

## 1. Differentiation

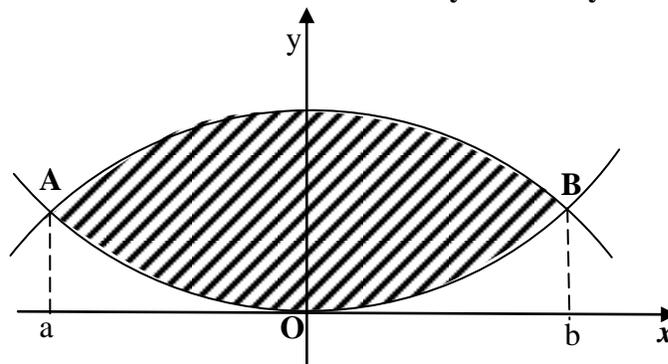
1. A particle moves in a straight line from a fixed point. Its velocity  $V$  m/s after  $t$  seconds is given by  $V = 9t^2 - 6t + 2$  calculate the distance traveled by the particle during the 2<sup>nd</sup> second. (4 mks)
2. A body moves in a straight line in such a way that at any time,  $t$  seconds, its distance  $S$  metres from the starting point is given by  $S = 8t - t^2$ .
  - (a) How fast is the body moving at (3mks)
    - (i)  $t = 1$  second
    - (ii)  $t = 3$  seconds.
  - (b) What is the maximum displacement from the starting point that the body achieves. (4mks)
  - (c) Find the acceleration of the body. (1mk)
  - (d) After how long will the body be back to the starting point? (2mks)
3. Find the equation of the normal to the curve  $X^2 = 4y$  at the point (6,9) (3 marks)
4. The acceleration of a particle in  $M5^{-2}$  is given by the expressions  $3t - 4$   
Find:-
  - (i) an expression for velocity  $V$ ms<sup>1</sup> (1 mark)
  - (ii) an expression for distance 5 metres from a fixed point O. Given that  $S=0$  when  $V=3$  and  $t=0$  (2 marks)
5. A particle P moves in a straight line such that  $t$  seconds after passing a fixed point Q, its velocity is given by the equation  $2t^2 - 10t + 12$ . find;
  - (a) The values of  $t$  when p is instantaneously at rest (2 marks)
  - (b) An expression for the distance moved by P after  $t$  seconds. (2 marks)
  - (c) The total distance traveled by P in the first 3 seconds after passing point O. (3 marks)
  - (d) The distance of P from O when the acceleration is zero. (3 marks)
6. (a) Find the derivative of  $y = (3x - 2x^2)(5 + 4x)$  (3mks)
  - (b) A diver leaps from a diving board 32m above the surface of a swimming pool. At time  $t$  second, his position  $h$ , above the surface of the swimming pool is given by  $h = 32 + 16t - 16t^2$ .  
Find:
    - (i) The time he took to hit the water surface. (4mks)
    - (ii) The velocity at which he hit the water surface. (3mks)
7. A particle moves such that  $t$  seconds after passing a given point O, its distance S metres from O is given by  $S = t(t-2)(t-1)$ 
  - (a) Find its velocity when  $t = 2$  seconds
  - (b) Find its minimum velocity

- (c) Find the time when the particle is momentarily at rest  
 (d) Find its acceleration when  $t = 3$  seconds

8. The table below gives the values of  $x$  and  $y$  for the curve  $y = x^2 + 1$

X	0	1	2	3	4	5	6	7	8	9	10
y	1	2		10	17		37	50		82	

- a) Complete the table  
 b) Use the mid-ordinate rule to estimate the area enclosed by the curve  $y = x^2 + 1$ .  
 Use five ordinates  
 c) Using integration, calculate the actual area in (a) above  
 d) Calculate the percentage error in the estimated area
9. The gradient function of a curve is given by the expression  $2x + 1$ . If the curve passes through the point  $(-4, 6)$ ; find the equation of the curve
10. A particle **P** moves in a straight line so that its velocity,  $V$  m/s at time  $t$  seconds where  $t \geq 0$  is given by  $v = 28 + t - 2t^2$   
**Find;**  
 (a) the time when **P** is instantaneously at rest  
 (b) the speed of **P** at the instant when the acceleration of **P** is zero  
 (c) Find the acceleration of **P** when the article is instantaneously at rest  
 (d) Find the distance covered by the particle during the 3<sup>rd</sup> second, when at  $t = 0$   $D = 5M$
11. A particle **K** moves along a straight line 50 cm long. At time  $t = 0$ , **k** is at **A** and  $t$  seconds later its velocity  $v$  cm/s is given by  $v = 15 + 4t - 3t^2$ .  
 a) Write down the expression for;  
 i) The acceleration of **K** at time  $t$  seconds.  
 ii) The distance of **K** from **A** at time  $t$  seconds.  
 b) i) Find  $t$  when **K** is instantaneously at rest.  
 ii) How far is **K** from **A** at this time?  
 c) Find the period of time during which the acceleration of **P** is positive.
12. The diagram below shows the sketch of the curve  $y = x^2$  and  $y = -x^2 + 8$  intersecting at **A** and **B**:-



- (a) Find the value of  $a$  and  $b$  hence find the coordinates of **A** and **B**  
 (b) Find the area enclosed by  $x = a$ ,  $x = b$ , the axis and:-  
 (i) the curve  $y = x^2$   
 (ii) the curve  $y = -x + 8$
13. The distance from a fixed point of a particle in motion at any time  $t$  seconds is given by :-  
 $S = t^3 - \frac{5}{2}t^2 + 2t + 5$  metres  
 Find its:  
 (a) Acceleration after  $t$  seconds  
 (b) Velocity when acceleration is zero
14. A particle moves in a straight line. It passes through point **O** at  $t = 0$  with a velocity  $v = 5$  m/s. The acceleration  $a$  m/s<sup>2</sup> of the particle at time  $t$  seconds after passing through **O** is given by

$$a = 6t + 4$$

- (a) Express the velocity  $v$  of the particle at time  $t$  seconds in terms of  $t$ .  
(b) Calculate the velocity of the particle when  $t = 4$ .  
(c) (i) Express the displacement  $s$  by the particle after  $t$  seconds in terms of  $t$ .  
(ii) Calculate the distance covered by the particle between  $t = 1$  and  $t = 4$ .

15. The displacement  $S$  metres of a particle moving along a straight line after  $t$  seconds is given by.

$$S = 3t + \frac{3t^2}{2} - 2t^3$$

a) Find its initial acceleration

b) Calculate:

- i) The time when the particle was momentarily at rest  
ii) Its displacement by the time it came to rest momentarily

c) Calculate the maximum speed attained

16. Find the equation to the tangent to the curve:-

$$y = 4x^3 - 2x^2 - 3x + 5 \text{ at the point } (2, 23)$$

17. A farmer wanted to make a trough for cows to drink water. He had a metal sheet measuring 240cm by 120cm and 1cm thick. The density of the metal is  $2.5\text{g/cm}^3$ . A square of sides 30cm is removed from each corner of the rectangle and the remaining part folded to form an open cuboid.

(a) Sketch the sheet after removing the squares for the four corners, showing all the dimensions

(b) Calculate:-

- (i) The area of the metal which forms the cuboid  
(ii) The mass of the empty cuboid in Kilograms

(a) The cuboid is filled with water whose density is  $1\text{g/cm}^3$ . Calculate the mass of the cuboid when full of water

18. A rectangular sheet of cardboard is 8cm long and 5cm wide. Equal squares are cut away at each corner and the remainder is folded so as to form an open box. Find the maximum volume

19. (a) Find the equation of the normal to the curve :-  $y = x^3 - 2x - 1$  at  $(1, -2)$

(b) Determine the nature of the turning points to the curve  $y = x^3 - 3x + 2$ ; Hence in the space provided below, sketch the curve

20. A particle moves in a straight line so that its velocity,  $v/\text{m/s}$  at time  $t$  seconds where

$$t \geq 0 \text{ is given by } v = 28 + t - 2t^2$$

Find:-

- (a) The time when  $P$  is instantaneously at rest  
(b) The speed of  $P$  at the instant when the acceleration of  $P$  is zero  
(c) Given that  $P$  passes through the point  $O$  of the line when  $t = 0$ ;  
(i) Find the distance of  $P$  from  $O$  when  $P$  is instantaneously at rest

21. A particle moves such that  $t$  seconds after passing a given point  $O$ , its distance  $S$  metres from  $O$  is given by  $S = t(t-2)(t-1)$
- (a) Find its velocity when  $t = 2$  seconds
  - (b) Find its minimum velocity
  - (c) Find the time when the particle is momentarily at rest
  - (d) Find its acceleration when  $t = 3$  seconds