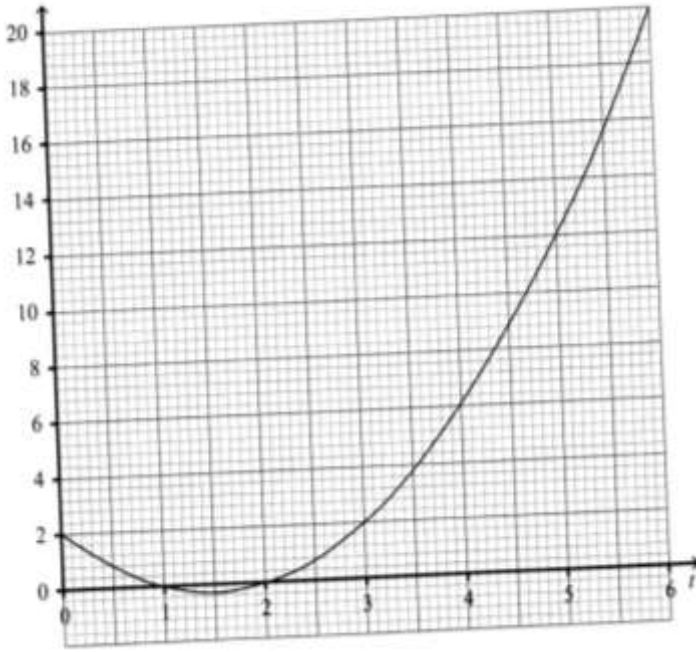
CALCULUS

DIFFERENTIATION

	KCSE 1989 – 2012 Form 4 Mathematics *Answer all the questions*
1.	**1990 Q15 P1** A farmer has 1200m of wire to fence three sides of a rectangular paddock. The fourth side is a wall. Find the dimension that will give the maximum possible area (4marks)
2.	**1990 Q11 P2** The gradient of a curve at any point (x, y) is $3x^2$.Given that the curve passes through the point (-2, 3), find its equation. (3 marks)
3.	**1991 Q11 P2** Use differentiation to find the *x* coordinate of the maximum point for the curve $y = x^3 + 2x^2 - 4x - 8$ (5 marks)
4.	**1992 Q11 P2** Find the equation of the tangent to the curve $y = 2x^2$ at (2, 8) 4marks)
5.	**1993 Q12 P2** Calculate the gradient of the curve $y = x^2 - 3x - 4$ at a point where x = -1 (2marks)
6.	**1993 Q24 P2** A projectile is fired vertically upwards. At anytime *t* (seconds) its height *h*(metres) above the ground is given by: $h = 30t - 5t^2$ a) How fast is it moving at i) t = 1 second? ii) t= 2 seconds? b) How far up does it travel
7.	**1994 Q11 P1** A rectangular plate has a perimeter of 28cm. Determine the dimensions of the plate that give the maximum area
8.	**1996 Q 19 P1** The equation of a curve us $y = 3x^2 - 4x + 1$ (a) Find the gradient function of the curve and its value when x = 2 (2 marks) (b) Determine (i) The equation of the tangent to the curve at the point (2, 5)(2 marks) (ii) The angle which the tangent to the curves at the point (2, 5) makes with the horizontal (1 mark) iii) The equation of the line through the point (2, 5) which is perpendicular to the tangent in (b) (i)
9.	**1997 Q 10 P1** The curve $y= ax^3 - 3x^2 - 2x + 1$ has the gradient 7 when x=1. Find the value of a

10.	**1999 Q 16 P2** Find the equation of the tangent to the curve $y = (x^2 + 1)(x- 2)$ when $x= 2$
11.	**2000 Q 5 P2** The distance from a fixed point of a particular in motion at any time t seconds is given by $S = t^3 - \frac{5t^2}{2} + 2t + 5$ metres Find its: (a) Acceleration after t seconds (b) Velocity when acceleration is Zero (c) Find all the integral value of x which satisfy the inequalities $2(2-x) < 4x - 9 < x + 11$
12.	**2001 Q 11 P2** A curve is given by the equation: $y = 5x^3 - 7x^2 + 3x + 2$ Find the: a) Gradient of the curve at x = 1 (2 mks) Equation of the tangent to the curve at the point(1,3) (2mks)
13.	**2001 Q 22 P2** The displacement x metres a particle after seconds given by. $x = t^3-2t^2 +6$, $t>0$. a) Calculate the velocity of the particle in m/s when t = 2 seconds. b) When the velocity of the particle is zero, calculate its:- i) Displacement ii) Acceleration.
14.	**2002 Q 16 P1** Given the curve $y = 2x^3 + \frac{1}{2}x^2 - 4x + 1$. Find the: i) Gradient of curve at $\{1, -\frac{1}{2}\}$ ii) Equation of the tangent to the curve at $\{1, -\frac{1}{2}\}$
15.	**2002 Q 24 P2** The displacement s metre of a particle moving Along straight line after t seconds is given by. $S = 3t + \frac{3}{2}t^2 - 2t^3$ a) Find its initial acceleration b) Calculate: i)The time when the particle was momentarily at rest. ii)Its displacement by the time it comes to rest momentarily c) Calculate the maximum speed attained.
16.	**2003 Q 8 P2** Find the coordinates of the turning point of the curve whose equation is $y =6 +2x - 4x^2$ (3 mks)
17.	**2003 Q 21 P2** a) i)Find the coordinated of the stationary points on the curve $y = x^3 - 3x + 2$ (2mks) ii)For each stationary point determine whether it is minimum or maximum. b) In the space provided below, sketch the graph of the Function $y= x^3 - 3x +2$ (2mks)
18.	**2004 Q 5 P1** The velocity V ms^{-1}, of a moving body at time *t* seconds is given by $V = 5t^2 - 12t + 7$. Calculate the acceleration when *t*=2 seconds (3 mks)

19.	**2005 Q 16 P2** A stone is thrown vertically upwards from a point O. After t seconds, the stone is S metres from O. Given that $S= 29.4t - 4.9t^2$, find the maximum height reached by the stone (3 marks)
20.	**2005 Q 17 P2** A curve is represented by the function $y = {}^1/_3 x^3 + x^2 - 3x + 2$ (a) Find $\frac{dy}{dx}$ (1 mark) (b) Determine the values of y at the turning points of the curve $y = {}^1/_3 x^3 + x^2 - 3x + 2$ (4 marks)
21.	**2006 Q 24 P1** A particle moves along straight line such that its displacement S metres from a given point is $S = t^3 - 5t^2 + 4$ where t is time in seconds Find (a) the displacement of particle at t = 5 (2 marks) (b) the velocity of the particle when t = 5 (3 marks) (c) the values of t when the particle is momentarily at rest (3 marks) The acceleration of the particle when t = 2 (2 marks)
22.	**2007 Q 5 P1** The gradient of the tangent to the curve $y = ax^3 + bx$ at the point (1,1) is -5. Calculate the values of a and b (4 marks)
23.	**2007 Q 13 P1** The sum of two numbers x and y is 40. Write down an expression, in terms of x, for the sum of the squares of the two numbers. Hence determine the minimum value of $x^2 + y^2$ (4 marks)
24.	**2008 Q 24 P1** The distance s metres from a fixed point O, covered by a particle after t seconds is given by the equation; $S = t^3 - 6t^2 + 9t + 5$. a) Calculate the gradient to the curve at t=0.5 seconds (3mks) b) Determine the values of s at the maximum and minimum turning points of the curve. (4mks) c) On the space provided, sketch the curve of $s= t^3-6t^2+9t + 5$. (3mks)
25.	**2008 Q 15 P2** A particle moves in a straight line from a fixed point. Its velocity Vms-1 after t seconds is given by $V=9t^2 - 4t +1$ Calculate the distance travelled by the particle during the third second. (3mks)
26.	**2011 Q 22 P1** The displacement, s metres, of a moving particle after t seconds is given by $s=2t^3 - 5t^2 + 4t + 2$. Determine: a) The velocity of the particle when *t*=3 seconds: (3 mks) b) The value of t when the particle is momentarily at rest; (3 mks) c) The displacement when the particle is momentarily at rest; (2 mks) d) The acceleration of the particle when *t*=3 seconds. (2 mks)
27.	**2012 Q13 P2** The graph below shows the relationship between distance *s* metres and time *t* seconds in the interval $0 \leq t \leq 6$.



Use the graph to determine:

(a) The average rate of change of distance between t =3 seconds and t =6 seconds; (2 marks)

(b) The gradient at t = 3 seconds. (2 marks)

28. **2012 Q24 P2**

The acceleration of a body moving along a straight line is (4-t) m/s^2 and its velocity is v m/s after t seconds,

(a) (i) If the initial velocity of the body is 3m/s, express the velocity v in terms of t. (3 marks)

(ii) Find the velocity of the body after 2 seconds. (2 marks)

(b) Calculate:

(i) The time taken to attain maximum velocity; (2 marks)

(ii) The distance covered by the body to attain the maximum velocity (3 marks)

INTEGRATION

KCSE 1989 – 2012 Form 4 Mathematics

Answer all the questions

1. **1989 Q15 P1**

A particle moves along a straight line PQ. Its velocity v metres per second after t seconds is given by $v = t^2 - 3t + 5$. Its distance from P at the time t = 1 is 6metres. Determine its distance from p when t = 3. (4marks)

2. **1991 Q14 P1**

Evaluate $\int_{-1}^{3}(2x+3)dx$

(3 marks)

3. **1992 Q12 P2**

The velocity v m/s of a particle moving along a straight line at any time t (sec) is given by $v = 3t - 2$. Its distance x (m) at the time t = 0 is equal to 2. Calculate x when t = 4 (4marks)

4. **1994 Q19 P2**

The velocity of a particle moving in a straight line after t seconds given by $v = 6t - t^2 + 4$ m/s.

Calculate

a) The acceleration of the particle after 2 seconds (2marks)

b) The distance covered by the particle between t = 2 sec and t =5sec. (3 marks)

c) The time when the particle will be momentarily at rest. (3 marks)

5. **1999 Q 16 P1**

A particle moves on a straight line. The velocity after t seconds is given by $V = 3t^2 - 6t - 8$. The distance of the particle from the origin after one second is 10 metres.

Calculate the distance of the particle from the origin after 2 seconds. (4 marks)

6. **2000 Q 14 P1**

The acceleration a m/s^2 of a particle moving in a straight line is given by $a = 18t - 4$, where t is time in seconds. The initial velocity of the particle is 2 m/s

a) Find the expression for velocity in terms of t

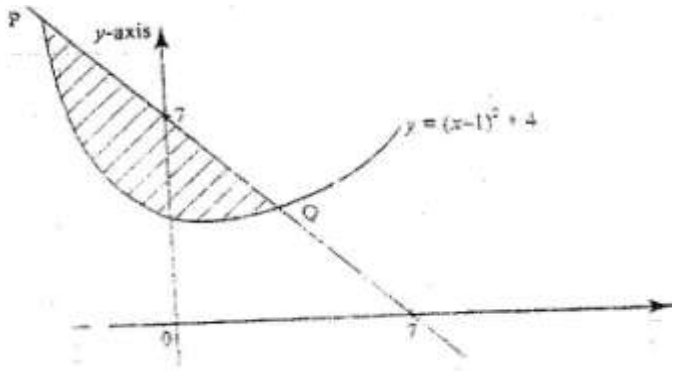
b) Determine the time when the velocity is again 2m/s

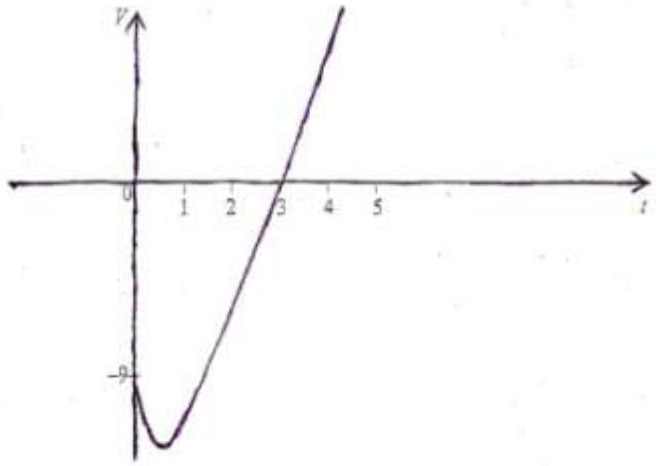
7. **2001 Q 21 P1**

(a) The gradient function of a curve is given by $\frac{dy}{dx} = 2x^2 - 5$

Find the equation of the curve, given that y = 3, when x = 2 (4 mks)

b) The velocity, vm/s of a moving particle after seconds is given: $v = 2t^3 + t^2 - 1$. Find the distance

	covered by the particle in the interval $1 \leq t \leq 3$ (4 mks)
8.	**2002 Q 20 P1** The diagram below shows a straight line intersecting the curve $y = (x-1)^2 + 4$ at the points P and Q. The line also cuts x-axis at (7, 0) and y axis at (0, 7)  a) Find the equation of the straight line in the form $y = mx + c$. b) Find the coordinates of p and Q. c) Calculate the area of the shaded region. (8mks)
9.	**2003 Q 16 P1** The velocity $V ms^{-1}$ of particle in motion is given by $V = 3t^2 - t + 4$, where t is time in seconds. Calculate the distance travelled by the particle between the time t=1 second and t=5 seconds. (3 mks)
10.	**2004 Q 13 P2** The gradient function of a curve is given $\frac{dy}{dx} = x^2 - 8x + 2$. If the curve passes through the point, (0, 2), find its equation. (3 mks)
11.	**2004 Q 22 P2** A particle moves in a straight line. It passes though point O at t = 0 with velocity v= 5m/s. The acceleration a m/s^2 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 (3mks) (b) Calculate (i) The velocity of the particle when t = 3 (2 mks) (ii) The distance covered by the particle between t = 2 and t = 4 (3 mks)
12.	**2005 Q 16 P1** The acceleration, a ms^{-2}, of a particle is given by $a = 25 - 9t^2$, where t in seconds after the particle passes fixed point O. If the particle passes O, with velocity of 4 ms^{-1}, find (a) An expression of velocity V, in terms of t (2 marks) (b) The velocity of the particle when t = 2 seconds (2 marks)
13.	**2005 Q 21 P1** The gradient of a curve at point (x,y) is $4x - 3$. the curve has a minimum value of $-\frac{1}{8}$ (a) Find (i) The value of x at the minimum point (1 mark) (ii) The equation of the curve (4 marks)

	b) P is a point on the curve in part (a) (ii) above. If the gradient of the curve at P is -7, find the coordinates of P (3 marks)
14.	**2006 Q 15 P2** A particle moving in a straight line passes through a fixed point O with a velocity of 9m/s. The acceleration of the particle, t seconds after passing through O is given by a = (10 – 2t) m/s^2. Find the velocity of the particle when t – 3 seconds (3 marks)
15.	**2007 Q 5 P2** A particle moves in a straight line through a point P. Its velocity v m/s is given by v= 2 -t, where t is time in seconds, after passing P. The distance s of the particle from P when t = 2 is 5 metres. Find the expression for s in terms of t. (3 marks)
16.	**2009 Q 16 P2** A particle moves in a straight line with a velocity V ms^{-1}. Its velocity after t seconds is given by $V= 3t^2 – 6t -9$ The figure below is a sketch of the velocity-time graph of the particle  Calculate the distance the particle moves between t = 1 and t = 4
17.	**2010 Q 24 P1** A rectangular box open at the top has a square base. The internal side of the base is x cm long and the total internal surface area of the box is 432 cm^2. (a) Express in terms x: (i) The internal height h, of the box. (3mks) (ii) The internal volume V, of the box. (1 mk) (b) Find: i) The value of x for which the volume V is maximum; (4 mks) ii) The maximum internal volume of the box. (2mks)
18.	**2010 Q 11 P2** A particle starts from O and moves in a straight line so that its velocity V ms^{-1} after time *t* seconds is given by $V = 3t – t^2$. The distance of the particle from O at time *t* seconds is *s* metres. a) Express *s* in terms of *t* and *c* where *c* is a constant. (1 mark) b) Calculate the time taken before the particle returns to O. (3 marks)