Lesson 12

A-Level Pure Mathematics, Year 1
Additional Mathematics
Coordinate Geometry

12.1 Revision

Any solution based entirely on graphical or numerical methods is not acceptable

Marks Available : 65

Question 1

The equation of a circle is;

$$(x + 7)^2 + (y - 3)^2 = 81$$

State the coordinates of the circle's centre, and its radius

[2 marks]

Question 2

Write down the equation of the circle with centre (5, 12) and which passes through the origin.

[2 marks]

Question 3

By completing the square, or otherwise, determine the centre and radius of the following circle;

$$x^2 + y^2 + 10x - 6y + 18 = 0$$

[5 marks]

Question 4
Differentiate
(i)

$$y = 7x^{11} - 5x^3$$

[2 marks]

(ii)

$$y = 24x^{0.25}$$

[2 marks]

(iii)

$$y = \frac{4}{5}x^{-5}$$

[2 marks]

Question 5
The equation of the curve, plotted on the next page, is

$$y = \frac{x^3}{24} - x$$

(i) Write down the gradient equation, $\frac{dy}{dx}$, for the curve

[2 marks]

(ii) Use your part (i) answer to find the value of the gradient on the curve when $x = 6$

[1 mark]

(iii) Use your part (ii) answer to determine the equation of the tangent to the curve at the point (6, 3)

[2 marks]

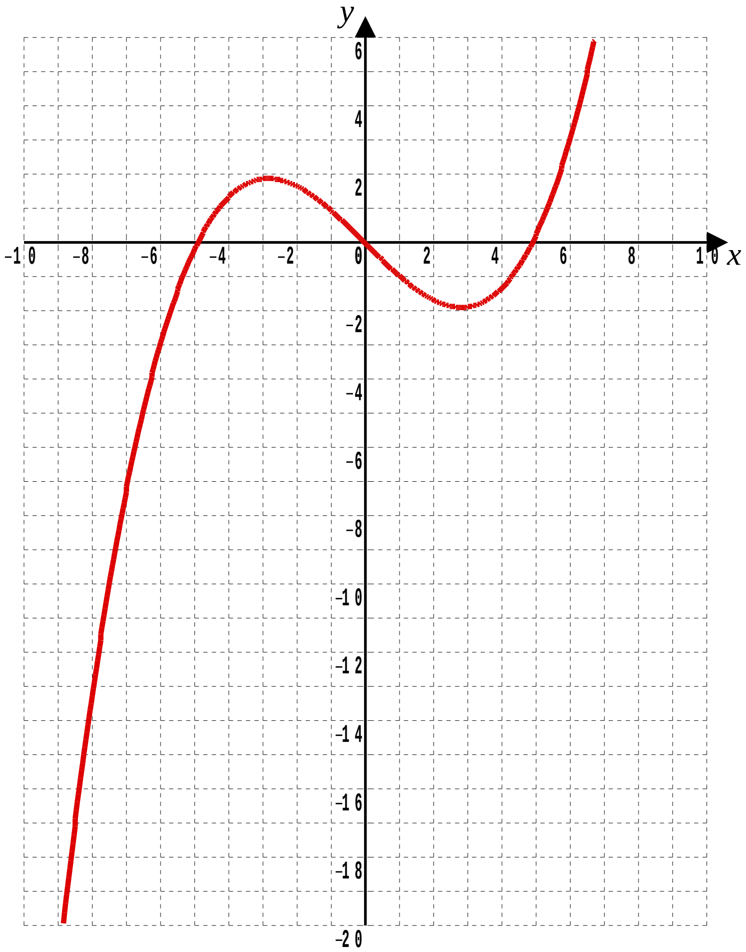
(iv) Use your part (ii) answer to determine the gradient of the normal to the curve at the point (6, 3)

[1 mark]

(v) Find the equation of the normal to the curve at the point (6, 3)

[2 marks]

(vi) On the graph, add your part (iii) tangent, and your part (v) normal, clearly indicating which is which and making sure they both pass through the point (6, 3)



[2 marks]

Question 6

$$(x + 1)^2 + y^2 = 9^2$$

Is the point (5, 7) inside, outside, or on the circumference of this circle ?
Justify your answer.

[3 marks]

Question 7

Find the point(s) of intersection, if any, of the circle

$$(x - 3)^2 + (y + 2)^2 = 13$$

and the line

$$y = 3x - 2$$

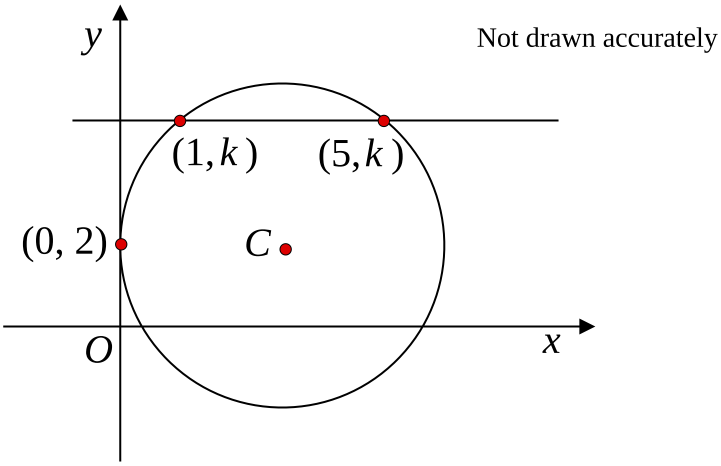
[6 marks]

Question 8

Further Mathematics Specimen Examination Question 2020, Paper 1, Q11 (AQA)

A circle, centre C, touches the y-axis at the point (0, 2)

The line $y = k$ intersects the circle at the points (1, k) and (5, k)



Work out the equation of the circle

[3 marks]

Question 9

Find the coordinates of the point on the curve $y = (4x - 5)^2$ such that the gradient of the normal to the curve is $\frac{1}{8}$

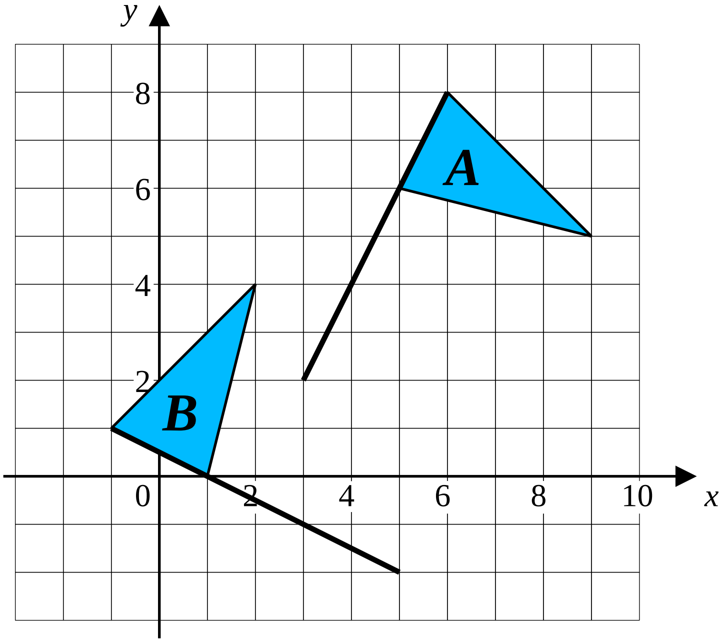
[4 marks]

Question 10

The diagram shows a flag *A*

The image of flag *A* when it is rotated by 90° is flag *B*

This question walks you through the steps involved in mathematically finding the centre of the rotation.



(i) **Step 1** :

Pick two matching points, say the foot of each flag pole, (3, 2) and (5, – 2)

Step 2 :

Find the midpoint of these two points.

[1 mark]

(ii) **Step 3** :

Find the gradient of the straight line between these two points.

[1 mark]

(iii) **Step 4** :

Use the answers to Steps 2 and 3 to determine the equation of the perpendicular bisector of the two points.

[2 marks]

(iv) **Step 5** :

Pick two other matching points, say the tip of the flag, (9, 5) and (2, 4)

Step 6 :

Find the equation of the perpendicular bisector between these two points.

[4 marks]

(v) **Step 7** :

Find the point of intersection of the two perpendicular bisectors.

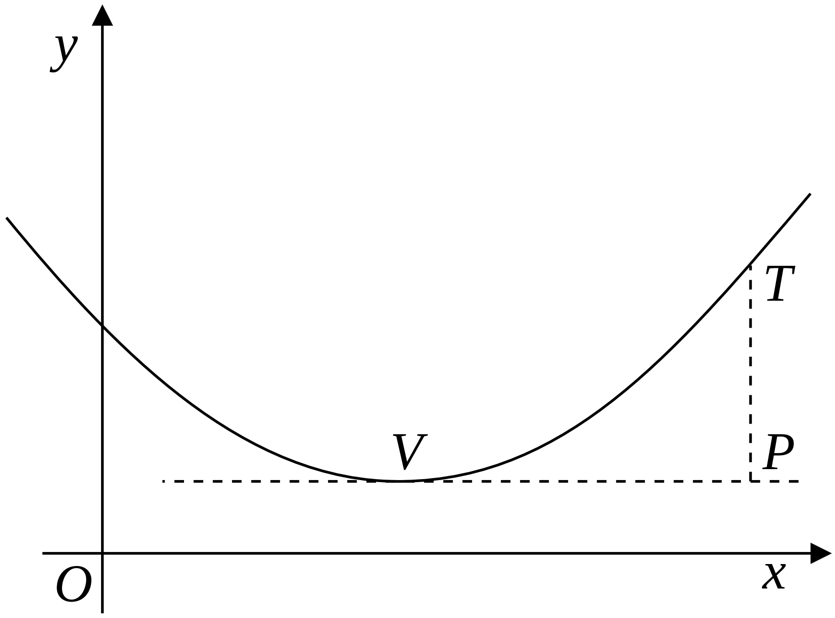
This is the centre of the rotation.

[4 marks]

Check your mathematics is correct by using tracing paper, and verifying that when rotated by 90° about the point you claimed was the answer, flag *A* does indeed map onto flag *B*

Question 11

Additional Mathematics Examination Question from June 2006, Q14 (OCR)



The diagram shows the quadratic curve

$$y = x^2 - 4x + 5$$

V (2, 1) is the minimum point of the curve.

T (5, 10) is a point on the curve.

The line VP is the tangent to the curve at V and TP is perpendicular to this line.

(i) Write down the coordinates of P

[1 mark]

(ii) Find the coordinates of M, the midpoint of VP

[2 marks]

(iii) Find the equation of the tangent of the curve at T

[4 marks]

(iv) Show that the tangent to the curve at *T* passes through the point *M*

[2 marks]

(v) Use the result in part (iv) to suggest a way of drawing a tangent to a point on a quadratic curve without involving calculus.

[3 marks]