convincing. The same was true to a lesser extent in part (a). It is sad to see candidates losing marks they possibly deserve by inventing extra terms to produce the right numerical answer and so turning what may have been a minor numerical slip into a wrong method.

Part (e) was rarely attempted and even more rarely correctly. A common misconception was that the force at *C* was vertical and this led to some worthless moments attempts about *C*. Some candidates correctly combined the known $10mg$ and $1.25mg$ forces without any reference to the point of suspension, and others simply added up everything which had been mentioned so far.

10. Part (a) was done very well although some lost unnecessary marks by the partial omission of a from their solution or from the use of approximate decimals on the way to the required exact answer. One error commonly seen was to find the distance of the centre of mass of the triangle from AE as $10\frac{2}{3}a$. Part (b) proved more difficult. Many were unclear how they should be using the given masses, attempting, often unsuccessfully, to write an equation involving both masses and areas. The simplest correct solution is to take moments about the X, obtaining the equation $\lambda M \times 4a = M \times \frac{44}{15}a$, which leads quickly to the answer. This part proved effective in distinguishing candidates who gained high grades.

11. No Report available for this question.