OCR Level 3 FSMQ: Additional Mathematics (6993)
Coordinate Geometry (CG1-CG5) - Past Paper Questions Grouped by Topic

Covers June 2015-2019, 2022, 2023, 2024. Sourced from official OCR question papers and mark schemes (ocr.org.uk).

Questions

CG1-CG2 - Distance between two points and the mid-point of a line segment

1. The coordinates of A and B are (1, 5) and (-3, 7) respectively.
(i) Calculate the exact length of AB. [2]
(ii) Find the coordinates of the midpoint of AB. [1]
Source: June 2017, Q4

CG3 - The coordinate geometry of circles

2. The equation of the circle C is $x^2 + y^2 - 8x + 2y - 19 = 0$.
(i) Express the equation of C in the form $(x - a)^2 + (y - b)^2 = r^2$. [4]
(ii) Hence, or otherwise, use an algebraic method to decide whether the point (8, 3) lies inside, outside or on the circumference of the circle. Show all your working. [2]
Source: June 2015, Q9

3. (i) Find the equation of the circle which has its centre at the origin and passes through the point (1, 7). [2]
(ii) Find the coordinates of the two points where the line $2x + y = 15$ cuts this circle. [4]
Source: June 2017, Q5

4. You are given that the line $y = 2x + k$ cuts the circle $x^2 + y^2 = 5$ in two points, A and B.
(a) Show that the x-coordinates of A and B satisfy the equation $5x^2 + 4kx + (k^2 - 5) = 0$. [2]
(b) Hence find the values of k for which the line is a tangent to the circle. [2]
Source: June 2019, Q10

5. A circle has centre (0, 3) and radius 3.
(i) Show that the equation of the circle is $x^2 + y^2 - ky = 0$ where k is to be determined. [2]
The line $y = mx - 2$ passes through the point P(0, -2) and is a tangent to the circle.
(ii) Find the two possible values of m. [6]
The two tangents from P meet the circle at the points A and B respectively.
(iii) Find the lengths PA and PB. [4]
Source: June 2018, Q11

6. The point A(1, 3) lies on a circle with centre (4, 5).
(a) Determine the equation of the circle. [2]
B is a point on the circle such that AB is a diameter of the circle.
(b) Find the coordinates of B. [2]
D is the point (2, 8).
(c) Show that AD and DB are perpendicular. [3]
(d) Explain what this tells you about the point D. [1]

Source: June 2023, Q12

CG4 - Sketching and plotting graphs

7. The graph of $y = x^2 + 2x - 3$ is given on the grid in the Printed Answer Book.
(i) Write down the solution to the equation $x^2 + 2x - 3 = 0$. [1]
(ii) By plotting the appropriate straight line on the grid, find the solution to the equation $x^2 - x - 6 = 0$. [3]
Source: June 2018, Q3

8. (a) On the grid, plot the graphs of $y = x^2 - 4x + 1$ and $y = 2^x - 2$. [4]
(b) Hence write down the root of the equation $2^x = x^2 - 4x + 3$, giving your answer correct to 1 decimal place. [1]
Source: June 2024, Q6

CG5 - Gradient, intercept, and straight-line problems

9. Find the equation of the line which is perpendicular to the line with equation $2x + 3y = 5$ and which passes through the point (3, 4). [3]
Source: June 2015, Q1

10. Find the equation of the line which is perpendicular to the line with equation $2x + 3y = 4$ and which passes through the point (3, -1). [4]
Source: June 2017, Q2

11. The point A has the coordinate (3, 7) and the point B has the coordinate (7, 1).
Find the equation of the perpendicular bisector of AB. [5]
Source: June 2023, Q9

12. The line L1 has equation $3x - y = 1$ and the point P has coordinates (8, 3).
(i) Find the equation of the line L2 which passes through P and is perpendicular to line L1. [3]
(ii) Find the coordinates of the point Q where L1 and L2 intersect. [3]
(iii) Find the length PQ. [2]
(iv) Write down the equation of the circle that has centre P and line L1 as a tangent. [1]
(v) Find the equation of the other line that is a tangent to the circle and is parallel to line L1. [3]
Source: June 2016, Q12

13. The points A and B have coordinates (3, 3) and (5, 7) respectively.
(a) On the grid below plot
(i) the points A and B, [1]
(ii) the line l with equation $x + 2y = 14$. [2]
(b) Verify that the line l is the perpendicular bisector of AB. [4]
AB is a diameter of the circle C.
(c) Find the equation of the circle C. [2]
The line l cuts the circle C in two points, P and Q.
(d) Determine the coordinates of P and Q. [3]
Source: June 2022, Q15

Answers

CG1-CG2

1. (i) AB = $\sqrt{[(1-(-3))^2+(5-7)^2]} = \sqrt{20} = 2\sqrt{5}$. (ii) Midpoint = $((1-3)/2, (5+7)/2) = (-1, 6)$ *-- mark scheme (June 2017)*

CG3

2. (i) Completing the square: $(x-4)^2 + (y+1)^2 = 36$ (centre (4,-1), radius 6). (ii) Distance^2 from centre to (8,3) = $(8-4)^2+(3+1)^2 = 32$, which is less than 36, so the point lies inside the circle *-- mark scheme (June 2015)*
3. (i) $x^2+y^2=50$. (ii) Substituting $y=15-2x$ gives $5x^2-60x+175=0 \Rightarrow x^2-12x+35=0 \Rightarrow (x-5)(x-7)=0 \Rightarrow$ points (5,5) and (7,1) *-- mark scheme (June 2017)*
4. (a) Substituting $y=2x+k$ into $x^2+y^2=5$ and simplifying gives the printed 3-term quadratic. (b) Tangency requires the discriminant to be zero: $(4k)^2-4(5)(k^2-5)=0 \Rightarrow -4k^2+100=0 \Rightarrow k = \pm 5$ *-- mark scheme (June 2019)*
5. (i) $(x-0)^2+(y-3)^2=9$ expands to $x^2+y^2-6y=0$, so $k=6$. (ii) Substituting $y=mx-2$ gives $(1+m^2)x^2-10mx+16=0$; tangency requires $(10m)^2-4(1+m^2)(16)=0 \Rightarrow 36m^2=64 \Rightarrow m = \pm 4/3$. (iii) In right-angled triangle PCA: PC=5, CA=3 (radius), so by Pythagoras PA=PB=$\sqrt{(25-9)}=4$ *-- mark scheme (June 2018)*
6. (a) $r^2=(1-4)^2+(3-5)^2=13$, so $(x-4)^2+(y-5)^2=13$. (b) B is diametrically opposite A through the centre: B=(2×4-1, 2×5-3)=(7,7). (c) Gradient AD = (8-3)/(2-1)=5; gradient DB=(7-8)/(7-2)=-1/5; product = -1, so AD and DB are perpendicular. (d) Since the angle ADB is 90° and AB is a diameter, this confirms (by the converse of the angle-in-a-semicircle theorem) that D lies on the circumference of the circle *-- mark scheme (June 2023)*

CG4

7. (i) $x = -3$ or $x = 1$ (the roots of $x^2+2x-3=0$). (ii) The line $y=3x+3$, plotted alongside the curve, meets it at $x=3$ (giving point (3,12)) and $x=-2$ (giving point (-2,-3)), which are the two roots of $x^2-x-6=0$ *-- mark scheme (June 2018)*
8. (a) The quadratic $y=x^2-4x+1$ and the exponential $y=2^x-2$ are plotted on the same grid. (b) The two curves intersect (equivalently, $2^x=x^2-4x+3$) at $x \approx 0.4$ or $x \approx 0.5$ *-- mark scheme (June 2024); see flag above*

CG5

9. Gradient of $2x+3y=5$ is -2/3, so the perpendicular gradient is 3/2. Line through (3,4): $y-4=(3/2)(x-3) \Rightarrow 3x-2y=1$ *-- mark scheme (June 2015)*
10. Gradient of $2x+3y=4$ is -2/3, so the perpendicular gradient is 3/2. Line through (3,-1): $y+1=(3/2)(x-3) \Rightarrow 3x-2y=11$ *-- mark scheme (June 2017)*
11. Midpoint of AB = (5,4). Gradient AB = (1-7)/(7-3) = -3/2, so the perpendicular gradient is 2/3. Line through (5,4): $y-4=(2/3)(x-5) \Rightarrow 3y=2x+2$ *-- mark scheme (June 2023)*
12. (i) Gradient of L1 is 3, so L2 has gradient -1/3; through P(8,3): $x+3y=17$. (ii) Solving $3x-y=1$ and $x+3y=17$ simultaneously gives Q=(2,5). (iii) PQ = $\sqrt{[(8-2)^2+(3-5)^2]} = \sqrt{40} = 2\sqrt{10}$. (iv) $(x-8)^2+(y-3)^2=40$. (v) The other tangent parallel to L1 (form $3x-y=c$) at the same perpendicular distance from P gives $c=41$: $3x-y=41$ *-- mark scheme (June 2016)*
13. (b) Midpoint of AB = (4,5), which lies on l (4+2×5=14 ✓. Gradient AB = (7-3)/(5-3)=2; gradient of l is -1/2; product = -1, confirming perpendicularity. (c) Centre (4,5), $r^2=(5-4)^2+(7-5)^2=5$, so $(x-4)^2+(y-5)^2=5$. (d) Substituting $x=14-2y$ into the circle's equation gives $y^2-10y+24=0 \Rightarrow (y-4)(y-6)=0$, so

P=(6,4) and Q=(2,6) -- *mark scheme (June 2022)*