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**AS Mathematics Exam Questions by Topic**  
**Chapter 10a: Differentiation**

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These questions are taken from the Specimen Exam materials and the real 2018 papers for the new syllabus AS and A-level mathematics courses and arranged by chapter of the textbooks by Goldie et al (available here: <https://amzn.to/39umfr5> and <https://amzn.to/3hE8kBL> ). There are a mixture of questions from OCR A, OCR B (MEI), Edexcel and AQA. Although the style of questions varies a little across the exam boards the content of the syllabus is almost identical so these are suitable for students preparing for any exam board.

Free problem sets for all other chapters, as well as video solutions, full past papers and other content for GCSE and A-level maths can be found at:

<https://mathsaurus.com/>

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Edexcel AS Sample Paper 1 Question 2:

2. The curve  $C$  has equation

$$y = 2x^2 - 12x + 16$$

Find the gradient of the curve at the point  $P(5, 6)$ .

*(Solutions based entirely on graphical or numerical methods are not acceptable.)*

(4)

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OCR A AS 2018 Paper 1 Question 4i:

4 (i) It is given that  $y = x^2 + 3x$ .

(a) Find  $\frac{dy}{dx}$ . [2]

(b) Find the values of  $x$  for which  $y$  is increasing. [2]

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Edexcel Sample Paper 1 Question 1:

1. The curve  $C$  has equation

$$y = 3x^4 - 8x^3 - 3$$

(a) Find (i)  $\frac{dy}{dx}$

(ii)  $\frac{d^2y}{dx^2}$

(3)

(b) Verify that  $C$  has a stationary point when  $x = 2$

(2)

(c) Determine the nature of this stationary point, giving a reason for your answer.

(2)

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OCR A AS 2018 Paper 2 Question 5:

5 In this question you must show detailed reasoning.

The line  $x + 5y = k$  is a tangent to the curve  $x^2 - 4y = 10$ . Find the value of the constant  $k$ . [5]

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OCR A AS Sample Paper 1 Question 1:

1 It is given that  $f(x) = 6x^3 - 5x$ . Find

(i)  $f'(x)$ , [2]

(ii)  $f''(2)$ . [2]

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OCR A AS Sample Paper 1 Question 4:

4 The curve  $y = 2x^3 + 3x^2 - kx + 4$  has a stationary point where  $x = 2$ .

(i) Determine the value of the constant  $k$ . [5]

(ii) Determine whether this stationary point is a maximum or a minimum point. [2]

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OCR A AS Sample Paper 2 Question 8:

- 8 A curve has equation  $y = kx^{\frac{3}{2}}$  where  $k$  is a constant. The point  $P$  on the curve has  $x$ -coordinate 4. The normal to the curve at  $P$  is parallel to the line  $2x + 3y = 0$  and meets the  $x$ -axis at the point  $Q$ . The line  $PQ$  is the radius of a circle centre  $P$ .  
Show that  $k = \frac{1}{2}$ . Find the equation of the circle. [10]

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OCR A Sample Paper 2 Question 2:

- 2 A curve has equation  $y = x^5 - 5x^4$ .
- (i) Find  $\frac{dy}{dx}$  and  $\frac{d^2y}{dx^2}$ . [3]
- (ii) Verify that the curve has a stationary point when  $x = 4$ . [2]
- (iii) Determine the nature of this stationary point. [2]

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OCR A Sample Paper 3 Question 6:

- 6 A curve has equation  $y = x^2 + kx - 4x^{-1}$  where  $k$  is a constant. Given that the curve has a minimum point when  $x = -2$
- find the value of  $k$ ,
  - show that the curve has a point of inflection which is not a stationary point.
- [7]

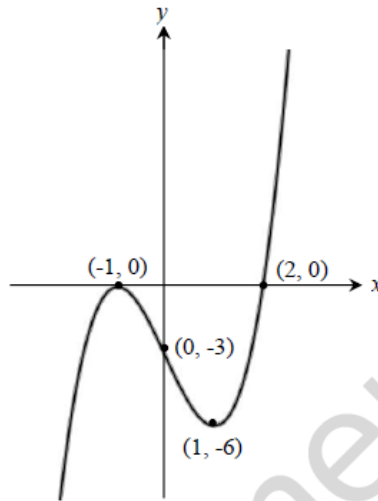
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OCR B MEI AS 2018 Paper 2 Question 10:

- 10 (i) A curve has equation  $y = 16x + \frac{1}{x^2}$ . Find
- (A)  $\frac{dy}{dx}$ , [2]
- (B)  $\frac{d^2y}{dx^2}$ . [2]
- (ii) Hence
- find the coordinates of the stationary point,
  - determine the nature of the stationary point. [5]

**11** In this question you must show detailed reasoning.

Fig. 11 shows the curve  $y = f(x)$ , where  $f(x)$  is a cubic function. The coordinates of the turning points and the points of intersection with the axes are shown in Fig. 11.



**Fig. 11**

Show that the tangent to  $y = f(x)$  at  $x = t$  is parallel to the tangent to  $y = f(x)$  at  $x = -t$  for all values of  $t$ . [6]

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OCR B MEI Sample Paper 3 Question 6:

- 6 Fig. 6 shows the curve with equation  $y = x^4 - 6x^2 + 4x + 5$ .

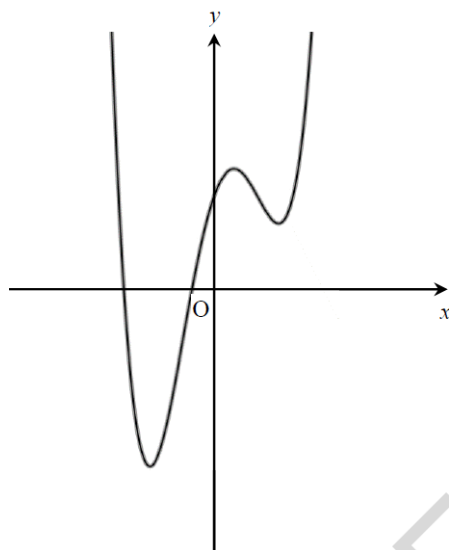


Fig. 6

Find the coordinates of the points of inflection.

[5]

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AQA 2018 Paper 1 Question 1:

1  $y = \frac{1}{x^2}$

Find an expression for  $\frac{dy}{dx}$

Circle your answer.

[1 mark]

$$\frac{dy}{dx} = \frac{0}{2x}$$

$$\frac{dy}{dx} = x^{-2}$$

$$\frac{dy}{dx} = -\frac{2}{x}$$

$$\frac{dy}{dx} = -\frac{2}{x^3}$$

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AQA 2018 Paper 3 Question 2:

**2** A curve has equation  $y = x^5 + 4x^3 + 7x + q$  where  $q$  is a positive constant.

Find the gradient of the curve at the point where  $x = 0$

Circle your answer.

[1 mark]

0                      4                      7                       $q$

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AQA AS 2018 Paper 1 Question 10:

**10** A curve has equation  $y = 2x^2 - 8x\sqrt{x} + 8x + 1$  for  $x \geq 0$

**10 (a)** Prove that the curve has a maximum point at (1, 3)

Fully justify your answer.

[9 marks]

**10 (b)** Find the coordinates of the other stationary point of the curve and state its nature.

[2 marks]

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AQA AS Sample Paper 1 Question 11:

**11** Chris claims that, "for any given value of  $x$ , the gradient of the curve  $y = 2x^3 + 6x^2 - 12x + 3$  is always greater than the gradient of the curve  $y = 1 + 60x - 6x^2$ ".

Show that Chris is wrong by finding all the values of  $x$  for which his claim is **not** true.

[7 marks]

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AQA AS Sample Paper 1 Question 12:

**12** A curve has equation  $y = 6x\sqrt{x} + \frac{32}{x}$  for  $x > 0$

**12 (a)** Find  $\frac{dy}{dx}$

[4 marks]

**12 (b)** The point A lies on the curve and has  $x$ -coordinate 4

Find the coordinates of the point where the tangent to the curve at A crosses the  $x$ -axis.

[5 marks]

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AQA AS Sample Paper 2 Question 8:

8 Prove that the function  $f(x) = x^3 - 3x^2 + 15x - 1$  is an increasing function.

[6 marks]

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AQA Sample Paper 1 Question 2:

2 A curve has equation  $y = \frac{2}{\sqrt{x}}$

Find  $\frac{dy}{dx}$

Circle your answer.

[1 mark]

$$\frac{\sqrt{x}}{3}$$

$$\frac{1}{x\sqrt{x}}$$

$$-\frac{1}{x\sqrt{x}}$$

$$-\frac{1}{2x\sqrt{x}}$$

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Edexcel 2018 Paper 1 Question 2:

2. A curve  $C$  has equation

$$y = x^2 - 2x - 24\sqrt{x}, \quad x > 0$$

(a) Find (i)  $\frac{dy}{dx}$

(ii)  $\frac{d^2y}{dx^2}$

(3)

(b) Verify that  $C$  has a stationary point when  $x = 4$

(2)

(c) Determine the nature of this stationary point, giving a reason for your answer.

(2)

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