

**Q1.** Differentiate the following, with respect to  $x$ .

(Chap 9 Pg 238/239)

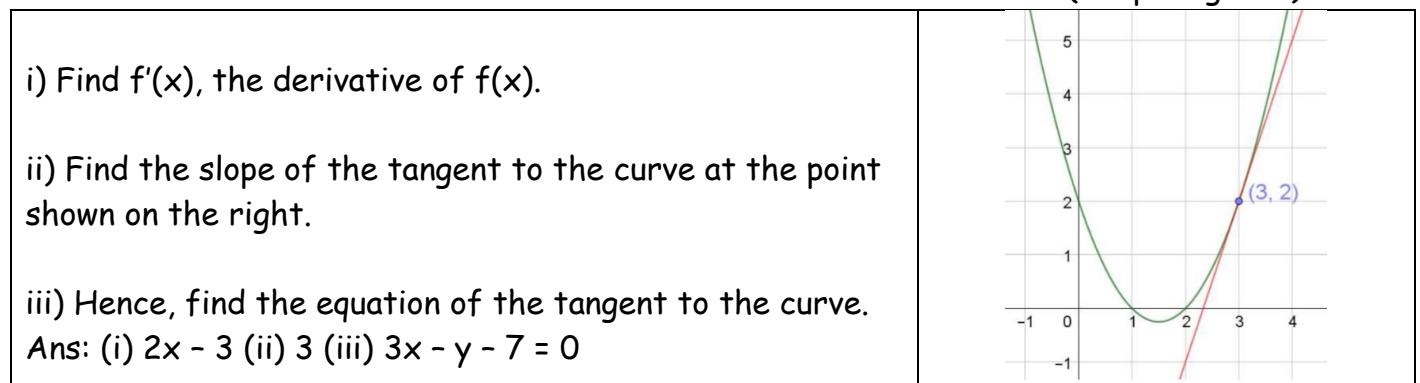
- i)  $y = 4x^2$       Ans:  $8x$       iii)  $f(x) = 2x^3 + 5x^2 - 3x + 1$       Ans:  $6x^2 + 10x - 3$   
 ii)  $y = 3x^2 - 5x + 2$       Ans:  $6x - 5$       iv)  $f(x) = (x^2 - 3)(2x + 7)$       Ans:  $6x^2 + 14x - 6$

**Q2.** Evaluate the following

(Chap 9 Pg 240)

- i) If  $y = 3x^2 - 4$ , find the value of  $\frac{dy}{dx}$  at  $x = 2$ .      Ans: 12  
 ii) If  $y = 3x^3 + x^2 - 4x$ , find the value of  $\frac{dy}{dx}$  at  $x = -1$ .      Ans: 3

**Q3.** A graph of the function  $f(x) = x^2 - 3x + 2$  is shown below. Answer the questions on the left below.      (Chap 9 Pg 242)



**Q4.** A function  $f(x) = 2x^2 + 3x - 5$ . Answer the questions below.      (Chap 9 Pg 242)

- i) Find  $f'(x)$ , the derivative of  $f(x)$ .      Ans:  $4x + 3$   
 ii) Find the slope of the tangent to the curve  $f(x)$  at the point  $(-3, 5)$ .      Ans: -9  
 iii) Find the equation of the tangent to the curve at that point.      Ans:  $9x + y + 22 = 0$

**Q5.** If  $y = 4x^3 - 6x^2 + 7x - 3$ , find  $\frac{d^2y}{dx^2}$ .      Ans:  $24x - 12$       (Chap 9 Pg 241)

**Q6.** A rectangular vegetable patch has width of  $x$  metres. The perimeter of the patch is 72 m.

- i) Show that the length is given by  $36 - x$ .  
 ii) Find an expression for the area of the patch.      Ans:  $36x - x^2$   
 iii) Find the value of  $x$  that will maximise the area of the patch.      Ans:  $x = 18$   
 iv) What is the maximum area of the patch?      Ans:  $324\text{m}^2$

**Q7.** Find the range of values for which the curve  $f(x) = 3x^2 - 12x + 8$  is (i) increasing (ii) decreasing.      (Chap 9 Pg 245)      Ans: (i)  $x \geq 2$  (ii)  $x \leq 2$

**Q8.** Find the coordinates of the turning point of the curve  $f(x) = x^2 - 4x - 5$ .      (Chap 9 Pg 248)  
 Ans:  $(2, -9)$

**Q9.** A truck speeds up in a straight line so that its distance  $s$  (in metres) from its starting point after  $t$  seconds is given by the function  $s(t) = 3t^2 - 6t$ .      (Chap 9 Pg 253/254)

- Find: (i) the distance the truck has travelled from its starting point after 5 seconds  
 (ii) the speed of the truck in terms of  $t$   
 (iii) the constant acceleration of the truck

Ans: (i) 45m (ii) Speed =  $6t - 6$  (iii) 6 m/s<sup>2</sup>

**Past Exam Questions:**

**Q10. 2019 Paper 1 Q3**

The function  $f$  is defined as  $f(x) = -x^3 + 4x^2 + x - 2$ , where  $x \in \mathbb{R}$ .

**Ans:  $x = 4/3$**

Find the value of  $x$  for which  $f''(x) = 0$ , where  $f''(x)$  is the second derivative of  $f(x)$ .

**Q11. 2019 Paper 1 Q7**

A camogie goalkeeper, on a level pitch, hit a ball straight up into the air. The path that the ball travelled can be modelled by the function:

$$f(t) = -4t^2 + 16t + 1, \quad t \in \mathbb{R},$$

where  $t$  is the time, in seconds, from when the ball is hit and  $f(t)$  was the height of the ball, in metres, above the pitch. The ball landed on the ground without being hit again.

(i) Find  $f'(t)$ , the derivative of  $f(t) = -4t^2 + 16t + 1$ . **Ans:  $-8t + 16$**

(ii) Use your answer from part (d)(i) to find the speed of the ball when it had been in the air for 4 seconds. Give your answer in metres per second. **Ans: 16 m/s**

(iii) Use your answer from part (d)(i) to find the value of  $t$  for which the ball was descending and travelling at a speed of 8 metres per second. **Ans: 3 secs**

**Q12. 2018 Paper 1 Q8**

The amount, in appropriate units, of a certain medicinal drug in the bloodstream  $t$  hours after it has been taken can be estimated by the function:

$$C(t) = -t^3 + 4.5t^2 + 54t, \quad \text{where } 0 \leq t \leq 9, \quad t \in \mathbb{R}.$$

(i) Use the drug amount function  $C(t) = -t^3 + 4.5t^2 + 54t$  to find, in terms of  $t$ , the rate at which the drug amount is changing after  $t$  hours. **Ans:  $-3t^2 + 9t + 54$**

(ii) Use your answer to part e(i) to find the rate at which the drug amount is changing after 4 hours. **Ans: 42 units/hr**

(iii) Use your answer to part e(i) to find the maximum amount of the drug in the bloodstream over the first 9 hours. **Ans: 270 units**

(iv) Use your answer to part e(i) to show that the drug amount in the bloodstream is decreasing 7 hours after the drug has been taken. Explain your reasoning.

**Q13. 2017 Paper 1 Q3**

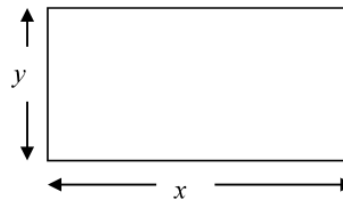
Find the co-ordinates of the minimum point of the function  $f(x) = 3x^2 - 6x - 8$ , where  $x \in \mathbb{R}$ .

**Ans: (1, -11)**

**Q14. 2016 Paper 1 Q8**

Kieran has 21 metres of fencing. He wants to enclose a vegetable garden in a rectangular shape as shown.

(a) By writing an expression for the perimeter of the vegetable garden in terms of  $x$  (length in metres) and  $y$  (width in metres), show that  $y = 10.5 - x$ .



(d) (i) Show that the area of the rectangle can be written as  $A = 10.5x - x^2$ .

(ii) Find  $\frac{dA}{dx}$ . **Ans:  $10.5 - 2x$**

(iii) Hence, find the value of  $x$  which will give the maximum area. **Ans:  $x = 5.25$**

(iv) Find this maximum area. **Ans:  $27.56\text{m}^2$**