HIGHER

8.9 Perpendicular Lines and the equation of a tangent: 1-hour Pack

Total Marks

EDEXCEL 1MA1 · Calculator allowed · about 60 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 A(2, 5) and B(6, -3) are two points on a coordinate grid.
Show that the line through A and B is perpendicular to the line with equation $y = (1/2)x + 4$

(Total for Question 1 is 3 marks)

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2 Line L has equation $3x + y = 7$
Find the equation of the line that is perpendicular to L and passes through the point (-3, 2). Give your answer in the form $x + by = c$, where b and c are integers.

(Total for Question 2 is 4 marks)

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3 A circle has centre C(2, 3) and radius 5, so it has equation $(x - 2)^2 + (y - 3)^2 = 25$
P is the point (5, 7).

(a) Show that P lies on the circle. **(2)**

(b) Find the equation of the tangent to the circle at P. Give your answer in the form $ax + by = c$, where a, b and c are integers. **(4)**

(Total for Question 3 is 6 marks)

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4 A circle has centre C(-1, 2) and radius $\sqrt{20}$, so it has equation $(x + 1)^2 + (y - 2)^2 = 20$
P is the point (3, 4).

(a) Show that P lies on the circle. **(2)**

(b) Find the equation of the tangent to the circle at P. Give your answer in the form $y = mx + c$ **(4)**

(Total for Question 4 is 6 marks)

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5 A straight line has equation $2x + 4y = 0$. Find an equation of the straight line that is perpendicular to this line and passes through the point (0, -2).

(Total for Question 5 is 4 marks)

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6 A is the point (1, 8) and B is the point (-1, -8). Find an equation of the perpendicular bisector of AB.

(Total for Question 6 is 5 marks)

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7 A straight line L has equation $y = 5x + 2$. Find an equation of the straight line that is perpendicular to L and passes through the point (-6, -6).

(Total for Question 7 is 3 marks)

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8 The circle with equation $(x - 1)^2 + (y + 4)^2 = 100$ passes through the point P(7, 4). Find an equation of the tangent to the circle at P.

(Total for Question 8 is 5 marks)

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9 A straight line has equation $2x - 4y = -6$. Find an equation of the straight line that is perpendicular to this line and passes through the point (-4, 2).

(Total for Question 9 is 4 marks)

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10 A circle with centre O, the origin, has equation $x^2 + y^2 = 169$
P is a point on the circle in the fourth quadrant (so the x-coordinate of P is positive and the y-coordinate of P is negative). The x-coordinate of P is 5.

(a) Find the y-coordinate of P. **(2)**

(b) Find the equation of the tangent to the circle at P. Give your answer in the form $ax + by = c$, where a, b and c are integers. **(4)**

(Total for Question 10 is 6 marks)

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Mark scheme · 8.9 Perpendicular Lines and the equation of a tangent: 1-hour Pack

Question 1

correct gradient of AB, e.g. (-3 - 5)/(6 - 2) = -2 (oe)	**M1**
multiplies gradient of AB by 1/2 (the gradient of the given line)	**M1**
correct conclusion with full reasoning: (-2) x (1/2) = -1, so the lines are perpendicular (cso)	**C1**

Answer: Perpendicular, since gradient AB x gradient of given line = -1

Question 2

rearranges L into the form y = mx + c and identifies its gradient as -3	**M1**
finds the perpendicular gradient as 1/3	**M1**
correct method using the point (-3, 2), e.g. y - 2 = (1/3)(x + 3)	**M1**
x - 3y + 9 = 0 (oe, e.g. x - 3y = -9) (cao)	**A1**

Answer: x - 3y = -9

Question 3

(a) substitutes x = 5 and y = 7 into $(x - 2)^2 + (y - 3)^2$	**M1**
(a) $(5 - 2)^2 + (7 - 3)^2 = 9 + 16 = 25$, which matches the circle equation (cso)	**A1**

(a) Answer: $3^2 + 4^2 = 25$ (shown)

(b) gradient of CP = (7 - 3)/(5 - 2) = 4/3 (oe)	**M1**
(b) tangent gradient = -3/4 (negative reciprocal of 4/3)	**M1**
(b) correct method using point P, e.g. y - 7 = -(3/4)(x - 5)	**M1**
(b) 3x + 4y = 43 (oe, integer coefficients) (cao)	**A1**

(b) Answer: 3x + 4y = 43

Question 4

(a) substitutes x = 3 and y = 4 into $(x + 1)^2 + (y - 2)^2$	**M1**
(a) $(3 + 1)^2 + (4 - 2)^2 = 16 + 4 = 20$, which matches the circle equation (cso)	**A1**

(a) Answer: $4^2 + 2^2 = 20$ (shown)

(b) gradient of CP = (4 - 2)/(3 - (-1)) = 1/2 (oe)	**M1**
(b) tangent gradient = -2 (negative reciprocal of 1/2)	**M1**
(b) correct method using point P, e.g. y - 4 = -2(x - 3)	**M1**
(b) y = -2x + 10 (cao)	**A1**

(b) Answer: y = -2x + 10

Question 5

rearranges to find the gradient -1/2	**M1**
perpendicular gradient 2	**M1**
substitutes the point	**M1**
y = 2x - 2 oe	**A1**

Answer: y = 2x - 2

Question 6

midpoint (0, 0)	**M1**
gradient of AB = 8	**M1**
perpendicular gradient -1/8	**M1**
substitutes the midpoint into y = mx + c	**M1**
y = -(1/8)x oe	**A1**

Answer: y = -(1/8)x

Question 7

gradient of the perpendicular = -1/(5) = -1/5	**M1**
substitutes (-6, -6) to find the intercept	**M1**
y = -(1/5)x - 36/5 oe	**A1**

Answer: y = -(1/5)x - 36/5

Question 8

centre (1, -4) identified	**M1**
gradient of the radius = 4/3	**M1**
gradient of the tangent = -3/4	**M1**
substitutes (7, 4)	**M1**
y = -(3/4)x + 37/4 oe	**A1**

Answer: y = -(3/4)x + 37/4

Question 9

rearranges to find the gradient 1/2	**M1**
perpendicular gradient -2	**M1**
substitutes the point	**M1**
y = -2x - 6 oe	**A1**

Answer: y = -2x - 6

Question 10

(a) substitutes x = 5 into $x^2 + y^2 = 169$ to get $25 + y^2 = 169$, so $y^2 = 144$	**M1**
(a) y = -12, selecting the negative root as P is in the fourth quadrant (cao)	**A1**

(a) Answer: y = -12

(b) gradient of OP = -12/5, ft their part (a)	**M1**
(b) tangent gradient = 5/12 (negative reciprocal of -12/5)	**M1**
(b) correct method using point P, e.g. y + 12 = (5/12)(x - 5)	**M1**
(b) 5x - 12y = 169 (oe, integer coefficients) (cao)	**A1**

(b) Answer: 5x - 12y = 169

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