Tangents & Normals: exam practice

10 questions · 38 marks · worked solutions and markschemes

Name _____ Date _____ Score / 38

- Answer every question before you look at the solutions. They start after the last question, with the marks for each line: M for method, A for accuracy, R for reasoning.
- Online, with more practice: ibmathrevision.com/slai/tangents-and-normals-exam-practice

1. **3 marks · Paper 1 style · calculator allowed**

Find the equation of the tangent to $y = x^2 + 3x$ at the point where $x = 1$. **[3]**

2. **3 marks · Paper 1 style · calculator allowed**

Find the equation of the normal to $y = 2x^3$ at the point where $x = 1$. **[3]**

3. **3 marks · Paper 1 style · calculator allowed**

Find the coordinates of the point on $y = x^2 + 3x + 2$ where the tangent is parallel to the line $y = 7x$. **[3]**

4. **3 marks · Paper 2 style · calculator allowed**

Let $f(x) = 0.5x^3 - 2x + 1$.

Use your calculator to find the equation of the tangent to the graph of f at $x = 1.4$, giving it in the form $y = mx + c$. **[3]**

5. **3 marks · Paper 1 style · calculator allowed**

The gradient of the tangent to $y = kx^2 - 3x$ at $x = 2$ is 5. Find the value of k. **[3]**

6. **4 marks · Paper 1 style · calculator allowed**

Find the equation of the normal to $y = 3x^2 - 4$ at $x = 1$, in the form $ax + by + d = 0$. **[4]**

7. **3 marks · Paper 1 style · calculator allowed**

Tangents are drawn to $y = x^2$ at $x = 1$ and at $x = c$. The tangents are perpendicular.

Find the value of c. **[3]**

8. 5 marks · Paper 1 style · calculator allowed

Let $f(x) = \dfrac{4}{x}$.

(a) Find the equation of the tangent to the graph of f at $x = 2$. **[3]**

(b) Find the area of the triangle formed by the tangent and the coordinate axes. **[2]**

9. 5 marks · Paper 2 style · calculator allowed

The normal to $y = x^2$ at the point $(1, 1)$ meets the curve again at R.

(a) Find the equation of the normal. **[2]**

(b) Find the coordinates of R. **[3]**

10. 6 marks · Paper 2 style · calculator allowed

Let $f(x) = x^3 - 2x$.

(a) Find the equation of the tangent at $x = -1$. **[3]**

(b) The tangent meets the curve again at Q. Find the coordinates of Q. **[3]**

Answers and worked solutions

Question 1

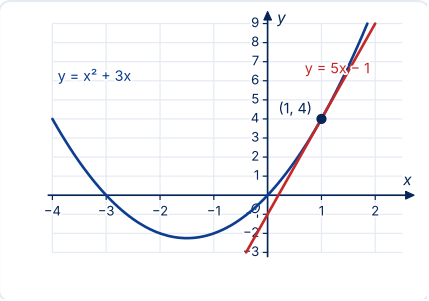
3 marks

Answer: $y = 5x - 1$

gradient $2(1) + 3 = 5$ A1

point $(1, 4)$ A1

$y = 5x - 1$ A1



Gradient 5 at (1, 4)

Question 2

3 marks

Answer: $y - 2 = -\frac{1}{6}(x - 1)$

gradient of tangent 6 A1

gradient of normal $-\frac{1}{6}$ (M1)

$y - 2 = -\frac{1}{6}(x - 1)$ A1

Question 3

3 marks

Answer: $(2, 12)$

$2x + 3 = 7$ M1

$x = 2$ A1

$(2, 12)$ A1

Question 4

3 marks

Answer: $y = 0.94x - 1.74$

$f'(1.4) = 0.94$ A1

$f(1.4) = -0.428$ A1

$y = 0.94x - 1.74$ A1

Question 5

3 marks

Answer: 2

$\frac{dy}{dx} = 2kx - 3$ A1

$4k - 3 = 5$ M1

$k = 2$ A1

Question 6

4 marks

Answer: $x + 6y + 5 = 0$

gradient of tangent 6 A1

point $(1, -1)$ A1

$y + 1 = -\frac{1}{6}(x - 1)$ (M1)

$x + 6y + 5 = 0$ A1

Question 7

3 marks

Answer: $-\frac{1}{4}$

gradients 2 and $2c$ A1

$2 \times 2c = -1$ M1

$c = -\frac{1}{4}$ A1

Question 8

5 marks

Answer: (a) $y = -x + 4$; (b) 8

(a)

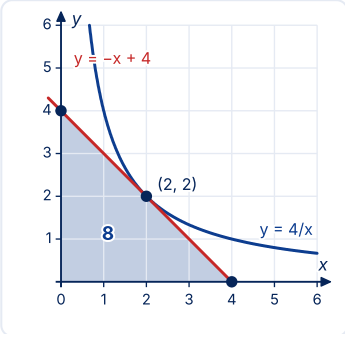
$f'(x) = -4x^{-2}$, $f'(2) = -1$ (M1)(A1)

$y = -x + 4$ A1

(b)

intercepts $(4, 0)$ and $(0, 4)$ (M1)

8 A1



Triangle with the axes: area 8

Question 9

5 marks

Answer: (a) $y = -\frac{1}{2}x + \frac{3}{2}$; (b) $(-1.5,\ 2.25)$

(a)

gradient $-\frac{1}{2}$ (M1)

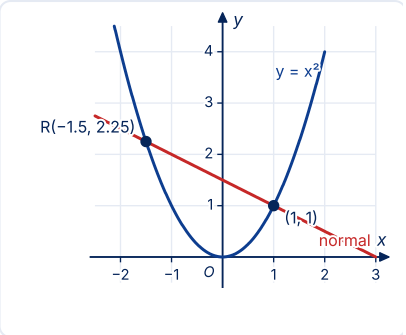
$y = -\frac{1}{2}x + \frac{3}{2}$ A1

(b)

$x^2 = -\frac{1}{2}x + \frac{3}{2}$ (M1)

$2x^2 + x - 3 = 0$, $x = -1.5$ A1

$R(-1.5,\ 2.25)$ A1



Normal meets the curve again at R

Question 10

6 marks

Answer: (a) $y = x + 2$; (b) $(2, 4)$

(a)

$f'(-1) = 3 - 2 = 1$ (A1)

$f(-1) = 1$ (A1)

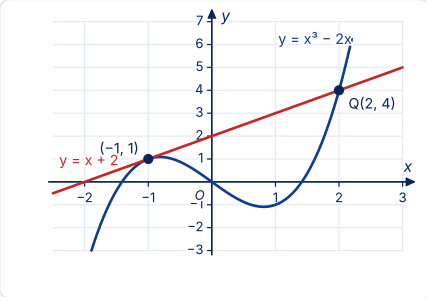
$y = x + 2$ A1

(b)

$x^3 - 2x = x + 2$ (M1)

$x = 2$ A1

$Q(2, 4)$ A1



The tangent cuts the curve again at $Q(2, 4)$

Every solution is also on ibmathrevision.com/slai/tangents-and-normals-exam-practice
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