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MATRICES AND TRANSFORMATIONS

1. **1989 Q12 P2**

   The point (5, 2) undergoes the transformation $\begin{bmatrix} 3 & 2 \\ -1 & 0 \end{bmatrix}$ followed by a translation $\begin{bmatrix} -6 \\ 11 \end{bmatrix}$. Determine the coordinates of the image. (3 marks)

2. **1990 Q16 P1**

   The vertices of a triangle ABC are A(-1, -4), B (3,3) and C (2, 5). Find the image of the triangle under the transformation whose matrix is $\begin{bmatrix} 4 & -2 \\ 6 & -3 \end{bmatrix}$
   Draw the triangle and its image on the same axis. (Grid was provided) (3 marks)

3. **1990 Q21 P2**

   A parallelogram whose vertices are A (1, 0), B (3, 0), C (4, 2) and D (2, 2) is mapped onto a parallelogram A′ B′ C′ D′ by a transformation whose matrix is M.
   Under the transformation the images of A and C are A′ (0, 1) and C′ (-2, 4) respectively.

   i) Find matrix M (3 marks)
   ii) Plot the parallelogram ABCD on its image on the given grid (3 marks)
   iii) A′ B′ C′ D′ is mapped onto ABCD by a transformation T. Obtain the matrix for T. (2 marks)

4. **1991 Q4 P1**

   The image of a point A, under the transformation represented by the matrix
   T = $\begin{bmatrix} 1 & -1 \\ 0 & 2 \end{bmatrix}$ is A′ (-2, 4). Find the coordinates of a. (3 marks)

5. **1991 Q21 P2**

   A rectangle OABC has the vertices O (0, 0), A (2,0), B (2, 3) and C (0, 3).
   O′ A′ B′ C′ is the Image of OABC under the translation given by $\begin{bmatrix} 0 \\ 4 \end{bmatrix}$. O′′A′′ B′′ C′′ is the image of O′ A′ B′ C′ under the transformation given by the matrix $\begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix}$.
   Draw the rectangles OABC, O′ A′ B′ C′ and O′′ A′′ B′′ C′′ on the grid provided.
   (grid was provided). (6 marks)
   Use your diagram to find the centre of rotation which maps OABC onto O′′ A′′ B′′ C′′ (2 marks)

6. **1992 Q18 P1**

   A point p′ (x', y') is the image of a point p(x, y) under a transformation, T, given by the Matrix $\begin{bmatrix} 3 & 4 \\ 4 & -3 \end{bmatrix}$

   a) Express x' and y' in terms of x and y (3 marks)
   b) If appoint Q and its image Q′ under the transformation T lie on the same line y=mx,
   Find two possible values of m (5 marks)

7. **1993 Q12 P1**

   A transformation is represented by the matrix $\begin{bmatrix} 1 & 2 \\ 3 & 2 \end{bmatrix}$. This transformation maps a triangle ABC of the area 3cm^2 onto another triangle A′B′C′. Find the area of triangle A′B′C′. (3 marks)

8. **1993 Q19 P1**

A transformation T_1 maps the triangle ABC whose coordinates are A (-2, 0), B (1, -2)C (0, 1) onto triangle ABC whose coordinates A′(2, 4), B′(4,1), and C′(1, 2). Another transformation T_2 maps the same triangle ABC onto triangle A″B″C″ whose coordinates are A″ (4, 2), B″ (1,4), C″ (2,1).

a) On the same axes plot triangle ABC, A′B′C′ and A″B″C″ (2 marks)

b) Determine

i) T_1

ii) T_2

iii) the matrix of T such that $TT_1 = T_2$ (6 marks)

9. **1994 Q23 P1**

A rectangle ABCD with vertices A (2, 0), B (4, 0), C (4, 4) and D (2,4) is given a Stretch transformation with line x = 2 as the invariant and point (4, 0) being mapped onto point (6,0). The image A′B′C′D′ of the rectangle is enlarged with a scale factor of -2, centre origin, followed by a reflection in the line y = 0.

On the grid below plot the images of the rectangle ABCD after the successive transformation. (Grid was provided)

a) Describe the transformation which map the third image onto the first image (2 marks)

b) Describe the single matrix that will map the matrix on the third image onto the first image (2 marks)

10. **1994 Q7 P2**

Determine the matrix of transformation that represents the following transformation:

Reflection in x + y = 0, followed by a positive quarter turnabout (0, 0) (2 marks)

11. **1995 Q 23 P1**

On the grid provided ABCE is a trapezium

(NB: Coordinates of the figure are A(2,0), B(6, 0), C(6, 5) and D(2,2)).

(a) ABCD is mapped onto A ′B ′C ′D′ by a positive quarter turn. Draw the image A′B′C ′D′ on the grid. (1 mark)

(b) A transformation maps $\begin{bmatrix} -2 & -1 \\ 1 & -1 \end{bmatrix}$ A ′B′C ′D′ onto A ″B ″C ″D″

(i) Obtain the coordinates of A ″B″ C″ D ″ on the grid (2 marks)

(ii) Plot the image A″ B ″C ″D″ on the grid (1 mark)

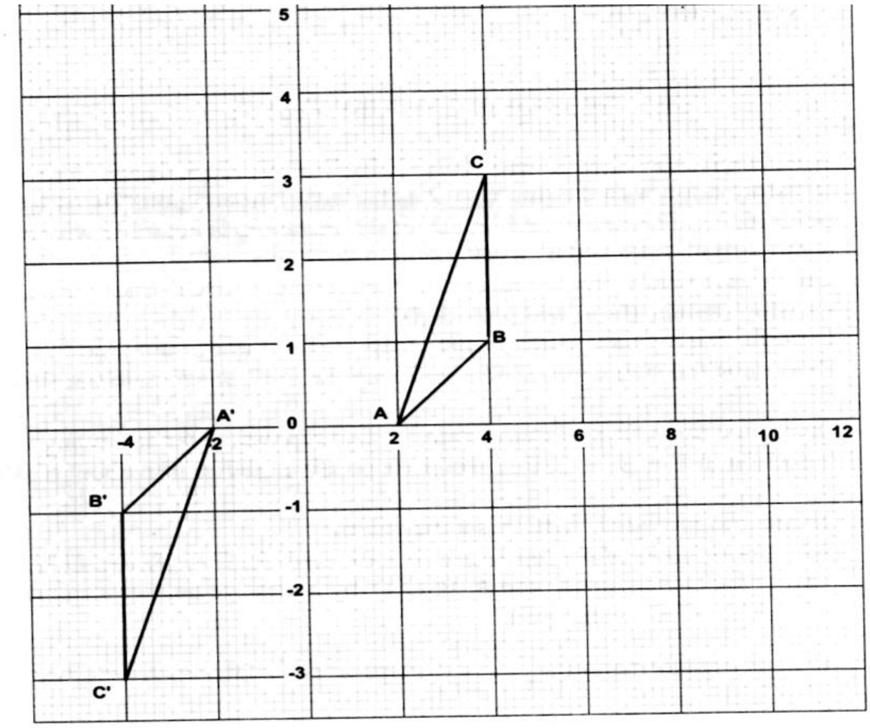
(c) Determine a single matrix that maps A ″B ″C ″D″ and ABCD (4 marks)

12. 1997 Q 23 P1

The figure on the grid shows a triangular shaped object ABC and its image A′ B ′C′

(NB: Coordinates of the figure are A(2,0), B(4, 1), C(4,3)).

(NB: Coordinates of the figure are A'(-2,0), B'(-4, -1), C'(-4,-3)).



(a) (i) Describe fully the transformation that maps ABC and A ′B ′C′ (1 mark)

(ii) Find a 2 x 2 matrix that transforms triangle ABC onto triangle A ′B′C′ (1 mark)

(b) The matrix P = $\begin{bmatrix} 2 & 1 \\ 1 & 1 \end{bmatrix}$ transforms triangle ABC onto A″ B″ C″

(i) Find the coordinates of A ″B ″C″ (2 marks)

(ii) Draw the image A″ B″ C″ (1 mark)

(c) Find the area of triangle ABC (1 mark)

(d) Hence find the area of the image A″B″C″ (2 marks)

13. 1998 Q 19 P1

A quadrilateral ABCD has vertices A (4, -4), B (2, -4), C (6, -6) and D (4, -2)

a) On the grid provided draw the quadrilateral ABCD. (1 mark)

b) A′ B ′C ′D′ is the image of ABCD under positive quarter turn about the origin. On the same grid draw the image A′B′C′D (2 marks)

c) A′ B ′C′ D′ is the image of A′ B ′C′ D′ under the transformation given by the matrix $\begin{bmatrix} 1 & -2 \\ 0 & 1 \end{bmatrix}$ (1 mark)

i) Determine the coordinators of A″B ″C ″D″ (2 marks)

ii) On the same grid draw the quadrilateral A″B ″C ″D″ (1 mark)

d) Determine a single matrix that maps ABCD onto A″B ″C ″D″ (2 marks)

14. 1999 Q 23 P2

The transformation R given by the matrix

A = $\begin{bmatrix} a & b \\ c & d \end{bmatrix}$ maps $\begin{bmatrix} 17 \\ 0 \end{bmatrix}$ to $\begin{bmatrix} 15 \\ 8 \end{bmatrix}$ and $\begin{bmatrix} 0 \\ 17 \end{bmatrix}$ to $\begin{bmatrix} -8 \\ 15 \end{bmatrix}$

(a) Determine the matrix **A** giving a, b, c and d as fractions (3 marks)

(b) Given that **A** represents a rotation through the origin determine the angle of rotation

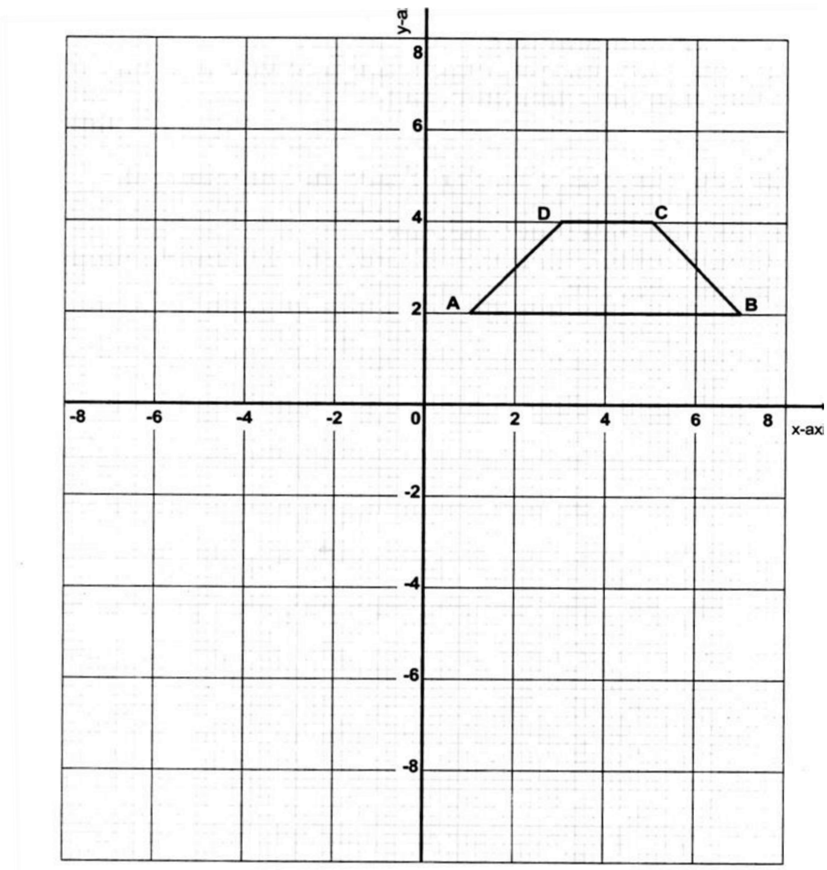
(2 marks)

(c) **S** is a rotation though 180^0 about the point (2, 3). Determine the image of (1,0) under S followed by **R**. (3 marks)

15. 2000 Q 23 P2

The diagram on the grid provided below shows a trapezium ABCD On the same grid

(NB: Coordinates of the figure are A (1, 2), B (7, 2), C (5,4)D(3, 4)).



(a) (i) Draw the image A ′B ′C ′D of ABCD under a rotation of 90^0 clockwise about the origin . (1 mark)

(ii) Draw the image A″B ″C″ D″ of A′ B′ C′ D′ under a reflection in line y = x. State coordinates of A″B ″C″ D″ (3 marks)

(b) A‴B ‴C‴ D‴ is the image of A″B ″C″ D″ under the reflection in the line x=0.
Draw the image A‴B ‴C ‴D‴ and state its coordinates. (2 marks)

(c) Describe a single transformation that maps A‴B‴ C‴ D‴ onto ABCD. (2 marks)

16. **2001 Q 18 P1**

The coordinates of the vertices of rectangle PQRS are P (1, 1), Q (6, 1), R (6, 4) and S (1, 4)

(a) (i) Find the coordinates of the vertices of its image, P ′Q′ R′S′ under the transformation defined by the matrix $\begin{bmatrix} 1 & -2 \\ 0 & 1 \end{bmatrix}$ (2 marks)

(ii) Draw the object and its image on the grade provided (2 marks)

(iii) On the same grid draw the image, P″Q″R″S″ of P ′Q ′R ′S′ under the transformation given by $\begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}$ (2 marks)

(b) Find a single matrix which will map P″Q″R″S″ onto PQRS (2 marks)

17. **2002 Q 22 P1**

A triangle T whose vertices are A (2, 3) B(5,3) and C (4,1) is mapped onto triangle T_1 whose vertices are A_1 (-4,3) B_1 (-1,3) and C_1 (x,y) by a Transformation

M = $\begin{bmatrix} a & b \\ c & d \end{bmatrix}$

Find the: (i)Matrix M of the transformation (4 marks)

(ii)Coordinates of C_1 (2 marks)

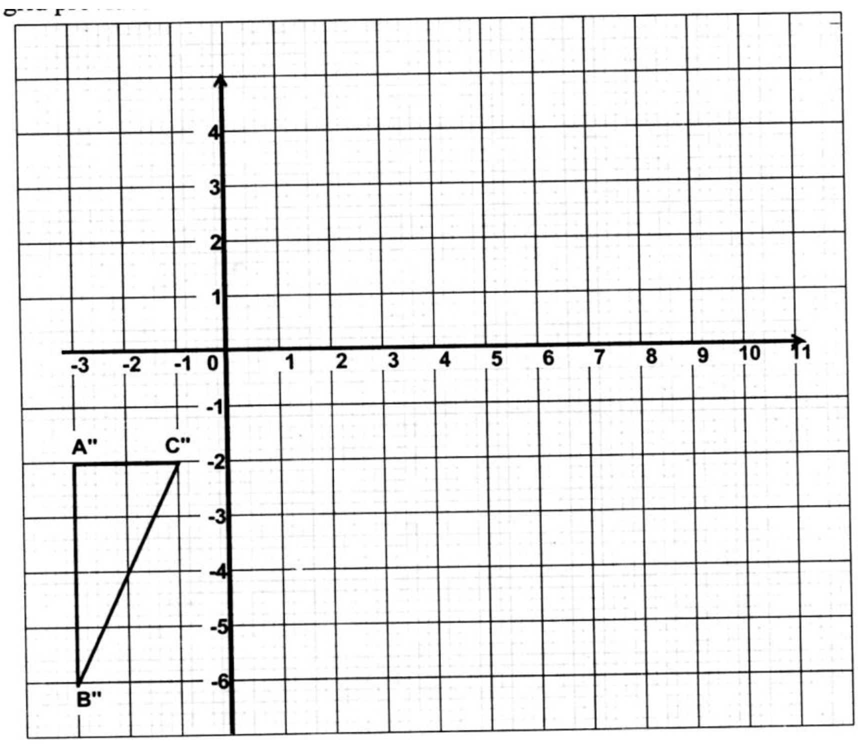
b) Triangle T^2 is the image of triangle T^1 under a reflection in the line y = x. (2 marks)
Find a single matrix that maps T and T^2

18. **2004 Q 21 P2**

Triangle ABC is the image of triangle PQR under the transformation M = $\begin{bmatrix} 2 & 4 \\ 0 & 2 \end{bmatrix}$

Where P, Q and P map onto A, B, and C respectively.

(a) Given the points P(5, -1), Q(6,-1) and R (4, -0.5), draw the triangle ABC on the grid provided below. (3 marks)



(b) Triangle ABC in part (a) above is to be enlarged scale factor 2 with centre at (11, -6) to map onto A ′B′C′. Construct and label triangle A ′B ′C′ on the grid above. (2 marks)

(c) By construction find the coordinates of the centre and the angle of rotation which can be used to rotate triangle A ′B ′C′ onto triangle A ″B ″C″, shown on the grid above.

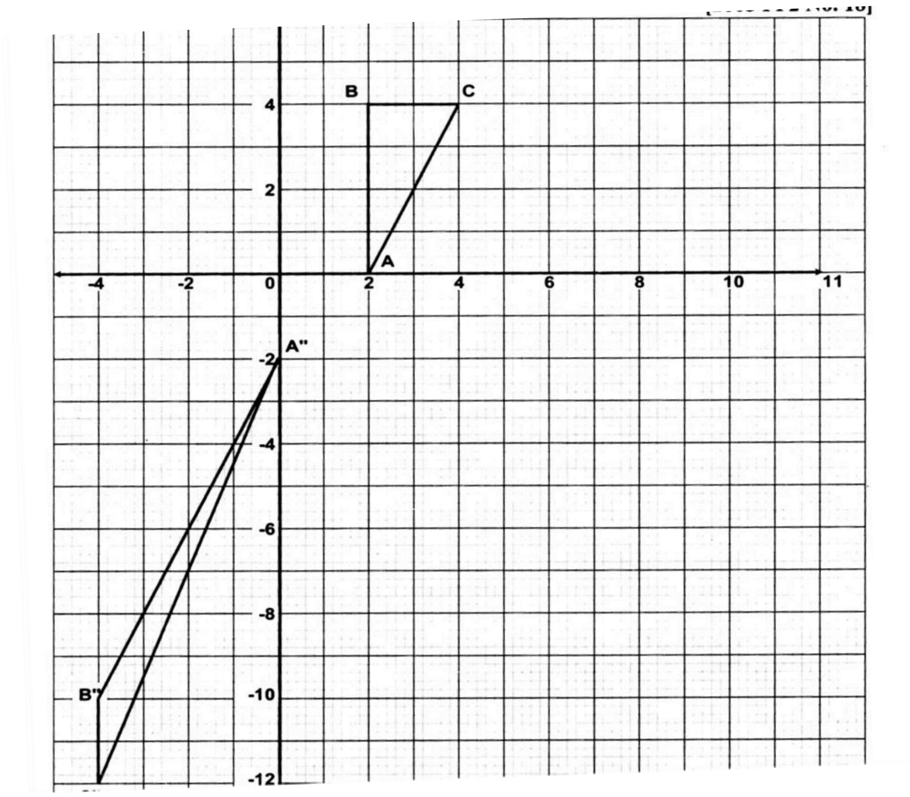
(3 marks)

19. 2005 Q 18 P2

Triangles ABC and A ″B ″C″ are drawn on the Cartesian plane provided.
Triangle ABC is mapped onto A ″B″C″ by two successive transformations

(NB: Coordinates of the figure are A (2, 2), B(2, 4), C (4,4)).

(NB: Coordinates of the figure are A" (0,- 2), B (-4, -10), C (-4,-12)).



R = $\begin{bmatrix} a & b \\ c & d \end{bmatrix}$ Followed by P = $\begin{bmatrix} 0 & -1 \\ -1 & 0 \end{bmatrix}$

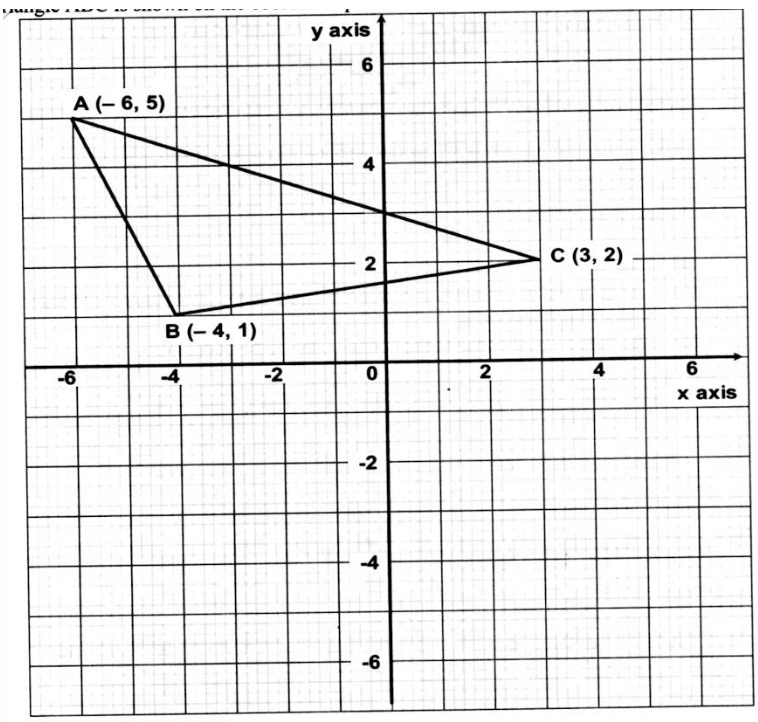
(a) Find R (4 marks)

(b) Using the same scale and axes, draw triangle A ″B ″C″, the image of triangle ABC under transformation R (2 marks)

(c) Describe fully, the transformation represented by matrix R (2 marks)

20. 2006 Q 19 P2

Triangle ABC is shown on the coordinates plane below



(a) Given that A (-6, 5) is mapped onto A′ (6,-4) by a shear with y- axis invariant

(i) draw triangle A′ B′ C′, the image of triangle ABC under the shear (3 marks)

(ii) Determine the matrix representing this shear (2 marks)

(b) Triangle A′ B′ C′ is mapped on to A″ B″ C″ by a transformation defined by the matrix $\begin{bmatrix} -1 & 0 \\ 1\frac{1}{2} & -1 \end{bmatrix}$

(i) Draw triangle A″ B″ C″ (3 marks)

(ii) Describe fully a single transformation that maps ABC onto A″ B″ C″ (2 marks)

21. 2008 Q 10 P2

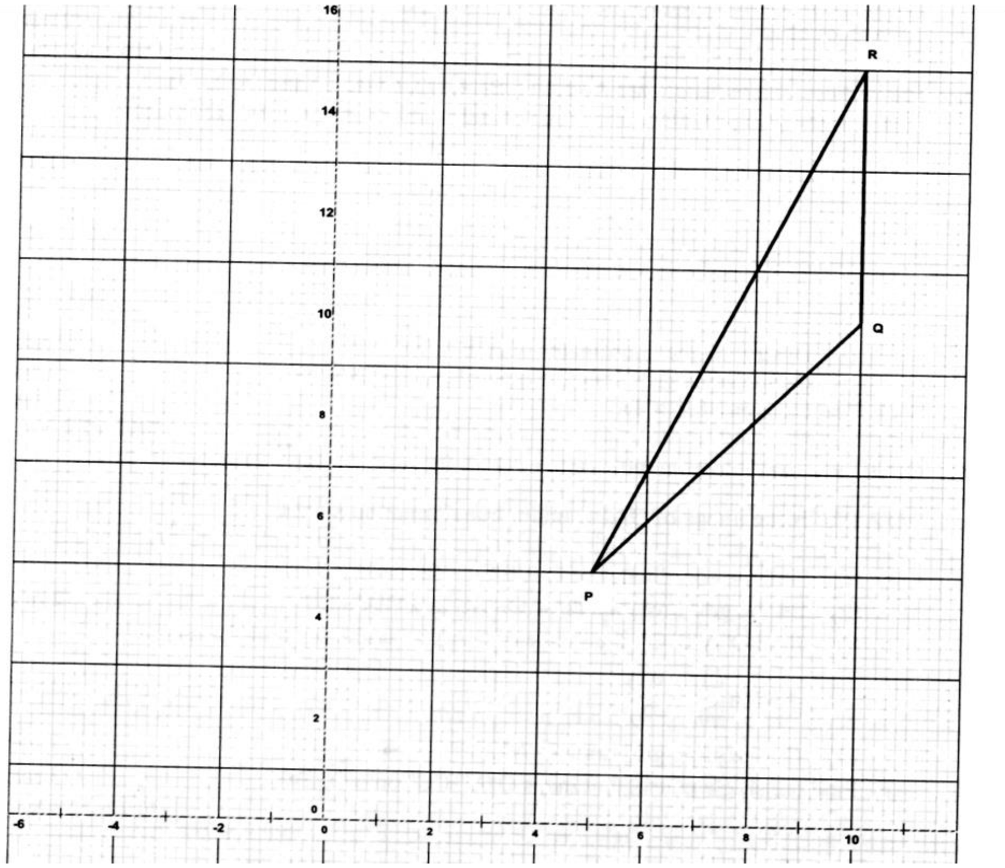
Points A(2,2)and B(4,3) are mapped onto A′(2,8) and B′ (4,15) respectively by a transformation T. Find the matrix of T. (4 marks)

22. 2009 Q 9 P2

The area of triangle FGH is 21cm^2. The triangle FGH is transformed using the matrix $\begin{bmatrix} 4 & 5 \\ 1 & 2 \end{bmatrix}$ Calculate the area of the image of triangle FGH (2 marks)

23. 2009 Q 20 P2

Triangle PQR shown on the grid has vertices P(5,5) Q(10,10) and R(10,15)



(a) Find the coordinates of the points P′, Q′ and R′, the images of P, Q and R respectively under transformation M whose matrix is $\begin{bmatrix} -0.6 & 0.8 \\ 0.8 & 0.6 \end{bmatrix}$ (2 marks)

(b) Given that M is a reflection

(i) Draw triangle P′ Q′ R′ and the mirror line of the reflection (2 marks)

(ii) Determine the equitation of the mirror line of the reflection (1 mark)

(c) Triangle P″Q″R″ is the image of triangle P′ Q′ R′ under reflection N where N is a reflection in the y-axis

(i) Draw triangle P″Q″R″ (1 mark)

(ii) Determine a 2 x 2 matrix equivalent to the transformation NM (2 marks)

(iii) Describe fully a single transformation that maps triangle PQR onto triangle P″Q″R″ (2 marks)

24. 2010 Q 10 P2

The point O, A and B have the coordinates (0,0), (4,0) and (3,2) respectively. Under shear represented by the matrix $\begin{bmatrix} 1 & k \\ 0 & 1 \end{bmatrix}$,triangle OAB maps onto triangle OAB′

a) Determine in terms of *k*, the *x* coordinates of point B′ (2 marks)

b) If OAB′ is a right angled triangle in which angle OB′ A is acute, find two possible values of *k*. (2 marks)

25. **2011 Q 19 P2**

The vertices of a rectangle are A(-1,-1) , B(-4,-1) , C(-4,-3) and D(-1,-3).

a) On the grid provided, draw the rectangle and its image A′ B′ C′ D′ Under a transformation whose matrix is $\begin{bmatrix} -2 & 0 \\ 0 & -2 \end{bmatrix}$ (4 marks)

b) A″ B″ C″ D″ is the image of A′ B′C′D′ under a transformation matrix,

P= $\begin{bmatrix} \frac{1}{2} & 1 \\ 1 & \frac{1}{2} \end{bmatrix}$

i) Determine the coordinates of A″ B″ C″D″ (2 marks)

ii) On the same grid draw the quadrilateral A″B″C″ D″ (1mark)

c) Find the area of ABCD. (3 marks)

26. **2012 Q18 P2**

OABC is a parallelogram with vertices O(0,0), A(2,0), B(3,2) and C(1,2).

O'A'B'C' is the image of OABC under the transformation matrix $\begin{bmatrix} -2 & 0 \\ 0 & -2 \end{bmatrix}$

(i) Find the coordinates of O'A'B'C' (2 marks)

ii) On the grid provided draw OABC and O'A'B'C' (2 marks)

(a) (i) Find O''A''B''C'', the image of O'A'B'C' under the transformation matrix $\begin{bmatrix} 1 & 0 \\ 0 & -2 \end{bmatrix}$ (2 marks)

(ii) On the same grid draw O''A''B''C''. (1 mark)

(c) Find the single matrix that maps O''A''B''C'' onto OABC. (3 marks)

27. **2013 Q16 P2**

The vertices of triangle T are A(1, 2), B(4, 2) and C(3, 4). The vertices of triangle T', the image of T are A'($\frac{1}{2}$,1) , B'(2,1) and C'($\frac{3}{2}$, 2).

Determine the transformation matrix $M = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$ that maps T onto T'.

(3 marks)

28. **2014 Q7 P2**

In a transformation, an object with an area of 5 cm^2 is mapped onto an image whose area is $30cm^2$. Given that the matrix of the transformation is $\begin{bmatrix} x & x-1 \\ 2 & 4 \end{bmatrix}$, find the value of x.

(3 marks)

29. **2015 Q24 P2**

A quadrilateral with vertices at K (1,1), L(4,1), M(2, 3) and N (1, 3) is transformed by a matrix T = $\begin{bmatrix} 1 & 3 \\ 0 & 1 \end{bmatrix}$ to a quadrilateral K'L'M'N'

a) Determine the coordinates of the image (3 marks)

b) On the grid provided draw the object and the image (2 marks)

c i)Describe fully the transformation which maps KLMN onto K'L'M'N (2 marks)

ii)Determine the area of the image. (1 mark)

d)Find a matrix which maps K'L'M;N' onto KLMN (2 marks)

STATISTICS II

1. **1989 Q12 P1**

The table below shows the defective bolts from 40 samples

No. of detective bolts (x)	0	1	2	3	4	5
Frequency (y)	20	8	6	4	1	1

Calculate the standard deviation (5 marks)

2. **1989 Q20 P2**

The table below shows the life expectancy, in hours, of 106 bulbs

Expectancy (hours)	90-94	95-99	100-104	105-109	110-114	115-119	120-124	125-129	130-134	135-139
Frequency (f)	5	14	16	17	24	12	11	4	2	1

(a) Calculate the mean life expectancy, (4 marks)
(b) On the grid provided draw a cumulative frequency curve and use it to Determine the median

(4 marks)

3. **1990 Q23 P1**

For a sample of 100 bulbs the time taken for each bulb to burn out was recorded. The table below shows the results of the measurements.

Time (hours)	12-19	20-24	25-29	30-34	35-39	40-44
Frequency (Number of bulbs)	6	10	9	5	7	11

Time (hours)	45-49	50-54	55-59	60-64	65-69	70-74
Frequency (Number of bulbs)	15	13	8	7	5	4

Using an assumed mean or otherwise, calculate

(i) The mean
(ii) The standard deviation of the distribution (8 marks)

4. **1991 Q22 P1**

The table below gives marks scored by 80 candidates in a test

Marks	1-10	11-20	21-30	31-40	41-50
No. of candidates	5	13	32	27	3

Using an assumed mean of 25.5 calculate the mean, the variance and the standard deviation of the marks (8 marks)

5. **1992 Q 23 P1**

Lengths of 100 mango leaves from a certain mango tree were measured to the nearest centimeter and recorded as per the table below

Lengths in cm	No. of leaves
10 to 12	3
13 to 15	12
16 to 18	40
19 to 21	37
22 to 24	8

(a) On the grid provided, draw a cumulative frequency graph to represent this data

(4 marks)

(b) Use the graph to estimate

(i) The median length of the leaves (1 mark)

(ii) The number of leaves whose lengths lie between 13 and 17cm

(3 marks)

6. 1993 Q20 P2

The table below shows the distribution of marks scored in a test by standard 8 pupils in one school.

Marks	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79
No. of pupils	1	5	10	10	19	20	20	8	4	3

Using 57 as the assumed mean mark, calculate

(i) The actual mean for the grouped marks (3 marks)

(ii) The standard deviation of the marks (5 marks)

7. 1994 Q10 P1

Determine the interquartile range for the following numbers: (3 marks)

4, 9, 5, 4, 7, 6, 2, 1, 6, 7, 8.

8. 1994 Q21 P2

The table below gives marks obtained in a mathematics test by 47 candidates

Marks	31-35	36-40	41-45	46-50	51-55	56-60
No. of candidates	4	6	12	15	8	2

(a) Calculate the mean score

(b) Draw a cumulative frequency graph and use it to estimate

(i) The median score (2 marks)

(ii) The semi-interquartile range (6 marks)

9. 1995 Q18 P2

The table below shows high altitude wind speeds recorded at a weather station in a period of 100 days.

Wind speed (knots)	0 - 19	20 - 39	40 - 59	60-79	80- 99	100- 119	120-139	140-159	160-179
Frequency (days)	9	19	22	18	13	11	5	2	1

(a) On the grid provided draw a cumulative frequency graph for the data (4 marks)

(b) Use the graph to estimate

(i) The interquartile range (3 marks)

(ii) The number of days when the wind speed exceeded 125 knots (1 mark)

10. **1996 Q10 P1**

Five pupils A, B, C, D and E obtained the marks 53, 41, 60, 80 and 56 respectively. The table below shows part of the work to find the standard deviation.

Pupil	Mark x	$x - \bar{x}$	$(x-\bar{x})^2$
A	53	-5	
B	41	-17	
C	60	2	
D	80	22	
E	56	-2	

(a) Complete the table (1 mark)

(b) Find the standard deviation (3 marks)

11. **1996 Q19 P2**

In an agricultural research centre, the lengths of a sample of 50 maize cobs were measured and recorded as shown in the frequency distribution table below.

Length in cm.	Number of cobs.
8 – 10	4
11 – 13	7
14 – 16	11
17 – 19	15
20 – 22	8
23 – 25	5

Calculate;

a) the mean

b) i) the variance

ii) the standard deviation (8 marks)

12. **1997 Q22 P2**

The table below shows the frequency distribution of masses of 50 new-born Calves in a ranch.

Mass (kg)	Frequency
15 – 18	2
19 – 22	3
23 – 26	10
27 – 30	14
31 – 34	13
35 – 38	6
39 – 42	2

a) On the grid provided draw a cumulative frequency graph for the data (4 marks)

b) Use the graph to estimate

(i) the median mass (1 mark)

(ii) the probability that a calf picked at random has a mass lying between 25kg and 28 kg

(3 marks)

13. 2001 Q18 P2

The marks obtained by 10 pupils in an English test were 15, 14, 13, 12, P, 16,11,13,12 and 17.The sum of the squares of the marks, $\sum x^2$ is 1,794

a) Calculate the:

i) Value of P (2 marks)

ii) Standard deviation. (4 marks)

b) If each mark is increased by 3, write down the:

i) New mean (1 mark)

ii) New standard deviation (1 mark)

14. 2002 Q19

The following distribution shows the masses to the nearest kilogram of 65 animals in a certain farm.

Mass Kg	26-30	31-35	36-40	41-45	46-50	51-55
frequency	9	13	20	15	6	2

a) On the grid provided draw the cumulative frequency curve for the given information.

(3 marks)

b) Use the graph to find the:-

i) Median mass

ii) Inter-quartile range

iii) Percentage of animals whose mass is at least 42kg. (5 marks)

15. 2003 Q18 P1

The mass of 40 babies in a certain clinic were recorded as follows:

Mass in Kg	No. of babies.
1.0 – 1.9	6
2.0 – 2.9	14
3.0 -3.9	10
4.0 – 4.9	7
5.0 – 5.9	2
6.0 – 6.9	1

Calculate

(a) The inter – quartile range of the data. (4 marks)

(b) The standard deviation of the data using 3.45 as the assumed mean (4 marks)

16. 2004 Q18 P2

The table below shows the ages in years of 60 people who attended a conference.

Age in years	30 – 39	40- 49	50- 59	60- 69	70-79
Number of people	10	12	18	17	3

Calculate

(a) The inter-quartile range of the data (5 marks)

(b) The percentage of the people in the conference whose ages were 54.5 years and below.

(3 marks)

17. 2005 Q22 P1

The data below shows the masses in grams of 50 potatoes

Mass (g)	25- 34	35-44	45 - 54	55- 64	65 - 74	75-84	85-94
No of potatoes	3	6	16	12	8	4	1

(a) On the grid provided, draw a cumulative frequency curve for the data (4 marks)

(b) Use the graph in (a) above to determine

(i) The 60^{th} percentile mass (1 mark)

(ii) The percentage of potatoes whose masses lie in the range 53 g to 68g (3 marks)

18. 2006 Q5 P2

The data below represents the ages in months at which 6 babies started walking: 9,11, 12, 13, 11, and 10. Without using a calculator, find the exact value of the variance (3 marks)

19. 2008 Q22 P2

The table below shows the distribution of marks scored by 60 pupils in a test.

Marks	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90
Frequency	2	5	6	10	14	11	9	3

a) On the grid provided, draw an ogive that represents the above information (4 marks)

b) Use the graph to estimate the interquartile range of this information. (3 marks)

20. 2009 Q19 P2

The table below shows the number of goals scored in handball matches during a tournament

Number of goals	0-10	10-19	20-29	30-39	40-49
Number of matches	2	14	24	12	8

(a) Draw a cumulative frequency curve on the grid provided (5 marks)

(b) Using the curve drawn in (a) above determine
- (i) The median; (1 mark)
- (ii) The number of matches in which goals scored were not more than 37; (1 mark)
- (iii) The inter-quartile range

21. 2010 Q8 P2

The heights, in centimeters, of 100 tree seedlings are shown in the table below.

Height (cm)	10-19	20-29	30-39	40-49	50-59	60-69
Number of seedlings	9	16	19	26	20	10

Find the quartile deviation of the heights. (4 marks)

22. 2012 Q8 P2

The masses in kilograms of 20 bags of maize were ;

90,94,96,98,99,102,105,91,102,99,105,94,99,90,94,99,98,96,102 and 105.

Using an assumed mean of 96kg, calculate the mean mass, per bag, of the maize (3 marks)

23. 2013 Q24 P2

The table below shows marks scored by 42 students in a test.

35	49	69	57	58	75	48
40	46	86	47	81	67	63
56	80	36	62	49	46	26
41	58	68	73	65	59	72
64	70	64	54	74	33	51
73	25	41	61	56	57	28

a) Starting with the mark of 25 and using equal class intervals of 10, make a frequency distribution table. (2 marks)

b) On the grid provided , draw the ogive for the data (4 marks)

c) Using the graph in (b) above , estimate:

(i) The median mark (2 marks)

(ii) The upper quartile mark (2 marks)

24. 2015 Q23 P2

The marks scored by 40 students in a mathematics test were as shown in the table below.

Marks	48-52	53-57	58-62	63-67	68-72	73-77
Number of students	3	4	10	12	8	3

a) Find the lower class boundary of the modal class (1 marks)

b) Using an assumed mean of 64, calculate the mean mark (3 marks)

ci)On the grid provided, draw the cumulative frequency curve for the data (3 marks)

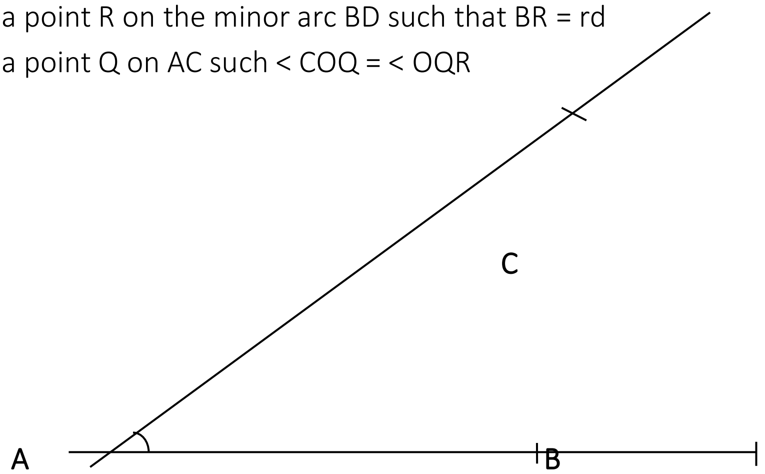
ii)Use the graph to estimate the semi-interquartile range (3 marks)

GEOMETRIC CONSTRUCTION AND LOCI

1 1989 Q20 P1

Use the straight lines AB and AC given below for the following construction.
A circle centre, O touches the line AC at C and passes through B.

(a) Use ruler and compasses only to locate the centre O. Draw the circle (3 marks)
(b) The circle cuts AB produced at D. Mark D and measure BD (1 mark)
(c) Locate a point R on the minor arc BD such that BR = rd (2 marks)
(d) Locate a point Q on AC such < COQ = < OQR (2 marks)

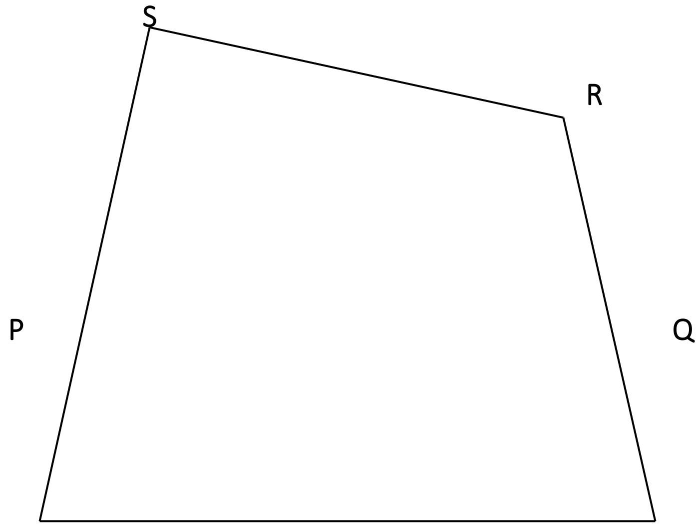


BD = cm

2 1989 Q5 P2

Construct triangle PST equal in area to quadrilateral PQRS such that T lies on PQ produced.

(4 marks)



3 1990 Q8 P1

Draw a line AB of length 9cm. On one side of the line AB construct the locus of a point P such that the area of triangle APB is $13.5cm^2$. On this locus locate two positions of P, P_1 and P_2 such that $<AP_1B = <AP_2B = 90^0$. (4 marks)

4 1990 Q17 P2

Use ruler and compass only for all the constructions in this question
A triangular plot of land ABC is such that AC = 300m, AB =280m and angle BAC = 75^0.

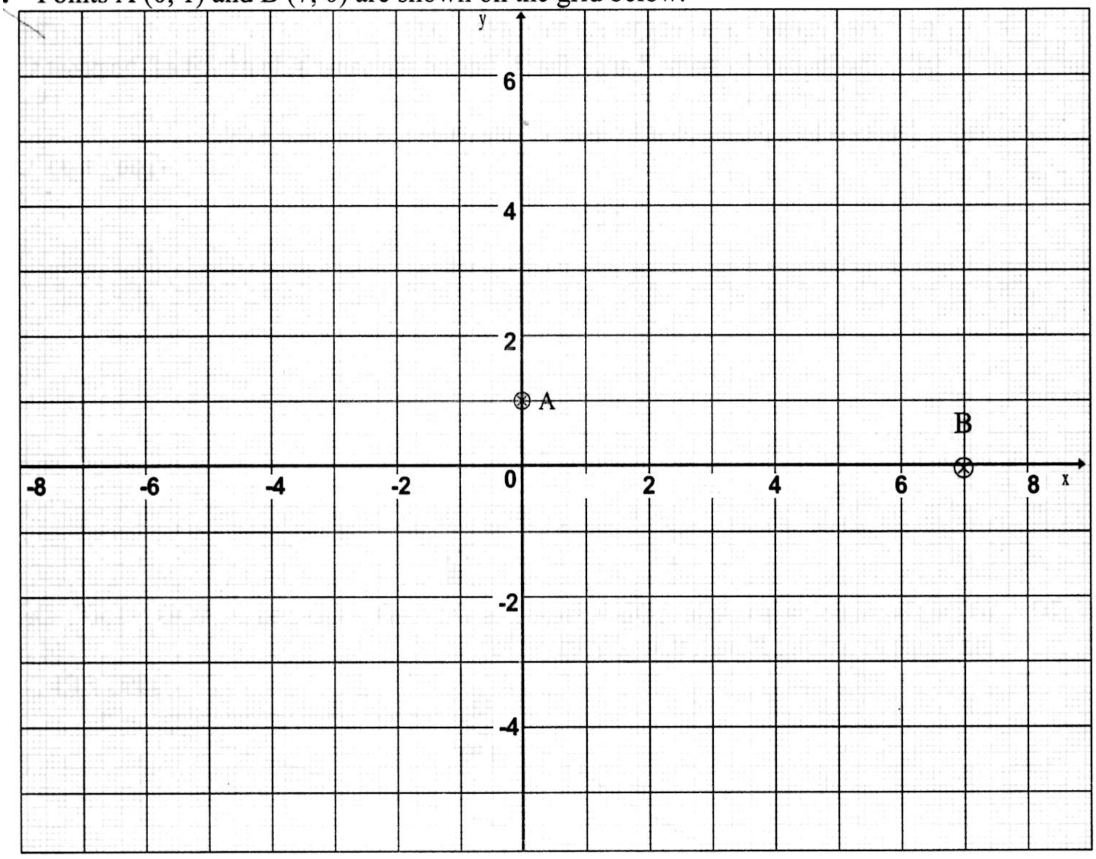
(a) Construct this plot of land using the scale 1cm : 50m (3 marks)

(b) A borehole P is equidistant from BA and lies on the perpendicular from C to AB.
Locate the position of P (3 marks)

(c) Find the point on this farm which is furthest from the borehole. What is its distance from the borehole? (2 marks)

5. 1991 Q8 P1

Points A (0, 1) and B (7, 0) are shown on the grid below.



Using ruler and compasses construct

(i) the locus of a point P such that P is equidistant from A and B,

(ii) the locus of Q such that AQ = 5 cm.

Write down the coordinates of the intersection of the two loci. (3 marks)

6. 1991 Q22 P2

Using ruler and compasses only construct an acute angled triangle ABC such that <ABC = 45^0, BC = 9cm and AC = 7cm.

(3 marks)

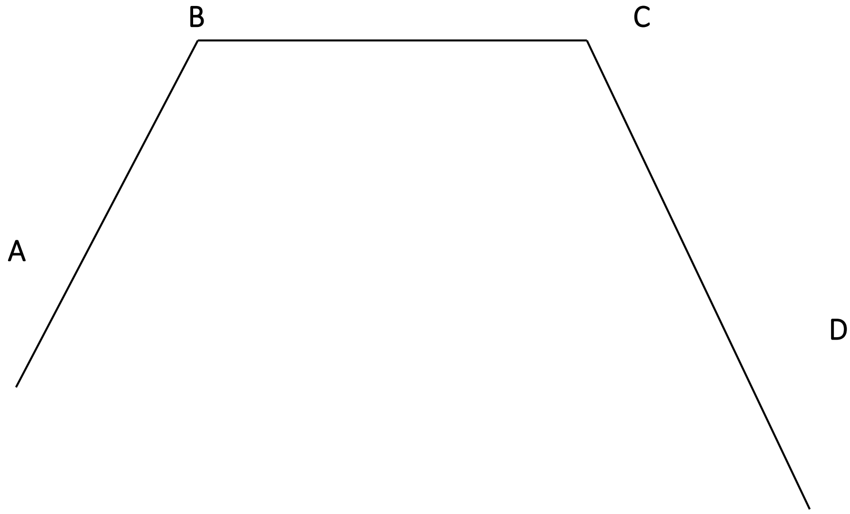
Locate appoint x in triangle ABC such that x is equidistant from A, B and C. (2 marks)
Measure AX, AB and < AXC. (3 marks)

7. 1992 Q8 P1

A point P moves so that its distance from the fixed point Q (2,3) is equal to 5 units. Draw the locus of P on the grid provided. Hence find the coordinates of the points were the locus of P cuts the x axis. (grid was provided) (3 marks)

8. 1992 Q13 P2

Using a ruler and a pair of compasses only, construct a circle to touch the three lines AB, BC and CD given below. (3 marks)



9. 1992 Q21 P2

(a) Use the points given below to construct

(i) The locus of a point Q such that AQ = AC (2 marks)

(ii) The locus of a point P such that P lies on the same side of AB as the point C and <APB = 45^0. (5 marks)

(b) The loci intersect at M and N. measure the distance MN. (1 mark)

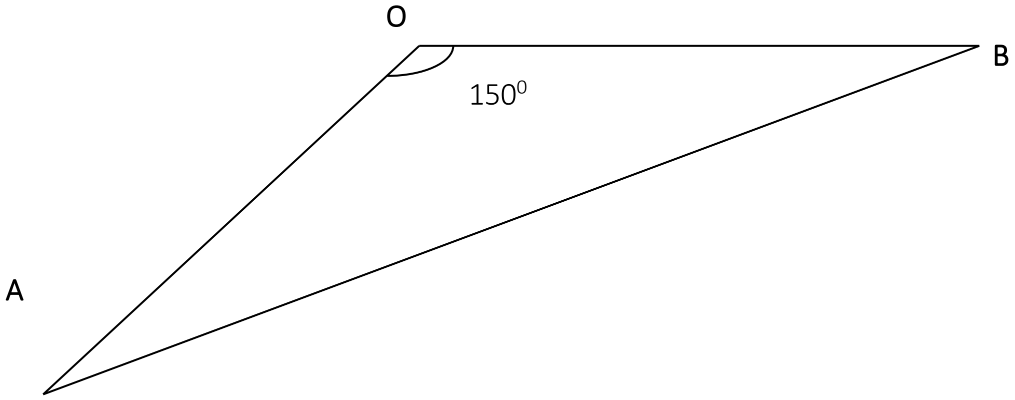
X C

X A

X B

10. 1993 Q11 P1

In the figure below triangle AOB is isosceles with AO = OB and <AOB = 150^0.Draw the locus of a point P such that <APB = 75^0.



11. 1993 Q19 P2

Using a ruler and a pair of compasses only, construct a triangle ABC in which ABC = $37\frac{1}{2}^0$, BC = 7cm and BA = 6cm. Drop a perpendicular from A TO BC to meet BC at D. Measure AD. Hence calculate the area of the triangle (8 marks)

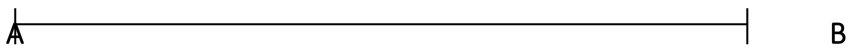
12. 1994 Q19 P1

On the line AB below and on the same side of the line, use ruler and compasses only to construct the following:

(a) Triangle ABC whose area is $20cm^2$ and ACB = 90^0. (3 marks)

(b) (i) the locus of a point P such that APB = 45^0 (2 marks)

(ii)locate the position of P such that triangle APB has maximum area and calculate this area (3 marks)



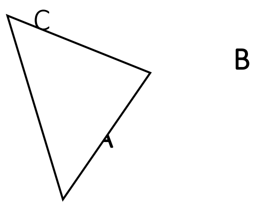
13. 1995 Q22 P2

Using ruler and compasses only, construct a parallelogram ABCD such that AB = 10cm, BC = 7cm and < ABC = 105^0. Also construct the loci of P and Q within the parallel such that AP ≤ 4 cm, and BC ≤ 6 cm. Calculate the area within the parallelogram and outside the regions bounded by the loci. (8 marks)

14. 1996 Q5 P2

Using the equilateral triangle below, construct the locus of a point P such that <APC = 30^0

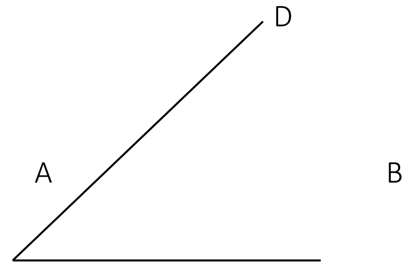
(3 marks)



15. **1996 Q23 P1**

Use ruler and compasses only in this question. The diagram below shows three points A, B and D.

(a) Construct the angle bisector of acute angle BAD. (1 mark)



(b) A point p, on the same side of AB as D, moves in such a way that

$<APB = 22\frac{1}{2}^0$ Construct the locus of P (6 marks)

(c) The locus of P meets the angle bisector of < BAD at C. Measure <ABC (1 mark)

16. **1997 Q19 P1**

Using ruler and compasses only construct triangle ABC such that AB = 4 cm, BC = 5cm and < ABC = 120^0. Measure AC. (3 marks)

On the diagram, construct a circle which passes through the vertical of the triangle ABC.

Measure the radius of the circle (4 marks)

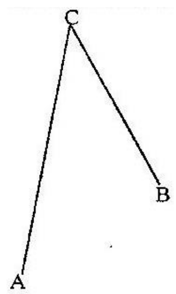
Measure the shortest distance from the centre of the circle to line BC. (1 mark)

17. **1997 Q4 P2**

On the figure below construct

(i) the perpendicular bisector of BC (1 mark)

(ii) The locus of a point P which moves such a way that ∠ APB = ∠ AVB and P is on the same side of AB on the same side of AB as C (2 marks)



18. **1998 Q23 P1**

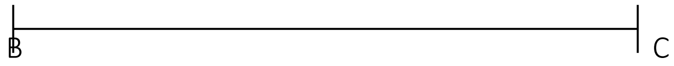
Use a ruler and a pair of compasses only for all constructions in this question.

(a) On the line BC given below, construct triangle ABC such that < ABC = 30^0 and BA = 12 cm (3 marks)

(b) Construct a perpendicular from A to meet BC produced at D.
Measure CD (2 marks)

(c) Construct triangle A'BC such that the area of triangle A'BC is three quarters of the area of triangle ABC and on the same side of BC as triangle ABC. (2 marks)

(d) Describe the locus of A’ (1 mark)

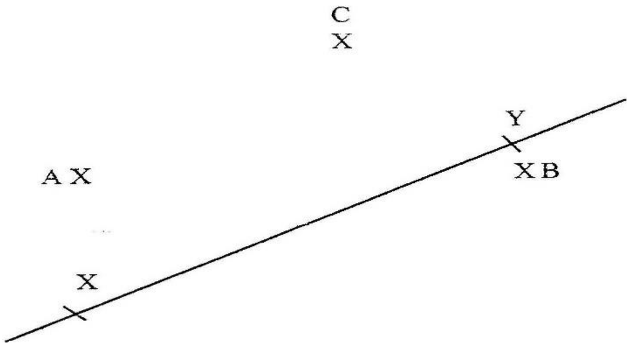


19. **1998 Q8 P2**

In the figure below a line XY and three points. A,B and C are given. On the figure construct

(a) The perpendicular bisector of AB (1 mark)

(b) A point P on line xy such that < APB= < ACB (2 marks)



20. **1999 Q11 P1**

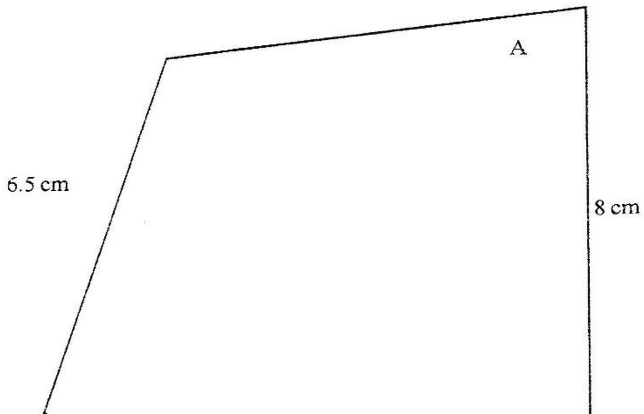
Given below is line BC. Without using a protractor construct another through B making an angle of $37\frac{1}{2}^0$ with BC. Using the constructed line subdivide BC into 7 equal parts.

B ———————————————— C

(4 marks)

21. **1999 Q21 P2**

The diagram below shows a garden drawn to scale of 1: 400. In the garden there are already tow trees marked A and B. The gardener wises to plant more trees. There are a number of rules he wishes to apply.



Rule 1: Each new tree must be an equal distance from both trees A and B.
Rule 2: Each new tree must be atleast 4 m from the edges of the garden.
Rule 3: each new tree is atleast 14 m from tree B.

(a) draw the locus given by each of these rules on the diagram (6 marks)
(b) If the new trees are to be planted 4m apart, show on your diagram the possible planting points for the new trees. (2 marks)

22. **2000 Q22 P2**

The line segment BC given below is one side of triangle ABC

(a) Use a ruler and compasses to complete the construction of a triangle ABC in Which < ABC = 45^0. AC = 5.6 cm and angle BAC is obtuse (2 marks)

(b) Draw the locus of point P such that P is equidistant from a point O and passes though the vertices of triangle. (2 marks)

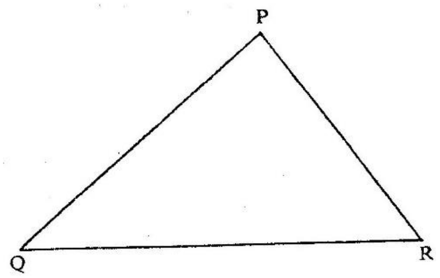
(c) Locate point D on the locus of P equidistant from lines BC and BO. Q lies in the region enclosed by lines BD, BO extended and the locus of P. Shade the locus of Q. (2 marks)

23. **2001 Q8 P1**

Use a ruler and compasses in this question. Draw a parallelogram ABCD in which AB = 8 cm, BC = 6 cm and <BAD = 75^0. By construction, determine the perpendicular distance between AB and CD. (4 marks)

24. **2001 Q14 P2**

The diagram below represents a field PQR.



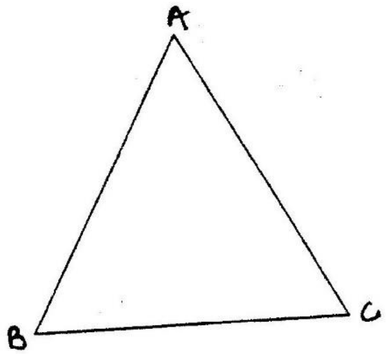
a) Draw the locus of points equidistant from sides PQ and PR. (1 mark)

b) Draw the locus of points equidistant from points P and R. (1 mark)

c) a coin is lost within a region which is nearest to point P than to R and closer to side PR than to side PQ. Shade the region where the coin can be located. (1 mark)

25. 2002 Q10 P1

The figure below shows a triangle ABC.



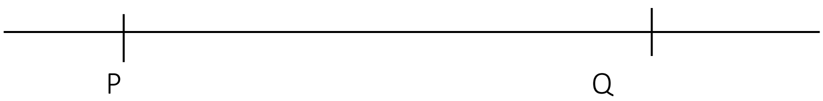
a) Using a ruler and a pair of compasses, determine a point D on the line BC such that BD:DC = 1:2. (2 marks)

b) Find the area of triangle ABD, given that AB = AC. (2 marks)

26. 2002 Q21 P1

In this question use a ruler and a pair of compasses.

a) Line PQ drawn below is part of a triangle PQR. Construct the triangle PQR in which < QPR = 30^0 and line PR = 8cm (2 marks)

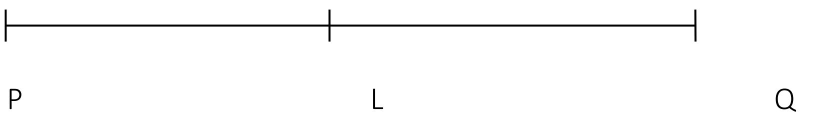


b) On the same diagram construct triangle PRS such that points S and Q are no the opposite sides of PR<PS = PS and QS = 8cm (2 marks)

c) A point T is on the a line passing through R and parallel to QS. If <QTS =90^0, locate possible positions of T and label them T_1 and T_2, Measure the length of T_1T_2. (2 marks)

27. 2003 Q22 P2

The line PQ below is 8cm long and L is its midpoint



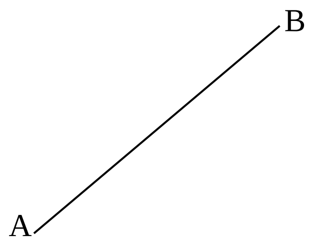
a) i) Draw the locus of point R above line PQ such that the area of triangle PQR is $12cm^2$. (2 marks)

ii) Given that point R is equidistant from P and Q, show the position of point R. (2 marks)

b) Draw all the possible loci of a point T such that < RQL = <RTL. (4 marks)

28. **2004 Q6 P1**

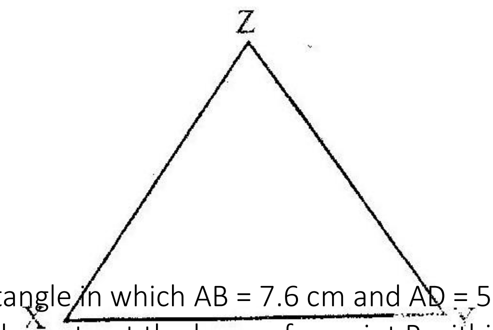
Point C divided the line AB given below externally in the ratio 5:2



By construction, determine the position of point c (3 marks)

29. **2004 Q15 P2**

The figure below is a triangle XYZ. Using a pair of compasses and a ruler only, construct an escribed circle such that the centre of the circle and the point x are the opposite sides of line YZ. (2 marks)



30. **2005 Q20 P2**

(a) BCD is a rectangle in which AB = 7.6 cm and AD = 5.2 cm. draw the rectangle and construct the locus of a point P within the rectangle such that P is equidistant from CB and CD (3 marks)

(b) Q is a variable point within the rectangle ABCD drawn in (a) above such that $60^0 \leq$ <AQB $\leq 90^0$

On the same diagram, construct and show the locus of point Q, by leaving unshaded, the region in which point Q lies (5 marks)

31. **2006 Q8 P1**

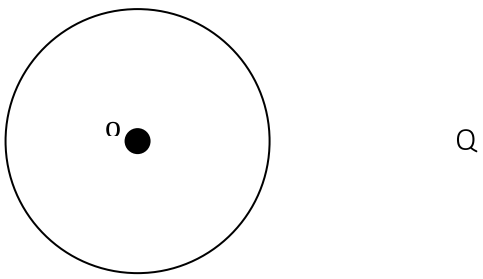
In this question use a pair of compasses and a ruler only

(i) Construct triangle ABC such that AB = 6 cm, BC = 8cm and ∠ABC 135^0 (2 marks)

(ii) Construct the height of triangle ABC in a) above taking BC as the base (1 mark)

32. **2006 Q7 P2**

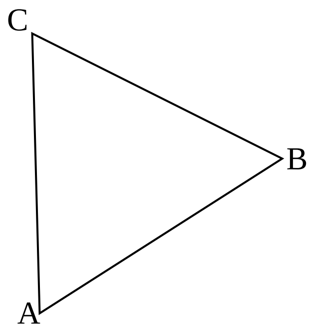
The figure below shows a circle centre O and a point Q which is outside the circle



Using a ruler and a pair of compasses, only locate a point on the circle such that angle OPQ = 90^o (2 marks)

33. 2006 Q13

The figure below is drawn to scale. It represents a field in the shape of an equilateral triangle of side 80m



The owner wants to plant some flowers in the field. The flowers must be at most, 60m from A and nearer to B than to C. If no flower is to be more than 40m from BC, show by shading, the exact region where the flowers may be planted

(4 marks)

34. 2007 Q12 P1

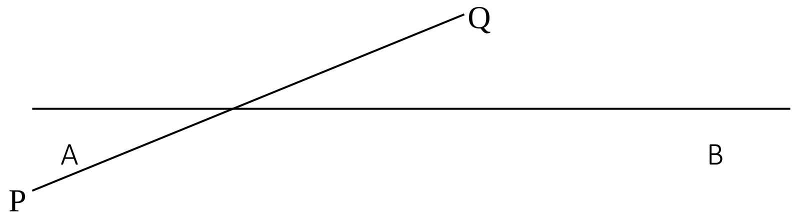
(a) Draw a regular pentagon of side 4 cm (1 mark)

(b) On the diagram drawn, construct a circle which touches all the sides of the pentagon (2 marks)

35. 2007 Q21 P2

In this question use a ruler and a pair of compasses only

In the figure below, AB and PQ are straight lines



(a) Use the figure to:

(i) Find a point R on AB such that R is equidistant from P and Q (1 mark)

(ii) Complete a polygon PQRST with AB as its line of symmetry and hence measure the distance of R from TS. (5 marks)

(b) Shade the region within the polygon in which a variable point X must lie given that X satisfies the following conditions

I: X is nearer to PT than to PQ

II: RX is not more than 4.5 cm

III. $\angle PXT > 90^0$ (4 marks)

36. 2008 Q8 P1

Line BC below is a side of a triangle ABC and also a side of a parallelogram BCDE.

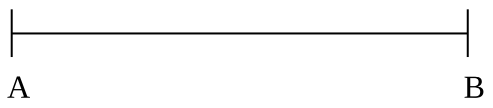
Using a ruler and a pair of compasses only construct:

(i) The triangle ABC given that $\angle ABC = 120^0$ and AB= 6cm (1 mark)

(ii) The parallelogram BCDE whose area is equal to that of the triangle ABC and point E is on line AB (3 marks)

37. 2008 Q3 P2

Line AB given below is one side of triangle ABC. Using a ruler and a pair of compasses only;



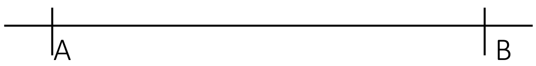
(i) Complete the triangle ABC such that BC=5cm and $\angle ABC=45^0$ (1 mark)

(ii) On the same diagram construct a circle touching sides AC, BA produced and BC

(3 marks)

38. 2009 Q11 P1

Line AB shown below is a side of a trapezium ABCD in which angle ABC = 105^0, BC= 4 CM, CD=5cm and CD is parallel to AB.



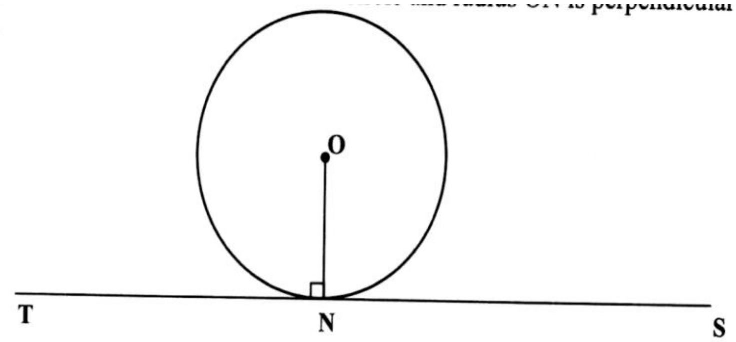
Using a ruler and a pair of compasses only.

(a) Complete the trapezium (3 marks)

(b) Locate point T on line AB such that angle ATD = 90◦ (1 mark)

39. 2009 Q4 P2

In the figure below, O is the centre of the circle and radius ON is perpendicular to the line TS at N



Using a ruler and a pair of compasses only, construct a triangle ABC to inscribe the circle, given that angle ABC = 60˚, BC =12cm and points B and C are on the line TS. (4 marks)

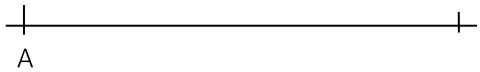
40. **2010 Q10 P1**

Using a ruler and a pair of compasses only, construct a rhombus QRST in which an angle TQR =60^0 and QS = 10cm. (3 marks)

41. **2010 Q13 P2**

a) Using line AB given below, construct the locus of a point P such that APB = 90^0

(1 mark)



b) On the same diagram locate **two** possible position of point C such that point C is on the locus of P and is equidistance from A and B. (2 marks)

42. **2011 Q9 P1**

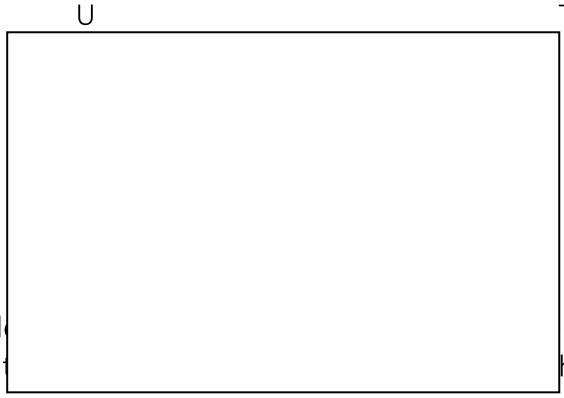
Using a ruler and a pair of compasses only:

a) Construct a parallelogram PQRS in which PQ= 6cm, QR = 4cm and angle SPQ = 75^0; (3 marks)

b) Determine the perpendicular distance PQ and SR (1mark)

43. **2011 Q12 P2**

The figure below represents a scale drawing of a rectangular piece of land, RSTU. RS =9cm and ST =7cm



An el of land. On the scale drawing, shade h that PU > PT and PS ≤ 7cm. (3 marks)

44. **2012 Q8 P1**

Using a pair of compasses and a ruler only, construct a quadrilateral ABCD in which AB= 4cm,BC = 6cm,AD=3cm, angle ABC =135^0 and angle DAB = 60^0. Measure the size of angle BCD.

45. **2012 Q21 P2**

(a) On the same diagram construct:

(i) Triangle ABC such that AB=9cm,AC=7cm and angle CAB=60^0 (2 marks)

(ii) The locus of a point P such that P is equidistant from A and B; (1 mark)

(iii) The locus of a point Q such that CQ≤3.5 cm. (1 mark)

(b) On the diagram in part (a):

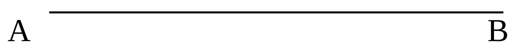
(i) Shade the region R, containing all the points enclosed by the locus of P and the locus of Q, such that AP≥BP; (2 marks)

(ii) Find the area of the region shaded in part (b)(i) above. (4 marks)

46. 2013 Q6 P1

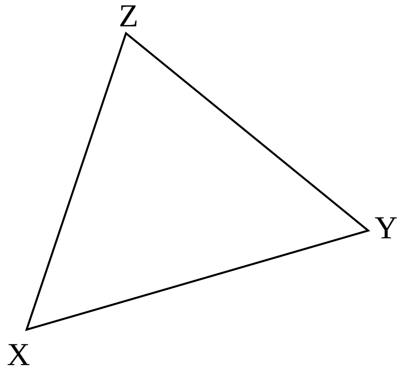
A point P on the line AB shown below is such that AP = $\frac{2}{7}$ AB. By construction locate P.

(3 marks)



47. 2013 Q5 P2

(a) Using a pair of compasses and ruler only, construct an escribed circle to touch side XZ of triangle XYZ drawn below (3 marks)



(b) Measure the radius of the circle (1 mark)

48. 2013 Q12 P2

A point P moves inside a sector of a circle, centre O, and chord AB such that 2cm < OP ≤ 3cm and angle APB = 65^0 Draw the locus of P (4 marks)

49. 2014 Q22 P1

Using a pair of compasses and a ruler only, construct

(a)

(i) Triangle ABC in which AB =5cm, <BAC = 30^0 and <ABC = 105^0 (3marks)

(ii) A circle that passes through the vertices of the triangle ABC. Measure the radius

(3marks)

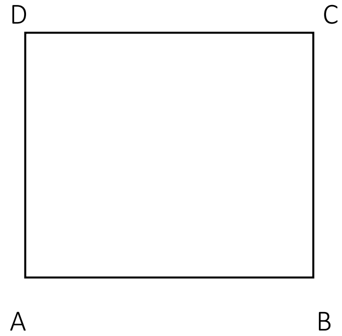
(iii) The height of triangle ABC WITH AB as the base. Measure the height

(2marks)

(b) Determine the area of the circle that lies outside the triangle correct to 2decimal places (2marks)

50. 2014 Q22 P1

Figure ABCD below is a scale drawing representing a square plot of side 80 metres.



(a) On the drawing, construct:

(i) the locus of a point P, such that it is equidistant from AD and BC. (2 marks)

(ii) the locus of a point Q such that <AQB = 60°. (3 marks)

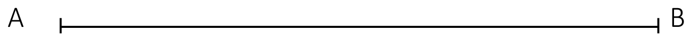
(b) (i) Mark on the drawing the point Q , the intersection of the locus of Q and line AD.

Determine the length of BQ_1 in metres. (1 mark)

(c) (ii) Calculate, correct to the nearest m^2, the area of the region bounded by the locus of P, the locus of Q and the line BQ_1 (4 marks)

51. 2015 Q19 P1

Line AB drawn below is a side of a triangle ABC.



(a) Using a pair of compasses and ruler only construct:

(i) triangle ABC in which BC = 10cm and ZCAB = 90°; (2 marks)

(ii) a rhombus BCDE such that ZCBE = 120°; (2 marks)

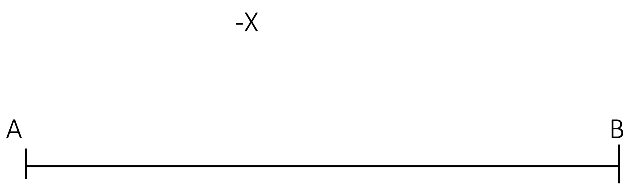
(iii) a perpendicular from F, the point of intersection of the diagonals of the rhombus, to meet BE at G. Measure FG; (2 marks)

(iv) a circle to touch all the sides of the rhombus. (1 mark)

b) Determine the area of the region in the rhombus that lies outside the circle (3marks)

52. 2015 Q10 P2

Below is a lien AB and a point X. Determine the locus of a point P equidistant from points A and B and 4 cm from X. (3 marks)



TRIGONOMETRY III

1. **1989 Q7 P2**

   Find the values of θ between 0^0 and 360^0 that satisfy the equation

   Sin 2θ = - 0.5 (4 marks)

2. **1991 Q2 P2**

   Solve for x

   $4 \sin (x + 20)^0 = 3$ for $0^0 \leq x \leq 360^0$ (3 marks)

3. **1992 Q4 P2**

   Determine the amplitude and the period for the graph of

   $y = 6 \sin\left(\frac{x}{2} - 90\right)^0$ (3 marks)

4. **1994 Q4 P2**

   Solve for θ in the equation

   $\sin (2\theta - 10^0) = - 0.5$ for $0^0 \leq \theta \leq 360^0$ (4 marks)

5. **1996 Q12 P1**

   Solve the equation

   $\sin \frac{5}{2}\theta = \frac{1}{2}$ for $0^0 \leq 0 \leq 180^0$ (2 marks)

6. **1997 Q11 P1**

   Find the value of θ between 0^0 and 360^0 satisfying the equation

   5 sin θ = - 4 (2 marks)

7. **1998 Q14 P1**

   Solve the equation

   $\cos (3\theta + 120^0) = \frac{\sqrt{3}}{2}$ for $0 \leq \theta \leq 180^0$ (4 marks)

8. **1999 Q12 P2**

   Solve the equation $8s^2 + 2s - 3 = 0$

   Hence solve the equation

   $8 \sin^2\theta + 2\sin\theta - 3 = 0$ for $0^0 \leq \theta \leq 180^0$ (4 marks)

9. **2000 Q8 P2**

   Solve the equation

   $2 \sin^2(x-30^0) = \cos 60^0$ for $-180^0 \leq x \leq 180^0$ (3 marks)

10. **2001 Q12 P1**

    Given that $\sin (x + 30)^0 = \cos 2x^0$ for $0^0 \leq x \leq 90^0$ find the value of x.

    Hence find the value of $\cos^2 3x^0$. (3 marks)

11. **2001 Q15 P2**

    Solve the equation $4 \sin^2 \theta + 4 \cos \theta = 5$

    For $0^o \leq \theta \geq 360^o$ give the answer in degrees (3 marks)

12. **2003 Q7 P1**

    Solve the equation

    $3 \tan^2 x - 4 \tan x - 4 = 0$ for $0^0 \leq x \geq 180^0$ (4 marks)

13. 2004 Q9 P1

Give that x° is an angle in the first quadrant such that 8 $\sin^2$ + 2 cos x -5=0

Find:

a) Cos x (3 marks)

b) Tan x (1 marks)

14. 2005 Q9 P2

Given that Cos $2x^0 = 0.8070$, find x when $0^0 < x < 360^0$ (4 marks)

15. 2007 Q3 P2

Solve the equation 3 cos x = 2 $\sin^2$ x, where $0^0 \le x \le 360^0$ (4 marks)

16. 2008 Q16 P1

Solve the equation;

$$2 \cos 2\theta = 1 \text{ for } 0^0 \le \theta \le 360^0$$ (4 marks)

17. 2008 Q16 P2

Find in radians, the values of x in the interval $0^c \le x \le 2\pi^c$ for which

$$2 \cos^2 x - \sin x = 1.$$

(Leave the answers in terms of π) (4 marks)

18. 2009 Q13 P1

Solve the equation

$$\sin(3x + 30^0) = \frac{\sqrt{3}}{2} \quad \text{for } 0 \le x \le 90$$ (4 marks)

19. 2009 Q14 P2

Solve

$$4 - 4\cos^2 \infty = 4 \sin\infty - 1 \text{ for } 0^\circ \le \infty \le 360^\circ$$ (4 marks)

20. 2012 Q5 P2

Solve the equation

$$\text{Sin}(2t + 10)^0 = 0.5 \text{ for } 0^0 \le t \le 180^0$$ (2 marks)

21. 2013 Q8 P1

Given that sin $(x + 20)^0$ = - 0.7660, find *x,* to the nearest degree, for $0^0 \le x \ge 360^0$. (3 marks)

22. 2013 Q14 P2

Solve the equation

$6 \cos^2 x + 7 \sin x - 8 = 0$ for $0^0 \le x \le 90^0$ (4 marks)

23. 2014 Q6 P2

Determine the amplitude and period of the function, y = 2 cos (3x — 45) °. (2marks)

GRAPHS OF TRIGONOMETRIC EQUATIONS

1. 1989 Q23 P2

Complete the table given below by filling in the blank boxes.

x^0	0^0	15^0	30^0	45^0	60^0	75^0	90^0	105^0	120^0	135^0	150^0	165^0	180^0
$3 \cos x^0$	3.0		2.60		1.50		0	-0.75					-3.0
4 sin $(2x - 10^0)$	- 0.69	1.37		3.94	3.76		0.69		-3.06		-3.76		-0.69

Taking 1 cm to represent 15^0 on the x-axis and 2cm to represent 1 unit on the y axis, draw the graph of $y = 3 \cos x$ and $y = 4 \sin(2x - 10^0)$ using the same axes on the graph provided.
Use your graph to find the value of x for which $3 \cos x = 4\sin (2x - 10^0)$ (8 marks)

2. **1990 Q19 P1**

Copy and complete the table given below.

x^0	30^0	0^0	30^0	60^0	90^0	120^0	150^0	180^0	210^0	240^0
$\text{Sin}(x+30^0)$	0	0.5	0.87							
$\text{Cos}(x-15^0)$		0.97								

(3 marks)

Using the same axes plot the curves $y = \sin(x+30^0)$ and $\cos(x - 15^0)$
For $-300 \leq x \geq 240^0$ (3 marks)

Use your graph to find the value of x such that $\cos(x-15^0) = \sin(x=30^0)$ (2 marks)

3. 1991 Q18 P1

a) Complete the table given below by filling in the blank boxes. (2 marks)

x^0	0^0	30^0	60^0	90^0	120^0	150^0	180^0	210^0
$3 \sin x^0 -1$	-1	0.5						
$\cos x^0$	1	0.87	0.5	0		-0.87	-1	

b) On the same axes draw the graph of $y = 3 \sin x^0 -1$ and $y = \cos x^0$ on the grid below. (grid was provided) (4 marks)

c) Use your graph to solve the equation
$3 \sin x^0 - \cos x^0\ 1$ (2 marks)

4. 1993 Q23 P1

Complete the table below by filling in the blank spaces.

x	-180^0	-135^0	-90^0	-45^0	0^0	45^0	90^0	135^0	180^0
2 sin x					0				
Cos 2x					1				

Draw the graph of y =2 sinx and y = cos 2x using the axes on the grid provided. (2 marks)

a) What is the difference in the values of y = 2sin x and y = cos 2x at x = $67\frac{1}{2}$? (2 marks)

b) State the periods of

i) Y = 2 sinx (1 mark)

ii) Y = cos 2x (1 mark)

5. 1995 Q 23 P2

(a) Complete the table for the function y = 2 sin x (2 marks)

x	0^0	10^0	20^0	30^0	40^0	50^0	60^0	70^0	80^0	90^0	100^0	110^0	120^0
Sin 3x	0	0.5000							-0.8666				
y	0	1.00							-1.73				

(b)(i) Using the values in the completed table, draw the graph of y = 2 sin 3x for $0^0 \leq x \leq 120^0$ on the grid provided

(ii) Hence solve the equation 2 sin 3x = -1.5 (3 marks)

6. 1996 Q 24 P2

Complete the table given below for the functions:

Y= -3 cos $2x^0$ and y= 2 sin ($^3/_2x^0 + 30^0$) for $0^0 \leq x \leq 180^0$ (2 marks)

X^0	0^0	20^0	40^0	60^0	80^0	100^0	120^0	140^0	160^0	180^0
-3 cos $2x^0$	-3.00			1.50	2.82	2.82		-0.52	-2.30	
2 sin($^3/_2x^0 + 30^0$)	1.00		2.00	1.73		0.00	-1.00			-1.73

a) Using the grid provided, draw the graphs of y= -3cos $2x^0$ and y= 2sin $^3/_2x^0 + 30^0$) on the same axis. Take 1 cm to represent 20^0 on the x-axis and 2cm to represent one unit on the y-axis (4 marks)

b) From your graphs, find the roots of 3cos $2x^0$ + 2sin ($^3/_2 x^0 + 30^0$) =0. (2 marks)

7. 1997 Q 18 P2

Complete the table below by filling in the blank spaces

X^0	0^0	30^0	60^0	90^0	120^0	150^0	180^0	210^0	240^0	270^0	300^0	330^0	360^0
Cos x^0	1.00		0.50			-0.87		-0.87					
2 cos ½ x^0	2.00	1.93				0.52			-1.00				-2.00

Using the scale 1 cm to represent 30^0 on the horizontal axis and 4 cm to represent 1 unit on the vertical axis draw, on the grid provided, the graphs of y = cosx^0 and y = 2 cos ½ x^0 on the same axis.

(a) Find the period and the amplitude of y = 2 cos $\frac{1}{2}x^0$ (2 marks)

(b) Describe the transformation that maps the graph of y = cosx^0 on the graph of y = 2 cos $\frac{1}{2}x^0$ (2 marks)

8. 1998 Q 18 P2

(a) Complete the table below for the value of y = 2 sin x + cos x.

x	0^0	30^0	45^0	60^0	90^0	120^0	135^0	150^0	180^0	225^0	270^0	315^0	360^0
2 sin x	0		1.4	1.7	2	1.7	1.4	1	0		-2	-1.4	0
Cos x	1		0.7	0.5	0	-0.5	-0.7	-0.9	-1		0	0.7	1
y	1		2.1	2.2	2	1.2	0.7	0.1	-1		-2	-0.7	1

(b) Using the grid provided draw the graph of y= 2 sin x + cos x for 0^0. Take 1 cm represent 30^0 on the x- axis and 2 cm to represent 1 unit on the axis. (3 marks)

(c) Use the graph to find the range of x that satisfy the inequalities 2 sin x cos x > 0.5 (2 marks)

9. 1999 Q 18 P2

(a) Complete the table below, giving your values correct to 2 decimal places.

x	0	10	20	30	40	50	60	70
Tan x	0							
2 x + 30^0	30	50	70	90	110	130	150	170
Sin (2x + 30^0)	0.50			1				

(2 marks)

b) On the grid provided, draw the graphs of y = tan x and y = sin (2x + 30^0) for $0^0 \leq x\ 70^0$

Take scale: 2 cm for 100 on the x- axis
4 cm for unit on the y- axis

Use your graph to solve the equation tan x- sin $(2x + 30^0) = 0$ (6 marks)

10. **2000 Q 24 P2**

(a) Complete the table for the equation $y = 2\sin(3x + 30^0)$ (2 marks)

x	0^0	10^0	20^0	30^0	40^0	50^0	60^0	70^0	80^0	90^0
$3x + 30^0$	30	60	90	120	150	180	210	240	270	300
$Y = 2\sin(3x + 30^0)$	1	1.73	2			0			-2	-1.73

(b) Using the grid provided, draw the graph of $y = 2\sin(3x + 30^0)$ for $0^0 \le x \le 90^0$.
Take 1cm to represent 40 on the x-axis and 2cm to represent 1 unit on the y axis (3 marks)

(c) Use the graph in (b) to find the range of values of x that satisfy the inequality $y \le 1.6$

(3 marks)

11. **2001 Q 21 P2**

a) Complete the table given below in the blank spaces.

X	0°	15^0	30^0	45^0	60^0	75^0	90^0	105^0	120^0	135^0	150^0	165^0	180^0
3 cos 2x	3	2.598	1.5	0	1.5	--3	-2.598	-1.5	0	2.598	3		
2 sin (2x +30°)	1		2	2.732	1	0		-1	-1.732	-2	-2.732	-2	1

b) On the grid provided draw, on the same axis, the graph of y = 3cos 2x and
y = $\sin(2x + 30^0)$ for $0° \le x \ge 180^0$. Take the scale: 1cm for 15^0 on the axis and 2cm for 1 unit on the y-axis.

(4 marks)

c) Use your graph to estimate the range of value of x for which 3 cos 2x ≤ 2sin (2x+30°).
Give your answer to the nearest degree. (2 marks)

12. **2002 Q 23 P2**

a) Complete the table below, giving your values correct to 2 decimal place.

	0^0	15^0	30^0	450	60^0	75^0	90^0	105^0	120^0	135^0	150^0	165^0	180^0
Tan Θ^0	0	0.27	0.58	1	1.73		∞	-3.73	-1.73	-1		-0.27	0
Sin Θ^0	0	0.5		1	0.87	0.5	0	-0.5		-1	-0.87	-0.5	0

b) Using the grid provided and the table in part (a) draw the graphs of Y = tan θ and y = sin 2θ. (5 marks)

c) Using your graphs, determine the range of values for which tan θ>Sin 2θ for $0^0 \le \theta \le 90^0$. (1 mark)

13. **2003 Q 23 P2**

a) Complete the table below, giving your values correct to 2 decimal places.

X	0	15	30	45	60	75	90	105	120	135	150	165	180
Cos x	1	0.77	0.87	0.71	0.15	0.24	0	-0.26	-0.5	-0.17	0.5	0.87	1
Sin $(x+30^0)$	0.5	0.17	0.87	0.97	0.10	0.97	0.87	0.71	0.5	- 0.26	0	-0.26	-0.5

b) Using the grid provided draw, on the same axes, the graph of y = cos 2x and y = sin $(x+30^0)$ for $0^0 < x < 180^0$ Take the scale: 1cm for 15^0 on the x axis 4cm for 1 unit on the y- axis. (4 marks)

c) Find the period of the curve y = axis (1 mark)

d) Using the graphs in part (b) above, estimate the solutions to the equation Sin $(x + 30^0)$ = Cos 2x (4 marks)

14. **2005 Q 21 P2**

(a) Complete the table below, giving your values correct to 2 decimal places (2 marks)

X^0	0	30	60	90	120	150	180
2 sin x^0	0	1		2		1	
1 – cos x^0			0.5	1			

(b) On the grid provided, using the same scale and axes, draw the graphs of y = sin x^0 and y = 1 – cos $x^0 \leq x \leq 180^0$ (4 marks)
Take the scale: 2 cm for 30^0 on the x- axis
2 cm for I unit on the y- axis

(c) Use the graph in (b) above to
(i) Solve equation
2 sin x^o + cos x^0 = 1 (1 mark)
(ii) Determine the range of values x for which 2 sin xo > 1 – cos x^0
(1 mark)

15. **2007 Q 19 P2**

(a) Given that y = 8 sin 2x – 6 cos x, complete the table below for the missing values of y, correct to 1 decimal place. (2 marks)

X	0^0	15^0	30^0	45^0	60^0	75^0	90^0	105^0	120^0
Y = 8 sin 2x – 6 cos x	-6	-1.8		3.8	3.9	2.4	0		-3.9

(b)On the grid provided, below, draw the graph of y = 8 sin 2x – 6 cos for $0^0 \leq x \leq 120^0$
Take the scale 2 cm for 15^0 on the x- axis
2 cm for 2 units on the y – axis (4 marks)

(c) Use the graph to estimate

(i) The maximum value of y (1 mark)

(ii) The value of x for which 4 sin 2x – 3cos x =1 (3 marks)

16. 2008 Q 19 P2

a) Complete the table below, giving the values correct to 2 decimal places.

x^0	0	30	60	90	120	150	180	210	240	270	300	330	360
Sin 2x	0		0.87		-0.87		0	0.87	0.87				0
3cosx-2	1	0.60		-2	-3.5			-4.60			-0.5		1

b) On the grid provided, draw the graphs of y=sin 2x and y=3cosx-2 for $0^0 \leq x \leq 360^0$ on the same axes. Use a scale of 1 cm to represent 30^0 on the x-axis and 2cm to represent 1 unit on the y-axis.

c) Use the graph in (b) above to solve the equation 3 Cos x – sin 2x = 2. (2 marks)

d) State the amplitude of y=3cosx-2. (1 mark)

17. 2010 Q 17 P2

(a) Complete the table below, giving the value correct to 2 decimal places. (2 marks)

X^0	0^0	20^0	40^0	60^0	80^0	100^0	120^0	140^0	160^0	180^0
Cos X^0	1.00	0.94	0.77	0.50		-0.17		-0.77		-1.00
Sin x^0 – Cos x^0	-1.00	-0.60		0.37	0.81		1.37		1.28	1.00

b) On the grid provided and using the same axes draw the graphs of y = Cos x^0 and y = sin x^0 – Cos x^0 for $0^0 \leq x \leq 180^0$ .Using the scale; 1 cm for 20^0 on the x-axis and 4cm for 1 unit on the y-axis. (5 marks)

c) Using the graph in part (b);

i)Solve the equation sin x^0 – cos x^0 = 1.2; (1 mark)

ii) Solve the equation cos $x^0 = \frac{1}{2}$ sin x^0; (1 mark)

iii)Determine the value of cos x^0 in part (c) (ii) above. (1 mark)

18. 2011 Q 16 P2

The table below shows values x and y for the function y=2sin3x^0 in the range $0^0 \leq x \leq 150^0$

x^0	0	15	30	45	60	75	90	105	120	135	150
y	0	1.4	2	1.4	0	-1.4	-2	-1.4	0	1.4	2

a. On the grid provided, draw the graph of y= 2sin 3x (2 marks)
b. From the graph determine the period. (1 mark)

19. 2013 Q21 P2

(a) Complete the table below, giving the values correct to 1 decimal place. (2 marks)

x^0	0	40	80	120	160	200	240
2 sin(χ +20)^0	0.7		2.0		0.0		-2.0
$\sqrt{3}$ cos x	1.7	1.3		-0.9		-1.6	

b) On the grid provided, using the same scale and axes, draw the graphs of

$y = 2 \sin (x + 20)^0$ and $y = \sqrt{3} \cos x$ for $0^0 \leq x \leq 240^0$. (5 marks)

c) Use the graphs drawn in (b) above to determine:

i) The value of x for which $2\sin (x + 20) = \sqrt{3} \cos x$; (2 marks)

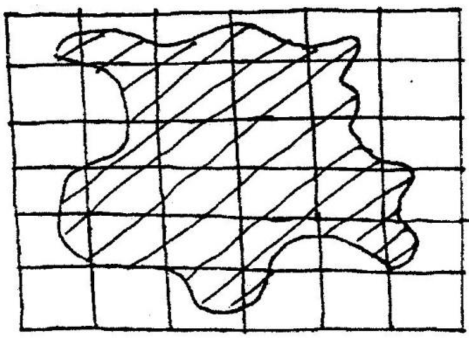
ii) The difference in the amplitudes of $y = 2\sin(x + 20)$ and $y = \sqrt{3} \cos x$. (1 mark)

AREA APPROXIMATIONS

(a). COUNTING SQUARES TECHNIQUE

1. 1999 Q 5 P1

The figure below is a map of a forest drawn on a grid of 1 cm squares



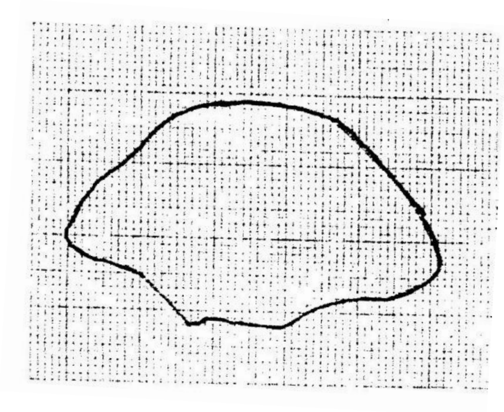
i. Estimate the area of the map in square centimeters (2 marks)

ii. If the scale of the map is 1: 50,000 estimate the area of the forest in hectares

2. 2000 Q 6 P1

The enclosed region shown in the figure below represents a ranch drawn to scale. The actual area of the ranch is 1075 hectares.

a) Estimate the area of the enclosed region in square centimeters (1 mark)

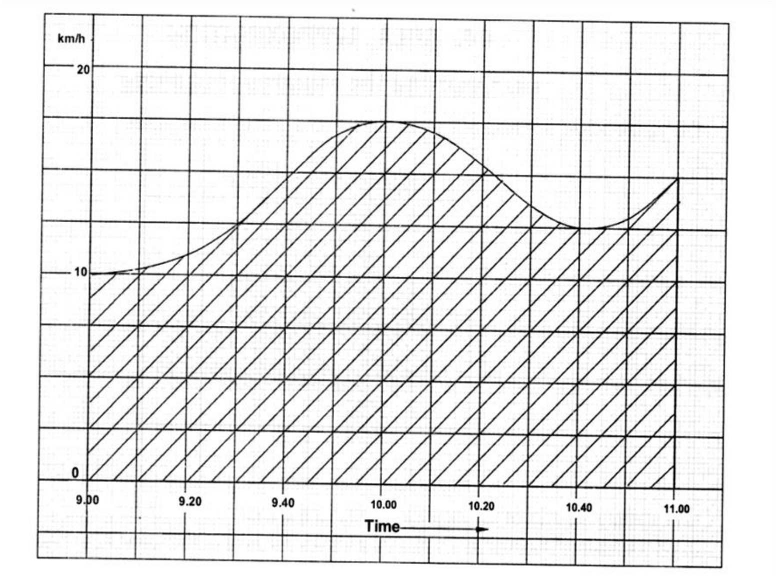


b) Calculate the linear scale used (2 marks)

(b). TRAPEZIODAL

1. 1991 Q24 P2

The travel graph of a cyclist given below represents a journey from 9am up to 11am. By dividing the shaded region into six strips of equal width and using trapezium rule, estimate the total distance travelled



2. **1992 Q24 P2**

In order to sketch the cross-section of a ditch 175cm wide, the depth of water was measured at intervals of 25cm from one of the banks. The reading of the depths were as follows:

Distance (cm)	0	25	50	75	100	125	150	175
Depth (cm)	100	115	132	156	167	200	163	153

i) Sketch the cross-section of the ditch (3 marks)

ii) Use trapezoidal rule to estimate the area of the cross-section (5 marks)

3. **1993 Q18 P1**

a) Use the trapezoidal rule to find the area under the curve $y = x^2 + 1$ From x = 1 to x = 15 using seven strips. (5 marks)

b) The cross-section areas in m^2 along the length of an 18m wooden log are:

5.0, 5.4, 7.0, 8.0, 5.5, 5.8, 6.0

The cross sectional areas are equally spaced. The first and the last areas represent the ends of the log. Estimate its volume using the trapezoidal rule.

(2 marks)

4. **1996 Q 11 P2**

Complete the table below for the function. $y= 3x^2 - 8x + 10$

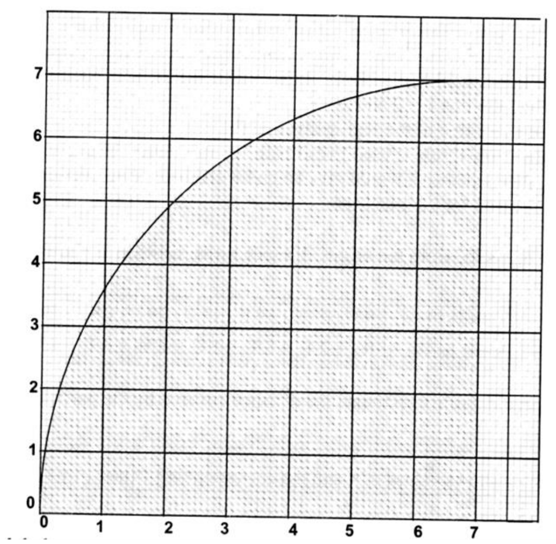
X	0	2	4	6	8	10
y	10	6		70		230

Using the values in the table and the trapezoidal rule, estimate the area bounded by the curve $y=3x^2 – 8x + 10$ and the lines y=0,x=0 and x=10

(3 marks)

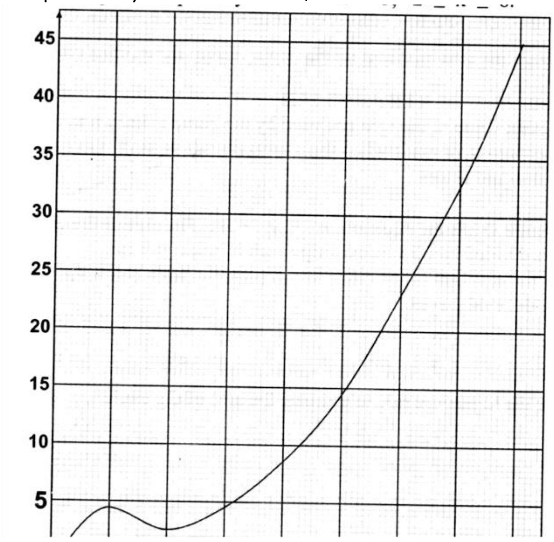
5. 1997 Q 8 P2

Use the trapezoidal rule with intervals of 1 cm to estimate the area of the shaded region below



6. 1999 Q 24 P1

The graph below consists of a non- quadratic part (0 ≤ x ≤ 2) and a quadrant part (2 ≤ x 8) The quadratic part is $y = x^2 - 3x + 5$, $2 \le x \le 8$



(a) Complete the table below (1 mark)

x	2	3	4	5	6	7	8
y	3						

(b) Use the trapezoidal rule with six strips to estimate the area enclosed by the curve, x = axis and the line x = 2 and x = 8 (3 marks)

(c) Find the exact area of the region given in (b) (3 marks)

(d) If the trapezoidal rule is used to estimate the area under the curve between x = 0 and x = 2, state whether it would give an under- estimate or an over- estimate. Give a reason for your answer (1 mark)

6. **2001 Q 11 P1**

A particle is projected from the origin. Its speed was recorded as shown in the table below

Time (sec)	0	5	10	15	20	25	39	35
Speed (m/s)	0	2.1	5.3	5.1	6.8	6.7	4.7	2.6

Use the trapezoidal rule to estimate the distance covered by the particle within the 35 seconds

7. **2002 Q 21 P2**

The table below shows the values of x and corresponding values of y for a given curve.

X	0	$\frac{\pi}{12}$	$\frac{\pi}{6}$	$\frac{\pi}{4}$	$\frac{\pi}{3}$	$\frac{5\pi}{12}$	$\frac{\pi}{2}$
y	0	0.26	0.48	0.65	0.76	0.82	0.84

a) Use the trapezium rule with seven ordinates and the values in the table only to estimate the area enclosed by the curve, x – axis and the line x = $^{Л}/_{2}$ to four decimal places. (Take Л = 3.142)

b) The exact value of the area enclosed by the curve is known to be 0.8940. Find the percentage error made when the trapezium rule is used. Give the answer correct to two decimal places.

8. **2006 Q 16 P1**

A circle centre O, ha the equation $x^2 + y^2 = 4$. The area of the circle in the first quadrant is divided into 5 vertical strips of width 0.4 cm

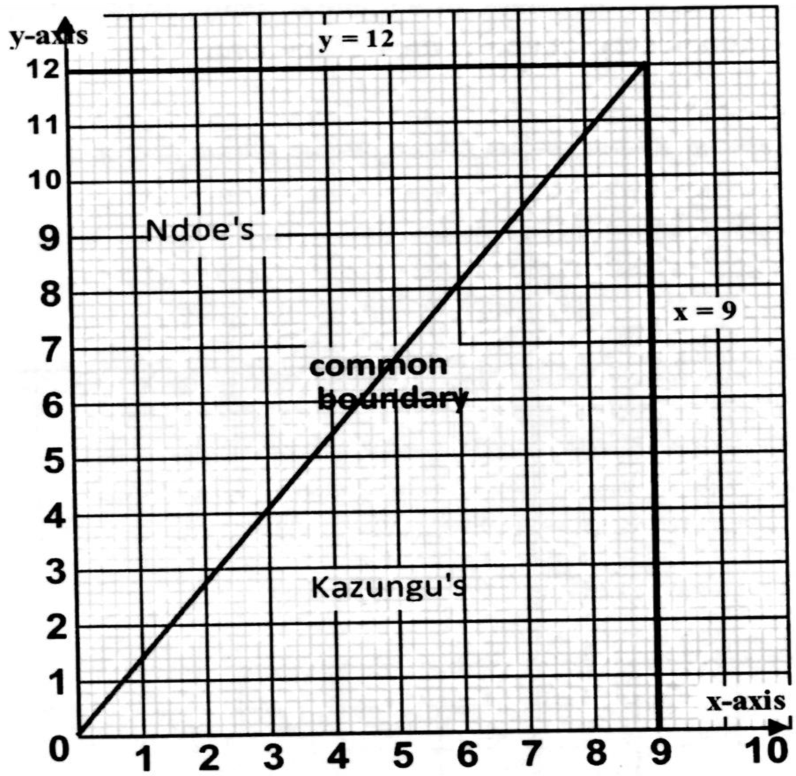
(a) Use the equation of the circle to complete the table below for values of y correct to 2 decimal places (1 mark)

X	0	0.4	0.8	1.2	1.6	2.0
Y	2.00			1.60		0

(b) Use the trapezium rule to estimate the area of the circle (3 marks)

9. 2007 Q 24 P1

The diagram on the grid below represents as extract of a survey map showing two Adjacent plots belonging to Kazungu and Ndoe.



The two dispute the common boundary with each claiming boundary along different smooth curves coordinates (x, y_1) and (x, y_2) in the table below, represents points on the boundaries as claimed by Kazungu Ndoe respectively

x	0	1	2	3	4	5	6	7	8	9
y_1	0	4	5.7	6.9	8	9	9.8	10.6	11.3	12
y_2	0	0.2	0.6	1.3	2.4	3.7	5.3	7.3	9.5	12

(a) On the grid provided above draw and label the boundaries as claimed by Kazungu and Ndoe (2 marks)

10. 2011 Q 21 P1

a) Using the trapezium rule with seven ordinates, estimate the area of the region bounded by the curve $y= -x^2 + 6x + 1$, the lines x=0,y=0 and x=6. (5 marks)

b) Calculate

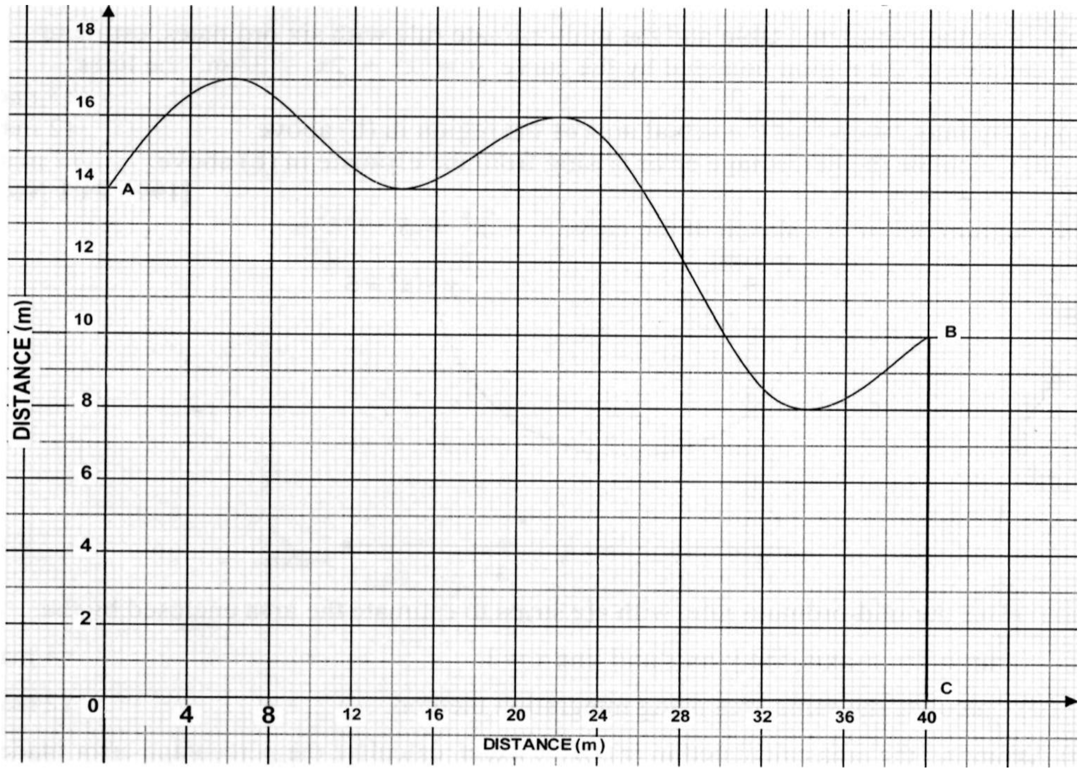
i) the area of the region in a) above by integration: (3 marks)

ii) the percentage error of the estimated area to the actual area of the region, correct to two decimal places. (2 marks)

(C). MID-ORDINATE

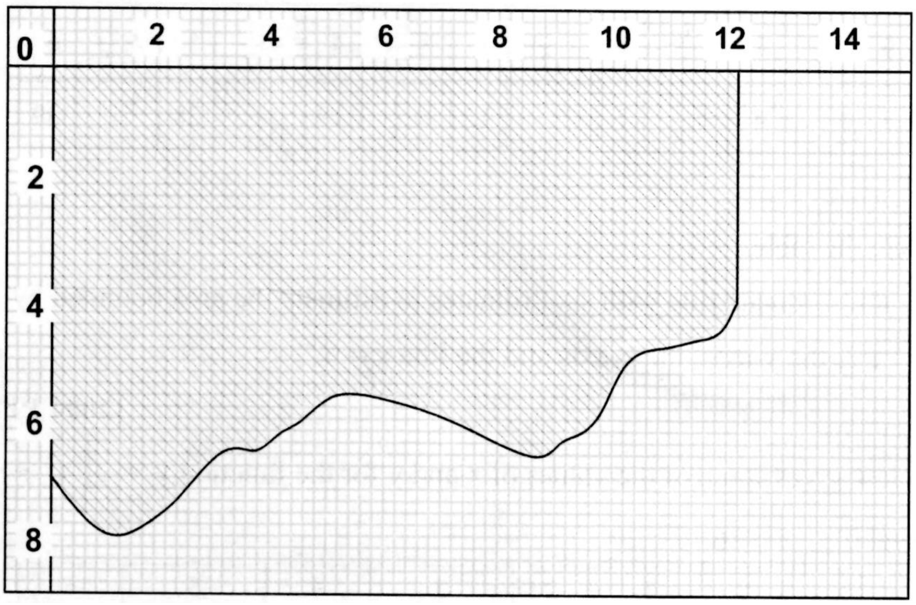
1. 1990 Q15 P2

The figure below shows the shape of a piece of land OABC. Using the mid-ordinate rule with 11 ordinates estimate the area of the land



2. 1995 Q 16 P2

The shaded region below represents a forest. The region has been drawn to scale where 1 cm represents 5 km. Use the mid – ordinate rule with six strips to estimate the area of forest in hectares. (4 marks)



3. 1996 Q 21 P1

The table below shows some values of the function $y = x^2 + 2x - 3$

x	-6	-6.75	-5.5	-5	-4.75	-4.5	4.25	-4.0	-3.75	-3.75	-3.5	-3.25	-3
y	21	18.56		14.06		10.06	8.25		5		2.25	1.06	0

a) Complete the table

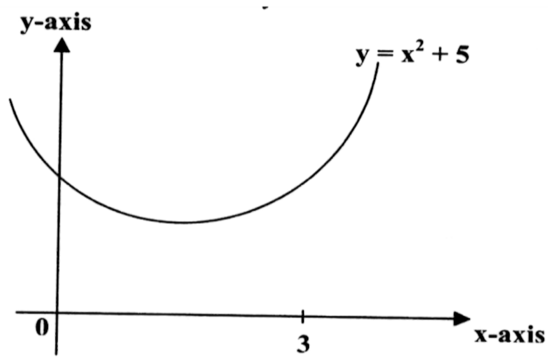
b) Using the completed table and the mid- ordinate rule with six ordinates, estimate the area of the region bounded by the $y = x^2 + 2x - 3$ and the line y = 0, x = -6 and x = -3 (3 marks)

(i) By integration find the actual area of the region in (b) above (2 marks)

(ii) Calculate the percentage error arising from the estimate in (b) (2 marks)

4. 2003 Q 20 P1

The diagram below is a sketch of the curve $y = x^2 + 5$.



a) i) Use the mid –ordinate rule, with six strips to estimate the area enclosed by the curve, the x – axis and the y – axis and line x =3. (4 marks)

ii) Calculate the same area using the integration method. (2 marks)

b) Assuming the area calculated in (a) (ii) is exact, calculate the percentage error made when the mid – ordinate rule is used. (2 marks)

5. 2004 Q 11 P1

The table below shows some values of the function $y = x^2 + 3$

X	0	½	1	$1^1/_2$	2	$2^1/_2$	3	$3^1/_2$	4	$4^1/_2$	5	$5^1/_2$	6
y	3		4	$5^1/_4$	7		12	$15^1/_4$	19		28		39

a) Complete the table (1 mark)

b) Use the mid – ordinate rule with six ordinates to estimate the area bounded by $y = x^2+3$, the y – axis, the x – axis and the line x = 6 (2 marks)

6. **2005 Q 20 P1**

The table below gives some of the values of x for the function $y=\frac{1}{2}x^2 + 2x + 1$ in the interval $0 \le x \le 6$.

x	0	1	2	3	4	5	6
y	1	3.5	7	11.5	17	23.5	31

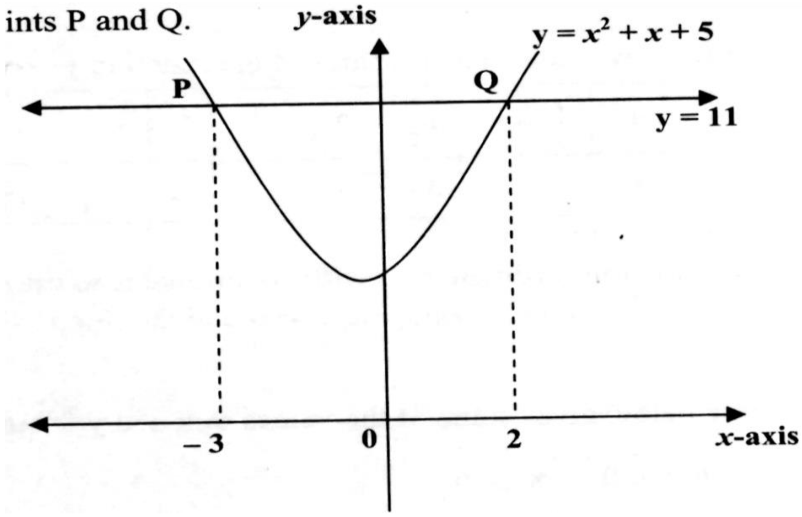
(a) Use the values in the table to draw the graph of the function (2 marks)

(b) (i) Using the graph and the mid – ordinate rule with six (6) strips, estimate the area bounded by the curve, the x- axis, the y- axis and the line = 6 (4 marks)

(ii) If the exact area of the region described in (b) (i) above is 78cm^2, calculate the percentage error made when the mid – ordinate rule is used. Give the answer correct to two decimal places (2 marks)

7. **2008 Q 18 P1**

The figure below is a sketch of the curve whose equation is $y=x^2+x+5$. It cuts the line y=11 at points P and Q.



a) Find the area bounded by the curve $=x^2+x+5$ and the line y=11 using the trapezium rule with 5 strips. (5 marks)

b) Calculate the difference in the area if the mid-ordinate rule with 5 ordinates was used instead of the trapezium rule. (5 marks)

8. **2009 Q 24 P1**

(a) On the grid provided, draw a graph of the function

$$y = \frac{1}{2}x^2 - x + 3 \text{ for } 0 \le x \le 6.$$

(b) Calculate the mid – ordinates for 5 strips between x = 1 and x=6, and hence use the mid- ordinate rule to approximate the area under the curve between x = 1, x=6 and the x – axis. (3 marks)

(c) Assuming that the area determine by integration to be the actual area, calculate the percentage error in using the mid-ordinate rule. (4 marks)

INTEGRATION

1. 1992 Q22 P1
   a) The gradient of the curve $y = ax^2 + bx$ at the origin is equal to 8. Find the values of a and b if the curve has a maximum point at x = 4 (5 marks)

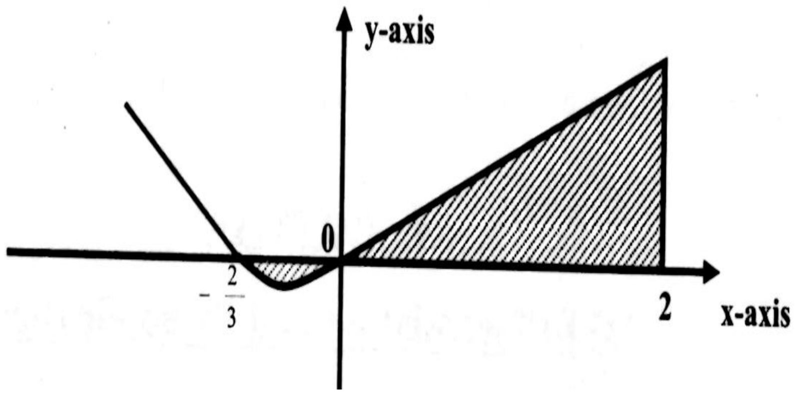
   b) Determine the area bounded by the lines x=0, x=6, y=0 and the curve $y=ax^2+bx$, for the values of a and b obtained in part (a) (3 marks)

2. 1994 Q6 P2
   Determine the area bounded by the curve $y=x^2 - 4$, the x axis and the line x=4
   (4 marks)
3. 1995 Q 7 P1

   Find the area enclosed by the curve $y=4x - x^2$, the x-axis and the lines x=1 and x=2
   (3 marks)
4. 1996 Q 8 P2

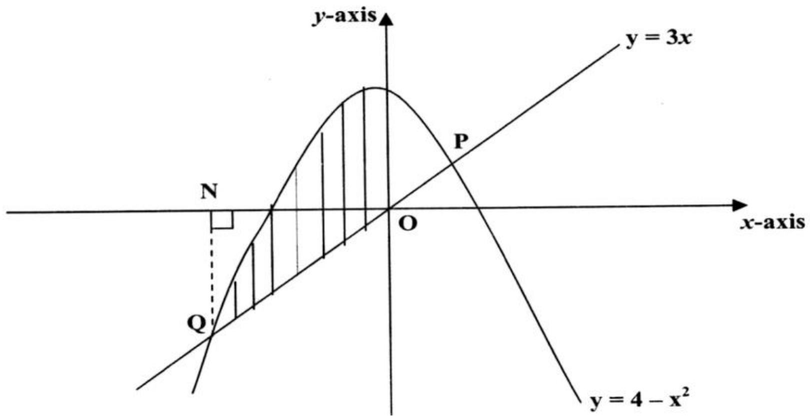
   Find the area bounded by the curve $y= 2x^3 -5$, the x-axis and the lines x=2 and x=4
5. 1998 Q 20 P2
   (a) Find the value of x at which the curve $y= x^2- 2x - 3$ crosses the x- axis (2 marks)

   (b) Find
   $$\int(x^2 - 2x - 3)dx$$ (1 mark)
   c) Find the area bounded by the curve $y = x^2 - 2x - 3$, the axis and the line x= 2 and x = 4
   (5 marks)
6. 2000 Q 21 P2
   The curve of the equation $y = 2x + 3x^2$, has $x = \frac{-2}{3}$ and x = 0 and x intercepts.
   The area bounded by the axis $x = \frac{-2}{3}$and x = 2 is shown by the sketch below.
   Find:
   (a) $\int(2x + 3x^2)dx$ (2 marks)
   (b) The area bounded by the curve x – axis, $x = \frac{-2}{3}$ and x =2 (6 marks)



7. **2006 Q 24 P2**

The diagram below shows a sketch of the line y = 3x and the curve y = 4 – x^2 intersecting at points P and Q.



(a) Find the coordinates of P and Q (4 marks)

(b) Given that QN is perpendicular to the x- axis at N, calculate

(i) The area bounded by the curve y = 4 – x^2, the x- axis and the line QN (2 marks)

(ii) The area of the shaded region that lies below the x- axis (2marks)

(iii)The area of the region enclosed by the curve y = 4-x^2, the line y – 3x and the y axis

(2 marks)

8. **2007 Q 20 P2**

The gradient function of a curve is given by the expression 2x + 1. If the curve passes through the point (-4, 6);

(a) Find:

(i) The equation of the curve (3 marks)

(ii) The values of x, at which the curve cuts the x- axis (3 marks)

(b) Determine the area enclosed by the curve and the x- axis (4 marks)

9. 2013 Q23 P2

The equation of a curve is given by $y = 5x - \frac{1}{2}x^2$

(a) On the grid provided, draw the curve of $y = 5x - \frac{1}{2}x^2$ for $0 \leq x \leq 6$ (3 marks)

(b) By integration, find the area bounded by the curve, the line *x* =6 and the x-axis. (3 marks)

(c) (i) On the same grid as in,(a).draw the line y = 2*x*. (1 mark)

(ii) Determine the area bounded by the curve and the line y = 2 *x*. (3 marks)

10. 2014 Q21 P1

(a) Complete the table below for the function y = x2 – 3x + 6 in range -2 ≤ x ≤ 8 (2marks)

x	-2	-2	0	1	2	3	4	5	6	7	8
y											

(b) Use the trapezium rule with strips to estimate the area bounded by the curve, $y = x^2 - 3x + 6$, the lines $x = -2$, $x = 8$, and x - axis (3marks)

(c) Use the mid-ordinate rule with 5 strips to estimate the area bounded by the curve, $y = x^2 - 3x + 6$, the lines $x = -2$, $x = 8$, and x –axis (2marks)

(d) By integration, determine the actual area bounded by the curve y = x2 – 3x + 6, the lines $x = -2$, $x = 8$, and x –axis (3marks)

CALCULUS

(a) DIFFERENTIATION

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 (4 marks)

2. **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)

3. **1992 Q11 P2**

   Find the equation of the tangent to the curve $y + 2x^2$ at (2, 8) (4 marks)

4. **1993 Q12 P2**

   Calculate the gradient of the curve $y = x^2 – 3x -4$ at a point where x = -1 (2 marks)

5. **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 (2 marks)
      i) t = 1 second?
      ii) t= 2 seconds? (1 mark)

   b) How far up does it travel (5 marks)

6. **1994 Q11 P1**

   A rectangular plate has a perimeter of 28cm. Determine the dimensions of the plate that give the maximum area

   (4 marks)

7. **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) (3 marks)

8. **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

   (3marks)

9. 1999 Q 16 P2

Find the equation of the tangent to the curve $y = (x^2 + 1)(x - 2)$ when $x = 2$ (3 marks)

10. 2000 Q 5 P2

The distance from a fixed point of a particular in motion at any time t seconds is given by

$$S = t^3 - \frac{5}{2}t^2 + 2t + 5 \ metres$$

Find its:

(a) Acceleration after t seconds (1 mark)

(b) Velocity when acceleration is Zero (2 marks)

11. 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 marks)

b) Equation of the tangent to the curve at the point(1,3) (2 marks)

12. 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. (3 marks)

b) When the velocity of the particle is zero, calculate its:-

i) Displacement (3 marks)

ii) Acceleration. (2 marks)

13. 2002 Q 16 P1

Given the curve $y = 2x^3 + \frac{1}{2}x^2 - 4x + 1$. Find the:

i) Gradient of curve at $\left[1, -\frac{1}{2}\right]$

ii) Equation of the tangent to the curve at $\left[1, -\frac{1}{2}\right]$ (4 marks)

14. 2002 Q 24 P2

The displacement, s metres, of a particle moving along straight line after t seconds is given by. $S = 3t + {}^3/_2\, t^2 - 2t^3$

a) Find its initial acceleration (3 marks)

b) Calculate: i) The time when the particle was momentarily at rest. (2 marks)

ii)Its displacement by the time it comes to rest momentarily (1 mark)

c) Calculate the maximum speed attained.

(2marks)

15. 2003 Q 8 P2

Find the coordinates of the turning point of the curve whose equation is

$y = 6 + 2x - 4x^2$ (3 marks)

16. 2003 Q 21 P2

a) i)Find the coordinated of the stationary points on the curve

$y = x^3 - 3x + 2$ (2 marks)

ii)For each stationary point determine whether it is minimum or maximum.

(4 marks)

b)In the space provided below, sketch the graph of the function $y = x^3 - 3x + 2$

(2 marks)

17. **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 marks)

18. **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)

19. **2005 Q 17 P2**

A curve is represented by the function $y = \frac{1}{3}x^3 + x^2 - 3x + 2$

(a) Find $\frac{dy}{dx}$ (1 mark)

(b) Determine the values of y at the turning points of the curve

$$y = \frac{1}{3}x^3 + x^2 - 3x + 2$$ (4 marks)

20. **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)

(d) The acceleration of the particle when t = 2 (2 marks)

21. **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)

22. **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)

23. **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 (3 marks)

b) Determine the values of s at the maximum and minimum turning points of the curve. (4 marks)

c) On the space provided, sketch the curve of $s = t^3 - 6t^2 + 9t + 5$. (3 marks)

24. **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. (3 marks)

(ii) The internal volume V, of the box. (1 mark)

(b) Find:

i) The value of x for which the volume V is maximum; (4 marks)

ii) The maximum internal volume of the box. (2 marks)

25. 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 marks)

b) The value of t when the particle is momentarily at rest; (3 marks)

c) The displacement when the particle is momentarily at rest; (2 marks)

d) The acceleration of the particle when *t*=3 seconds. (2 marks)

26. 2012 Q22 P1

The equation of a curve is $y = 2x^3 + 3x^2$

(a) Find (i) The x-intercept of the curve

(ii) The y-intercept of the curve

(b) (i) Determine the stationary points of the curve

(ii) For each point in (b) (i) above, determine whether it is a maximum or minimum curve

(c) Sketch the curve

27. 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)

28. 2013 Q21 P1

The displacement, s metres, of a moving particle from a point O, after t seconds is given by,

$s = t^3 - 5t^2 + 3t + 10$.

a) Find s when t =2. (2 marks)

b) Determine:

i. The velocity of the particle when t = 5 seconds; (3 marks)

ii. The value of t when the particle is momentarily at rest. (3 marks)

c) Find the time, when the velocity of the particles is maximum. (2 marks)

29. **2014 Q24 P1**

The equation of acurve is given by $y = x^3 - 4x^2 - 3x$

(a) Find the value of y when x = -1 (1mark)

(b) Determine the stationary points of the curve (5marks)

(c) Find the equation of the normal to the curve at x = 1 (4marks)

30. **2014 Q24 P1**

A particle was moving along a straight line. The acceleration of the particle after t seconds was given by (9 — 3t) ms^{-2}. The initial velocity of the particle was 7 ms^{-1}.

Find:

a) the velocity (v) of the particle at any given time (t); (4 marks)

b) The maximum velocity of the particle; (3 marks)

c)the distance covered by the particle by the time it attained maximum velocity

(b) INTEGRATION

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.

(4 marks)

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

(4 marks)

4. **1994 Q19 P2**

The velocity of a particle moving in a straight line after t seconds given by

$$v = 6t - t^2 + 4 \text{ m/s}.$$

Calculate

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

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 bya = 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 (2 marks)

b) Determine the time when the velocity is again 2m/s (4 marks)

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 marks)

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 marks)

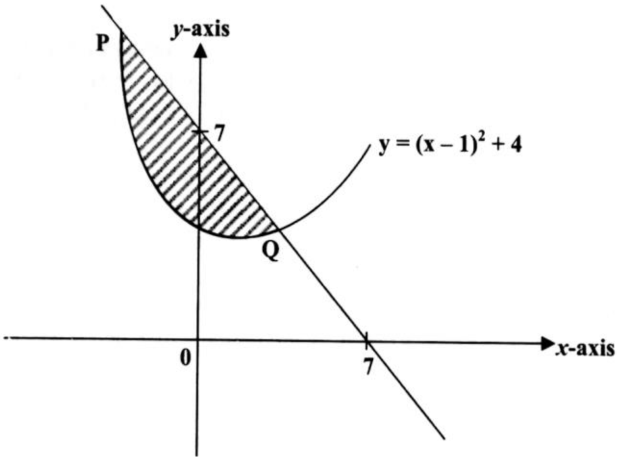
8. 2002 Q 20 P1

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. (2 marks)

b) Find the coordinates of p and Q. (2 marks)

c) Calculate the area of the shaded region. (3 marks)



9. 2003 Q 16 P1

The velocity Vms^{-1} of particle in motion is given by $V = 3t^2 - t + 4$, where t is time in seconds. Calculate the distance traveled by the particle between the time t=1 second and t=5 seconds. (3 marks)

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 marks)

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 (3marks)
(b) Calculate
(i) The velocity of the particle when t = 3 (2 marks)
(ii) The distance covered by the particle between t = 2 and t = 4 (3 marks)

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 – $^1/_8$
(a) Find
(i) The value of x at the minimum point (1 mark)
(ii) The equation of the curve (4 marks)

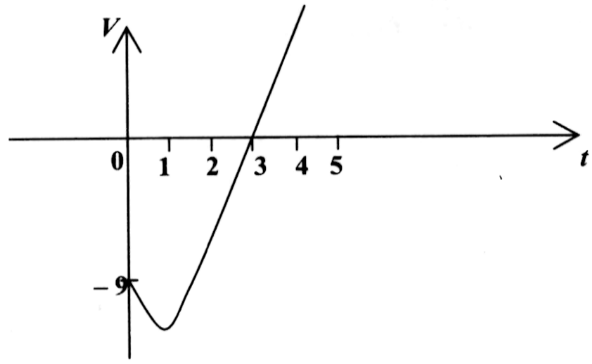
b) P is a point on the curve in part (a) (ii) above. If the gradient of the curve at P is -7, find the coordinates of P (3 marks)

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. **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 traveled by the particle during the third second. (3 marks)

17. **2009 Q 16 P2**
A particle moves in a straight line with a velocity V ms^{-l}. Its velocity after t seconds is given by V= $3t^2$ – 6t -9
The figure below is a sketch of the velocity-time graph f the particle



Calculate the distance the particle moves between t = 1 and t = 4

18. **2010 Q 11 P2**

A particle starts from O and moves in a straight line so that its velocityV 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)

19. **2014 Q15 P2**

The gradient of a curve is given by $\frac{dy}{dx}$ = x^2 - 4x 4- 3. The curve passes through the point (1,0). Find the equation of the curve. (3 marks).

20. **2015 Q24 P1**

The gradient of the curvey $y = 2x^3 - 9x^2 + px - 1$ at x = 4 is 36.

a)Find :

i) the value of *p*; (3 marks)

ii)The equation of the tangent to the curve at x = 0.5. (4 marks)

b) Find the coordinates of the training points of the curve (3 marks)

21. **2015 Q13 P2**

Evaluate $\int_{2}^{4} x^2 + 2x - 15dx$ (3 marks)

LINEAR PROGRAMMING

1. **1989 Q18 P2**

   At an agricultural research station, a rectangular plot is to be allocated for a certain experiment. The length of the plot must be greater than the breadth but not more than twice the breadth. The area must be more than $400m^2$ and the perimeter must be less than 200m.

   (a) Form inequalities representing the above information and graph them on the grid below. (graph was provided) (6 marks)

   (b) If the plot must also be exactly divisible into the sub plots of 10m by 10m, determine the size of the plot which will give maximum area (2 marks)

2. **1990 Q20 P1**

   A farmer has 15 hectares of land on which he can grow maize n beans only. In a year he grows maize on more land than beans. It costs him sh 4,400 to grow maize per hectare and sh. 10,800 to grow beans per hectare. He is prepared to spend at most sh 90,000 per year to grow the crops. He makes a profit of sh 2,400 from one hectare of maize and sh3,200 from one hectare of beans. Find the maximum profit he can make from the crops in a year. (8 marks)

3. **1991 Q24 P1**

   A chemical firm has 160 litres of solution A, 110 litres of solution B and 150 litres of solution C. To prepare a bottle of syrup X, 200ml of solution A, 100ml of solution B and 100ml of solution Care needed. For a bottle of Y 100ml of A, 200ml of B and 300ml of C are needed. Syrup X sells at sh 60 per bottle and syrup Y sells at sh 100 per bottle.
   How many bottles of each type of syrup should the firm make inorder to obtain the maximum amount of money? (8 marks)

4. **1992 Q20 P1**

   A transporter has two types of trucks to transport sugar. Type A truck carries 2000 bags while type B carries 3000 bags per trip. The transporter has to transport 120000 bags. He has 2 make more than 50 trips. Type B trucks are to make at most twice the number of trips made type A (B to be at most twice A).

   (a) By taking x to be the number of trips made by type A trucks and y to B the number of trips made by type b trucks, write down the inequalities representing this information (3 marks)

   (b) If the transporter makes a profit of sh 1000 per trip for the type A truck and sh 2000 per trip for the type B truck use graphical methods to find the number of trips he should make with each type of truck in order to maximize his profit (5 marks)

5. **1993 Q23 P2**

A coffee merchant has 400kg of Robusta coffee and 480kg of Arabica coffee.
The coffee is packed by weight as follows:

Type I : 30% Robusta and 70% Arabica
Type II: 50% Robusta and 50% Arabica

Type I is sold at sh 34 per kg while type II is sold at sh 36 per kg. Use graphical method to determine the number of kilograms of type I and type II which should be packed to maximize the profit. (8 marks)

6. **1994 Q 18 P2**

A factory manufacturers two products which are produced on the three machines X, Y and Z. The first product requires 2 hours on machine X, 3hours on machine Y and 1 hour on machine Z. The second product requires 1 hour on machine X, 4hours on machine Y and 2 hours on machine Z.Machine X can be used for at most 100 hours, machine Y for at most 240 hours and machine Z for at most 90 hours The profit per unit is sh 300 for the first product and sh 400 for the second product.

Form inequalities representing the above information and represent them on the grid provided.. From the graph determine the number of units of each product that should be produced to give maximum profit. (8 marks)

7. **1995 Q24 P2**

A manufacture of jam has 720 kg of strawberry syrup and 800 kg of mango syrup for making two types of jam, grade A and B. Each types is made by mixing strawberry and mango syrups as follows:

Grade A: 60% strawberry and 40% mango
Grade B: 30% strawberry and 70% mango

The jam is sold in 400 gram jars. The selling prices are as follows:

Grade A: Kshs. 48 per jar
Grade B: Kshs 30 per jar.

(a) Form inequalities to represent the given information (3 marks)

(b) (i) On the grid provided draw the inequalities (3 marks)

(ii) From your, graph, determine the number of jars of each grade the manufacturer should produce to maximize his profit (1 mark)

(iii) Calculate the total amount of money realized if all the jars are sold (1 mark)

8. **1997 Q19 P2**

An institute offers two types of courses technical and business courses. The institute has a capacity of 500 students. There must be more business students

than technical students but at least 200 students must take technical courses.
Let x represent the number of technical students and y the number of business students.

(a)Write down three inequalities that describe the given conditions (3 marks)

(b) On the grid provided, draw the three inequalities (3 marks)

(c) If the institute makes a profit of Kshs 2, 500 to train one technical students and Kshs 1,000 to train one business student, determine

(i)the number of students that must be enrolled in each course to maximize the profit (1 mark)

(ii) The maximum profit. (1 mark)

9. **1997 Q22 P2**

A school has to take 384 people for a tour. There are two types of buses available, type X and type Y. Type X can carry 64 passengers and type Y can carry 48 passengers. They have to use at least 7 buses.

(a) Form all the linear inequalities which will represent the above information. (3 marks)

(b) On the grid provided below,draw the inequalities and shade the unwanted Region (3 marks)

(c) The charges for hiring the buses are:

Type X: sh 25,000
Type Y: sh 20,000

Use your graph to determine the number of buses of each type that should be hired to minimize the cost (2 marks)

10. **1998 Q24 P2**

A draper is required to supply two types of shirts A and type B.The total number of shirts must not be more than 400. He has to supply more type A than of type B however the number of types A shirts must be more than 300 and the number of type B shirts not be less than 80.

Let x be the number of type A shirts and y be the number of types B shirts.

(a) Write down in terms of x and y all the linear inequalities representing the information above. (3 marks)

(b) On the grid provided, draw the inequalities and shade the unwanted regions (3 marks)

(c) Type A: Kshs 600 per shirt
Type B: Kshs 400 per shirt

(i) Use the graph to determine the number of shirts of each type that should be made to maximize the profit. (1 mark)

(ii) Calculate the maximum possible profit. (1 mark)

11. 2000 Q24 P2

A theatre has a seating capacity of 250 people. The charges are Kshs. 100 for an ordinary seat and Kshs 160 for a special seat. It cost Kshs 16,000 to stage a show and the theater must make a profit. There are never more than 200 ordinary seats and for a show to take place at least 50 ordinary seats must be occupied. The number of special seats is always less than twice the number of ordinary seats.

(a) Taking x to be the number of ordinary seats and y the number of special seats write down all the inequalities representing the information above. (2 marks)

(b) On the grid provided, draw a graph to show the inequalities in (a) above (4 marks)

(b) Determine the number of seats of each type that should be booked in Order to maximize the profit. (2 marks)

12. 2001 Q24 P2

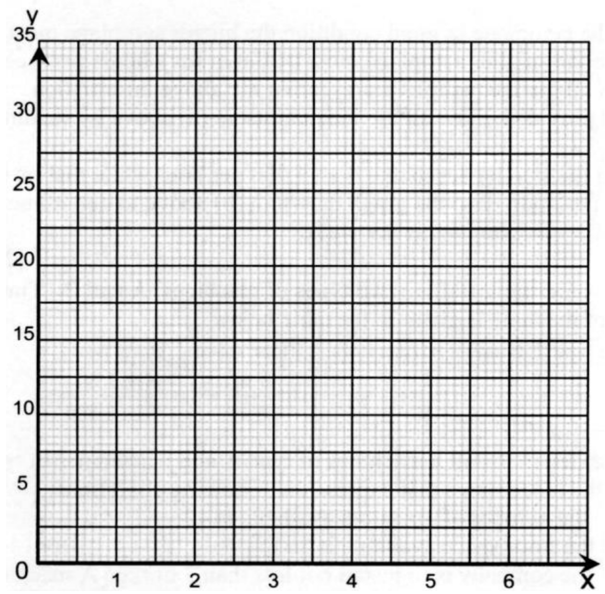
Bot juice Company has two types of machines, A and B, for juice production. Type A machine can produce 800 litres per day while type B machine produces 1,600 litres per day.

Type A machine needs 4 operators and type B machine needs 7 operators. At least 8,000litres must be produced daily and the total number of Operators should not exceed 41. There should be 2 more machines of each type.

Let x be the number of machines of type A and Y the number of machines for type B

a) Form all inequalities in x and y to represent the above information. (3 marks)

b) On the grid provided below, draw the inequalities to shade the unwanted regions. (3 marks)



13. 2003 Q20 P2

Omondi makes two types of shoes: A and B. He takes 3 hours to make one pair of type A and 4 hours to make one pair of type B.He works for a maximum of 120 hours to *x* pairs of type A and *y* pairs of type B.It costs him sh 400 to make a pair of type A and sh 150 to make a pair of type B.

His total cost does not exceed sh 9000. He must make 8 pairs of type A and more than 12 pairs of type B.

(a) Write down four inequalities representing the information above (3 marks)

(b) On the grid provided, draw the inequalities and shade the unwanted regions (3 marks)

(c) Omondi makes a profit of sh40 on each pair of type A and sh70 on each pair of type B shoes.
Use the graph provided to determine the maximum possible profit he makes. (2 marks)

14. 2005 Q24 P2

A diet expert makes up a food product for sale by mixing two ingredients N and S. One kilogram of N contains 25 units of protein and 30 units of vitamins. One kilogram of S contains 50 units of protein and 45 units of vitamins.
The food is sold in small bags containing atleast 175 units of protein and atleast 180 units of vitamins. The mass of food product in each bag must not exceed 6kg.
If one bag of the mixture contains x kg of N and y kg of S

(a) Write down all the inequalities, in terms of x and representing the information above (2 marks)

(b) On the grid provided draw the inequalities by shading the unwanted regions (2 marks)

(c) If one kilogram of N costs Kshs 20 and one kilogram of S costs Kshs 50, use the graph to determine the lowest cost of one bag of the mixture (3 marks)

15. 2006 Q23 P2

Mwanjoki flying company operates a flying service. It has two types of aeroplanes. The smaller one uses 180 litres of fuel per hour while the bigger one uses 300 litres per hour.The fuel available per week is 18,000 litres. The company is allowed 80 flying hours per week while the smaller aeroplane must be flown for y hours per week.

(a) Write down all the inequalities representing the above information (3 marks)

(b) On the grid provided on page 21, draw all the inequalities in a) above by shading the unwanted regions (3 marks)

(c) The profits on the smaller aeroplane is Kshs 4000 per hour while that on the bigger one is Kshs 6000 per hour
Use the graph drawn in (b) above to determine the maximum profit that the company made per week. (3 marks)

16. 2007 Q22 P2

A company is considering installing two types of machines. A and B. The information about each type of machine is given in the table below.

Machine	Number of operators	Floor space	Daily profit
A	2	$5m^2$	Kshs 1,500
B	5	$8m^2$	Kshs 2,500

The company decided to install x machines of types A and y machines of type B

(a) Write down the inequalities that express the following conditions

I. The number of operators available is 40

II. The floor space available is $80m^2$

III. The company is to install not less than 3 type of A machine

IV. The number of type B machines must be more than one third the number of type A machines

(4 marks)

(b) On the grid provided, draw the inequalities in part (a) above and shade the unwanted region (4 marks)

(c) Draw a search line and use it to determine the number of machines of each type that should be installed to maximize the daily profit.

(2 marks)

17. 2010 Q20 P2

A carpenter takes 4 hours to make a stool and 6 hours to make chair. It takes the carpenter and at least 144 hours to make x stools and y chairs. The labour cost should not exceed Ksh.4800 the carpenter must make a least 16 stools and more than 10 chairs.

a) Write down inequalities to represent the above information. (3 marks)

b) Draw the inequality in (a) above on a grid. (4 marks)

c) The carpenter makes a profit of Ksh 40 on a stool and Ksh 100 on a chair. Use the graph to determine the maximum profit the carpenter can make.

(3 marks)

18. 2011 Q24 P2

A building contractor has two Lorries, P and Q used to transport atleast 42 tonnes of sand to a building site. Lorry P carries 4 tonnes of sand per trip while lorry Q carries 6 tonnes of sand per trip. Lorry P uses 2litres of fuel per trip while lorry Q uses 4litres of fuel per trip.

The two Lorries are to use less than 32 litres of fuel. The number of trips made by lorry Pshould be less than 3 times the number of trips made by lorry Q. Lorry p should make more than 4 trips.

(a) Taking *x* to represent the number of trips made by the lorry Pand *y* to represent the number of trips made by lorry Q, write the inequalities that represent the above information. (4 marks)

(b) On the grid provided, draw the inequalities and shade the unwanted regions

(4 marks)

(c) Use the graph drawn in (b) above to determine the number of trips made by lorry P and by lorry Q to deliver the greatest amount of sand (2 marks)

19. 2014 Q20 P2

The dimensions of a rectangular floor of a proposed building are such that

- the length is greater than the width but at most twice the width;
- the sum of the width and the length is, more than 8 metres but less than 20metres.

If'x represents the width and y the length.

(a) write inequalities to represent the above information.

(b) (i) Represent the inequalities in part (a) above on the grid provided.

(ii) Using the integral values of x and y, find the maximum possible area of the floor. (2 marks)

20. 2015 Q12 P1

A school decided to buy at least 32 bags of maize and beans. The number of bags of maize were to be more than 20 and the number of bags of beans were to be at least 6. A bag of maize costs Ksh 2500 and a bag of beans costs Ksh 3500. The school had Ksh 100 000 to purchase the maize and beans. Write down all the inequalities that satisfy the above information. (4 marks)

LATITUDES AND LONGITUDES

1. **1989 Q18 P1**

   A globe representing the earth has a radius 0.5m. Points *A*(10^0W), *B* (0^0, 35^0E) *P*(60^0N, 110^0E) and *Q* (60^0N, 120^0W) are marked on the globe.

   (a) Find the length of the arc AB, leaving your answer in terms of Л (3 marks)

   (b) If O is the centre of the latitude 60^0 N, find the area of the minor sector OPQ (5 marks)

2. **1990 Q18 P1**

   (a) Calculate the distance round the latitude 600 N. (*Take the radius of the earth, R = 6370 km and Л =* $^{22}/_{7}$) (4 marks)

   (b) An aeroplane flew due south from a point A (60^0N, 45^0E), to a point B. The distance covered by the aeroplane was 8000km. Determine the position of B. (4 marks)

3. **1991 Q13 P2**

   The latitude and longitude of two stations A and B are (47^0N, 25^0 E) and (47^0N, 70^0 E).

   Calculate the distance in nautical miles between A and B along latitude 47^0 N. (3 marks)

4. **1992 Q11 P2**

   A point Q is 2000 nm to the west of P (60^0N, 0^0). Find the longitude of Q to the nearest degree. (3 marks)

5. **1994 Q18 P1**

   A and B are two points on the latitude 40^0 N. The two points lie on the longitudes 20^0 W and 100^0E respectively. Calculate

   (i) The distance from A to B along a parallel of latitude (5 marks)

   (ii) The shortest distance from A to B along a great circle (Take Л = $^{22}/_{7}$ and R = 6370 km) (4 marks)

6. **1995 Q24 P1**

   An aeroplane flies from a point A(1^o 15'S, 37^oE) to a point B directly north of A. The arc AB suspends an angle of 45^o at the centre of the earth.From B, the aeroplane flies due West to a point C on longitude 23^o W. (Take the value of л as $^{22}/_{7}$ and radius of the earth as 6370)

   a) (i)Find the latitude of B (1 mark)

   (ii) Find the distance travelled by the aeroplane between Band C (5 marks)

   b) The aeroplane left B at 1.00 am local time. When the aeroplane was leaving B, what was the local time at C? (2 marks)

7. **1996 Q20 P1**

The position of two A and B on the earth's surface are (36^0 N, 49^0E) and (360^0N, 131^0 W) respectively.

(a) Find the difference in longitude between town A and town B (2 marks)

(b) Given that the radius of the earth is 6370, calculate the distance between town A and town B. (3 marks)

(d) Another town, C is 840 east of town B and on the same latitude as towns A and B. Find the longitude of town C. (3 marks)

8. **1997 Q18 P1**

A ship leaves an island (5^0N, 45^0E) and sails due east for 120 hours to another island.

The average speed of the ship is 27 knots.

(a) Calculate the distance between the two islands

(i) in nautical miles (2 marks)

(ii) in kilometers (1 mark)

(b) Calculate the speed of the ship in kilometers per hour (3 marks)

(c) Find the position of the second island (3marks)

(take 1 nautical mile to be 1.853 Km and the radius of the earth to be 6370 Km)

9. **1998 Q20 P1**

The position of two towns X and Y are given to the nearest degree as X (45^0 N, 10^0W) and Y (45^0 N, 70^0W)

Find

a) the difference in longitude (1 mark)

b) The distance between the two towns in

(i) Kilometers (take the radius of the earth as 6371) (3 marks)

(ii) Nautical miles (take I nautical mile to be 1.85 km) (2 marks)

c) The local time at X when the local time at Y is 2.00 pm. (2 marks)

10. **2000 Q22 P1**

A plane leaves an airport A (38.5^0N, 37.05^0W) and flies dues North to a point B on latitude 52^0N.

(a) Find the distance covered by the plane (4 marks)

(b) The plane then flies due east to a point C, 2400km from B. Determine the position of C

Take the value л of as $^{22}/_7$ and radius of the earth as 6370 km (4 marks)

11. 2001 Q24 P1

A plane flying at 200 knots left an airport A (30^0S, 31^0E) and flew due North to an airport B (30^0 N, 31^0E)

(a) Calculate the distance covered by the plane, in nautical miles (2 marks)

(b) After a 15 minutes stop over at B, the plane flew west to an airport C (30^0N, 13^0E) at the same speed.

Calculate the total time to complete the journey from airport C, though airport B. (6 marks)

12. 2003 Q24 P1

Two towns A and B lie on the same latitude in the northern hemisphere. When its 8am at A, the time at B is 11.00am.

a) Given that the longitude of A is 150 E find the longitude of B. (2 marks)

b) A plane leaves A for B and takes $3^1/_2$ hours to arrive at B traveling along a parallel of latitude at 850km/h. Find:

(i) The radius of the circle of latitude on which towns A and B lie. (3 marks)

(ii) The latitude of the two towns (take radius of the earth to be 6371km) (3 marks)

13. 2006 Q16 P2

Two places P and Q are at (36^0N, 125^0W) and 36^0N, 125^0W) and 36^0 N, 125^0W) and 36^0 N, 55^0E) respectively. Calculate the distance in nautical miles between P and Q measured along the great circle through the North pole. (3 marks)

14. 2007 Q13 P2

Two places A and B are on the same circle of latitude north of the equator. The longitude of A is 118^0W and the longitude of B is 133^0E. The shorter distance between A and B measured along the circle of latitude is 5422 nautical miles. Find, to the nearest degree, the latitude on which A and B lie (3 marks)

15. 2008 Q7 P2

An aero plane flies at an average speed of 500 knots due East from a point P(53.4^0E,40^0E) to another point Q. It takes 2 ¼ hours to reach point Q.

Calculate:

(i) The distance in nautical miles it traveled; (1 mark)

(ii) The longitude of point Q to 2 decimal places (2 marks)

16. 2009 Q13 P2

Point (40˚S, 45˚E) and point Q (40˚S, 60˚W) are on the surface of the Earth.

Calculate the shortest distance along circle of latitude between the two points (3 marks)

17. **2010 Q19 P2**

The position of three points A, B and C are (34^0N, 16^0W) , (34^0N, 24^0E) and (26^0S, 16^0W) respectively.

a) Find the distance in nautical miles between:

   i) Port A and B to the nearest nautical miles; (3 marks)

   ii) Ports A and C. (2 marks)

b) A ship left port A on Monday at 1330h and sailed to Port B at 40 knots.

   Calculate:

   i) The local time at port B when the ship left port A; (2 marks)

   ii) The day and the time the ship arrived at port B (3 marks)

18. **2011 Q14 P2**

A point M (60^0N, 18^0E) is on the surface of the earth. Another point N is situated at a distance of 630 nautical miles east of M.

Find;

a) the longitude difference between M and N; (2 marks)

b) the position of N (1 mark)

19. **2012 Q22 P2**

A tourist took 1h 20 minutes to travel by an aircraft from T(3^0S, 35^0E) to town U(9^0N,35^0E). (Take the radius of the earth to be 6370km and $\pi = \frac{22}{7}$,

a) Find the average speed of the aircraft. (3 marks)

b) After staying at town U for 30 minutes, the tourist took a second aircraft to town V (9^0N,5^0E). The average speed of the second aircraft was 90% that of the first aircraft. Determine the time, to the nearest minute, the aircraft took to travel from U to V.

(3 marks)

c) When the journey started at town T, the local time was 0700h.Find the local time at V when the tourist arrived. (4 marks)

20. **2013 Q15 P2**

The position of two towns are (2^0 S,30^0 E) and 2^0S, 37.4 ^{0}E) calculate , to the nearest km, the shortest distance between the two towns.(take the radius of the earth to be 6370 km)

(2 marks)

21. **2014 Q13 P2**

The shortest distance between two points A (40°N, 20°W) and B (0°S, 20°W) on the surface of y the earth is 8008km. Given that the radius of the earth is 6370km, determine the position of B. (Take n = $\frac{22}{7}$). (3 marks)

22. **2015 Q14 P2**

The positions of two points P and Q, on the surface of the earth are

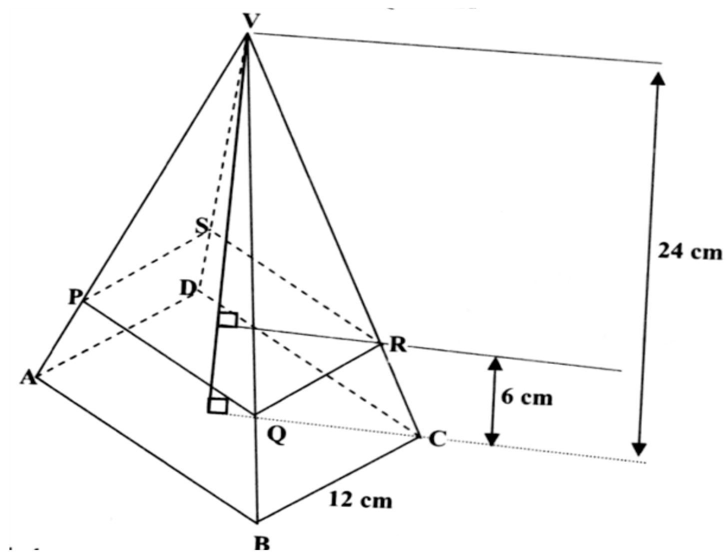
P(45 °N, 36°E) and Q(45 °N, 71°E). Calculate the distance, in nautical miles,

between P and Q, correct to 1 decimal place. (3 marks)

THREE DIMENSIONAL GEOMETRY

1. 1990 Q23 P2

The figure below shows a right pyramid VABCD whose rectangular base is 18cm by 12 cm. The altitude is 24cm. The plane PQRS and ABCD are parallel and 6cm apart



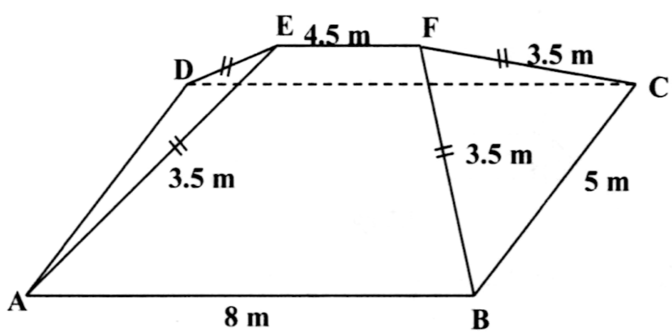
Calculate

(a) The angle between the planes ABCD and VAB (4 marks)

(b) The area of the rectangle PQRS (4 marks)

2. 1991 Q23 P2

The figure below shows a shape of a roof with a horizontal rectangular base ABCD. The ridge EF is also horizontal. The measurements of the roof are AB =8m, BC = 5m, EF = 4.5m and EA = ED = FC = 3.5m



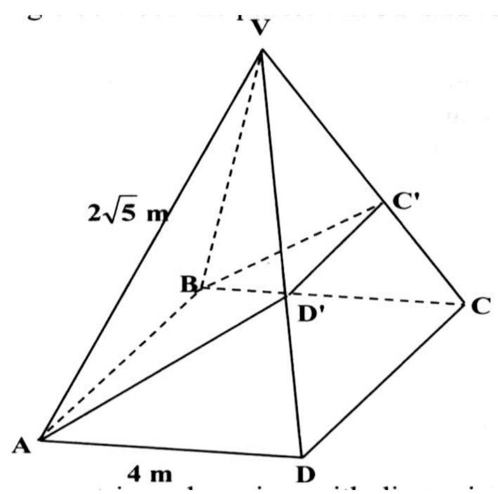
Calculate:

i) the height of the ridge EF above the base ABCD (4marks)

ii) the angle between the face and the base ABCD (4marks)

3. 1992 Q19 P2

A pyramid VABD has a square base ABCD of side 4m. The slant edges VA, VB, VC and VD are 2 $\sqrt{5}$ m long



Calculate

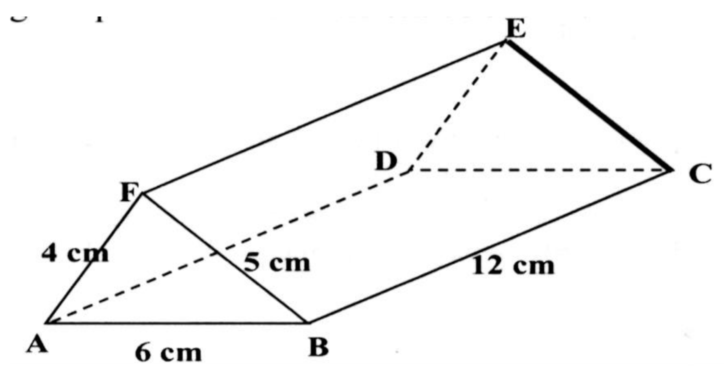
i) The height of the pyramid (3 marks)

ii) The angle between the plane VAB and the base ABCD (2 marks)

a) C′ and D′ are midpoints of VC and VD respectively.
Calculate the angle between the planes ABCD and ABC′D′ (3 marks)

4. 1993 Q22 P2

The figure below shows a triangular prism with dimensions as shown



Calculate

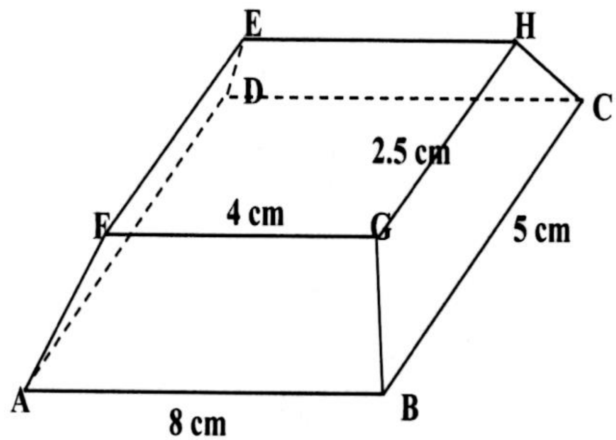
a) The angle between the faces FBCE and ABCD
(2marks)

b) the volume of the prism (3 marks)

c) the angle between the planes DFC and ABCD (3 marks)

5. 1994 Q22 P1

In the figure below ABCDEFGH is a frustum of a right pyramid. The altitude of the frustum is 2cm.



Calculate

a) The altitude of the pyramid (2 marks)

b) The volume of the frustum (3 marks)

c) The angle between the base of the frustum and the face ABGF (3 marks)

6. 1996 Q 13 P2

The base of a right pyramid is a square ABCD of side 2a cm. The slant egdes VA, VB, VC and VD are each of length 3a cm.

a) Sketch and label the pyramid (1 mark)

b) Find the angle between a slanting edge and the base (3 marks)

7. 1997 Q 6 P2

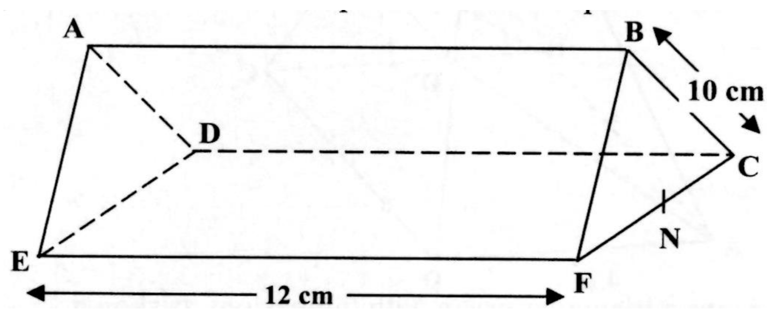
A pyramid of height 10cm stands on a square base ABCD of side 6 cm

(a) Draw a sketch of the pyramid (1mark)

(b) Calculate the perpendicular distance from the vertex to the side AB (2marks)

8. 1998 Q 16 P2

The triangular prism shown below has sides AB= DC = EF = 12 cm. The ends are equilateral triangle of sides 10cm. The point N is the midpoint FC.



(a) Find the length of

(i) BN (1 mark)

(ii) EN (1 mark)

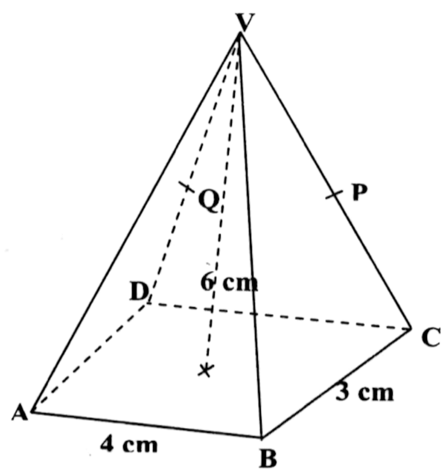
(b) Find the angle between the line EB and the plane CDEF (2 marks)

9. 1999 Q 14 P1

An equilateral triangle ABC lies in a horizontal plane, A vertical flag AH stand at A. If AB = 2 AH find the angle between the places ABC and HBC (3 marks)

10. 1999 Q 24 P2

The diagram below shows a right pyramid VABCD with V as the vertex. The base of the pyramid is rectangle ABCD, with ab = 4 cm and BC= 3 cm. The height of the pyramid is 6cm



(a) Calculate the

(i) length of the projection of VA on the base (2 marks)

(ii) Angle between the face VAB and the base (2 marks)

(b) P is the mid- point of VC and Q is the mid – point of VD.
Find the angle between the planes VAB and the plane ABPQ (4 marks)

11. 2000 Q 11 P1

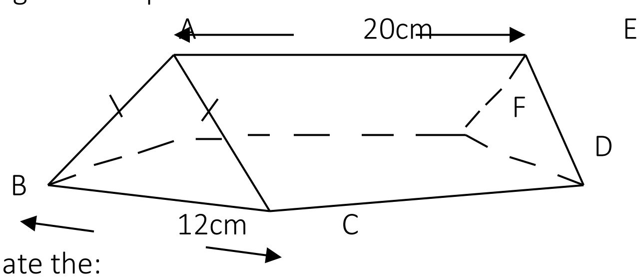
A pyramid VABCD has a rectangular horizontal base ABCD with AB= 12 cm and BC = 9cm.

The vertex V is vertically above A and VA = 6cm. calculate the volume of the pyramid.

(2 marks)

12. 2002 Q 18 P1

The figure below represents a right prism whose triangular faces are isosceles. The base and height of each triangular face are 12cm and 8cm respectively. The length of the prism is 20cm



Calculate the:

a) Angle CE (2 marks)

b) Angle between

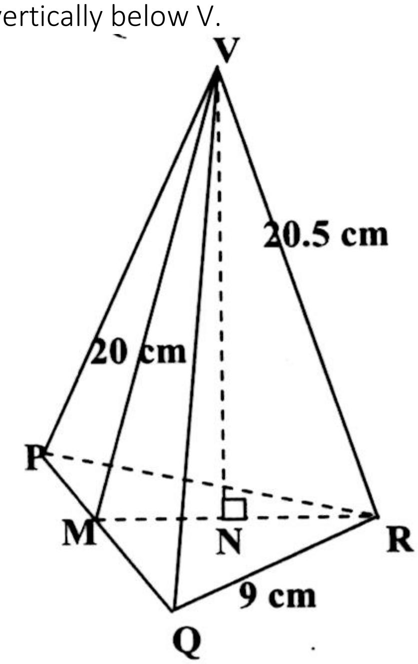
i) The line CE and the plane BCDF (2 marks)

ii) The plane EBC and the base BCDF (2 marks)

13. 2002 Q 20 P2

The figure VPQR below represents a model of a top of a tower. The horizontal base PQR is an equilateral triangle of side 9cm. The lengths of edges are VP = VQ = VR = 20.5cm. Point M is the midpoint of PQ and VM = 20cm

Point N is on the base and vertically below V.



Calculate:

a) i) Length of RM (2 marks)

ii) Height of model (2 marks)

iii) Volume of the model (2 marks)

b) The model is made of material whose density is 2,700 kg/m^3. Find the mass of the model. (2 marks)

14. 2003 Q 15 P1

Three points O, A and B are on the same horizontal ground. Point A is 80 metres to the north of O. Point B is located 70 metres on a bearing of 060^0 from A. A vertical mast stands at point B.

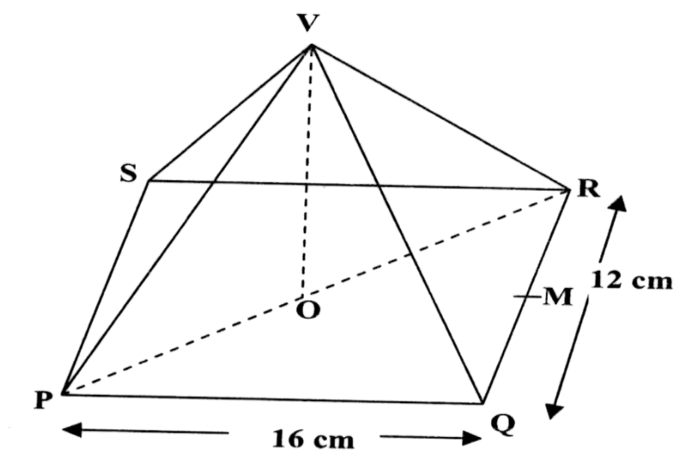
The angle of elevation of the top of the mast from o is 20^0.

Calculate: a) The distance of B from O. (2 marks)

b) The height of the mast in metres (2 marks)

15. 2003 Q 24 P2

The figure below represents a right pyramid with vertex V and a rectangular base PQRS. VP = VQ = VR= VS = 18cm and QR =16cm and QR = 12cm. M and O are the midpoints of QR and PR respectively.



Find:

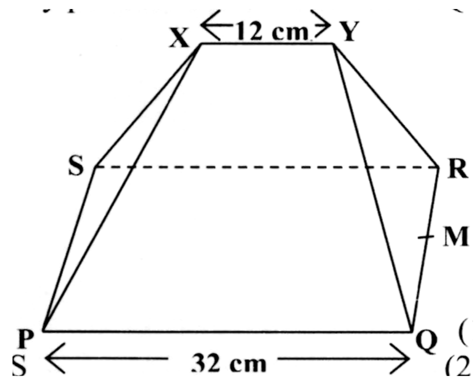
a) The length of the projection of line VP on the plane PQES (2 marks)

b) The size of the angle between line VP and the plane PQRS. (2 marks)

c) The size of the angle between the planes VQR and PQRS. (2 marks)

16. **2004 Q 24 P2**

The figure below shows a model of a roof with a rectangular base PQRS . PQ = 32 cm and QR = 14 cm. The ridge XY = 12 cm and is centrally placed. The faces PSX and QRY are equilateral triangles M is the midpoint of QR.



Calculate

(a) (i) the length of YM (1 mark)

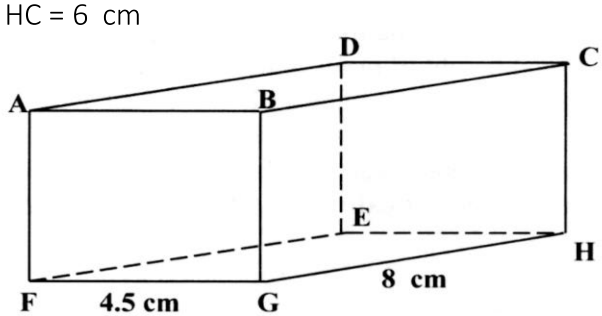
(ii) The height of Y above the base PQRS (2 marks)

(b) The angle between the planes RSXY and PQRS (3 marks)

(c) The acute angle between the lines XY and QS (2 marks)

17. **2005 Q 23 P2**

The diagram below represents a cuboid ABCDEFGH in which FG= 4.5 cm, GH = 8cm and HC = 6 cm



Calculate:

(a) The length of FC (2 marks)

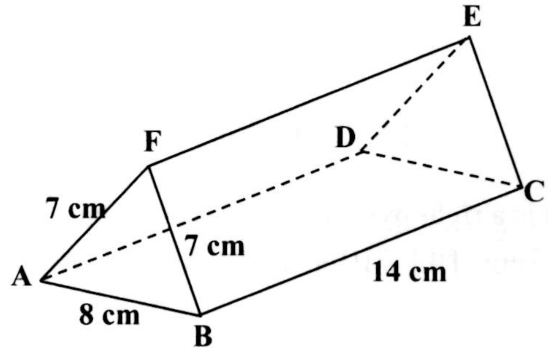
(b) (i) the size of the angle between the lines FC and FH (2 marks)

(ii) The size of the angle between the lines AB and FH (2 marks)

(c) The size of the angle between the planes ABHE and the plane FGHE (2marks)

18. 2008 Q 14 P2

The figure below represents a triangular prism. The faces ABCD, ADEF and CBFE are rectangles. AB=8cm, BC=14cm, BF=7cm and AF=7cm.

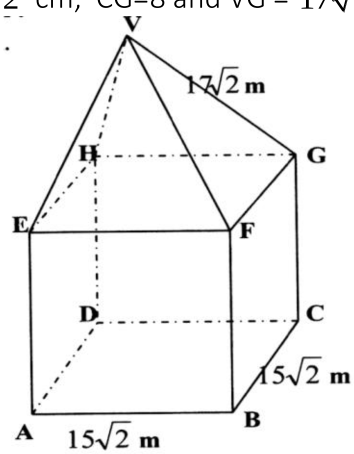


Calculate the angle between faces BCEF and ABCD. (3 marks)

19. 2009 Q 22 P2

The figure below shows a right pyramid mounted onto a cuboid

AB = BC = $15\sqrt{2}$ cm, CG=8 and VG = $17\sqrt{2}$ cm



Calculate

(a) The length of AC; (1 mark)

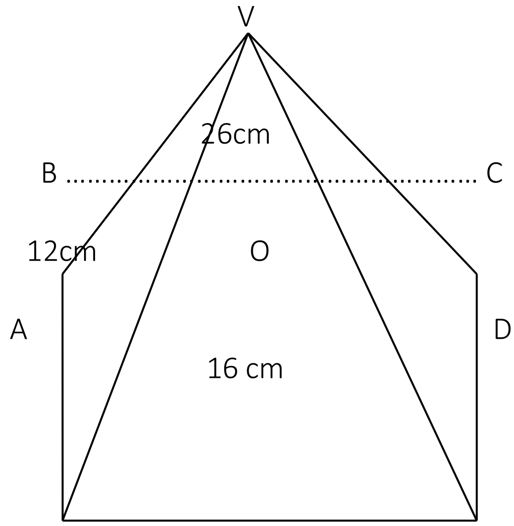
(b) The angle between the line AG and the plane ABCD; (3 marks)

(c) The vertical height of point V from plane ABCD; (3 marks)

(d) The angle between the planes EFV and ABCD (3 marks)

20. **2011 Q 22 P2**

The figure below represents a rectangular based pyramid VABCD.
AB=12cm and AD=16 cm.
Point O is vertically below V and VA=26cm.



Calculate

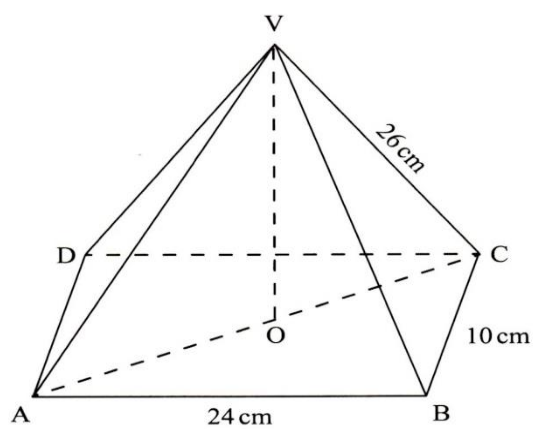
a) The height ,VO, of the pyramid; (4 marks)

b) The angle between the edge VA and the plane ABCD; (3 marks)

c) The angle between the planes VAB and ABCD. (3 marks)

21. **2012 Q16 P2**

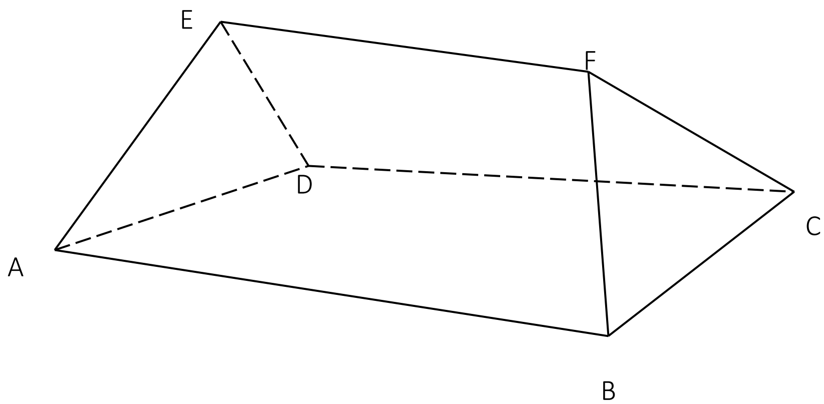
In the figure below, VABCD is a right pyramid on a rectangular base. Point O is vertically below the vertex V. AB=24cm, BC=10cm and CV=26cm.



Calculate the angle between the edge CV and the base ABCD. (3 marks)

22. **2013 Q20 P2**

The figure ABCDEF below represents a roof of a house. AB=DC=12 m, BC = AD = 6m, AE = BF = CF= DE = 5m and EF = 8m



(a) Calculate, correct to 2 decimal places, the perpendicular distance of EF from the plane ABCD. (3 marks)

(b) calculate the angle between :

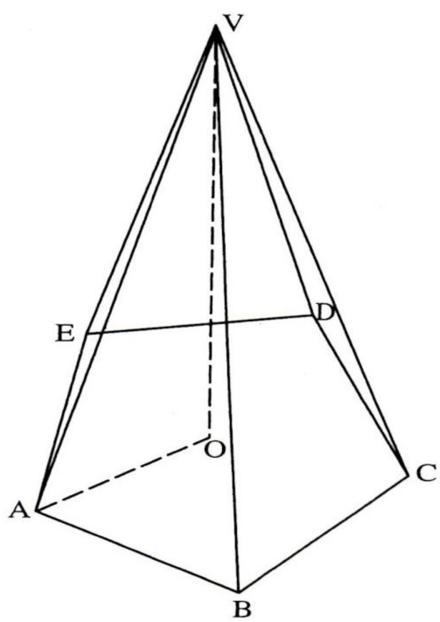
(I) the planes ADE and ABCD (2 marks)

(II) The line AE and the plane ABCD, correct to 1 decimal place; (2 marks)

(III) The planes ABFE and DEFE, correct to 1 decimal place. (3 marks)

23. **2014 Q20 P1**

The figure below shows a right pyramid VABCDE. The base ABCDE is regular pentagon. AO = 15cm and VO = 36 cm.



Calculate:

(a) The area of the base correct to 2decimal places (3marks)

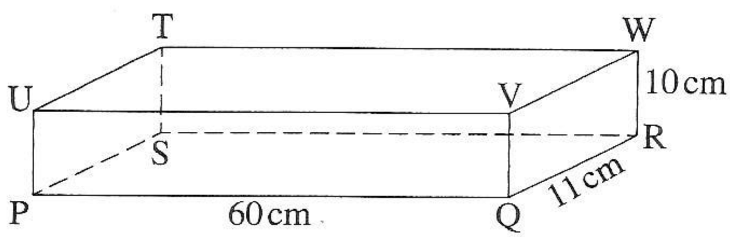
(b) The length AV (1mark)

(c) The surface area of the correct to 2decimal places (4marks)

(d) The volume of the pyramid correct to 4 significant figures (2marks)

24. **2014 Q10 P2**

The figure below represents a cuboid PQRSTUVW. PQ = 60cm, QR = 11 cm and RW - 10cm.

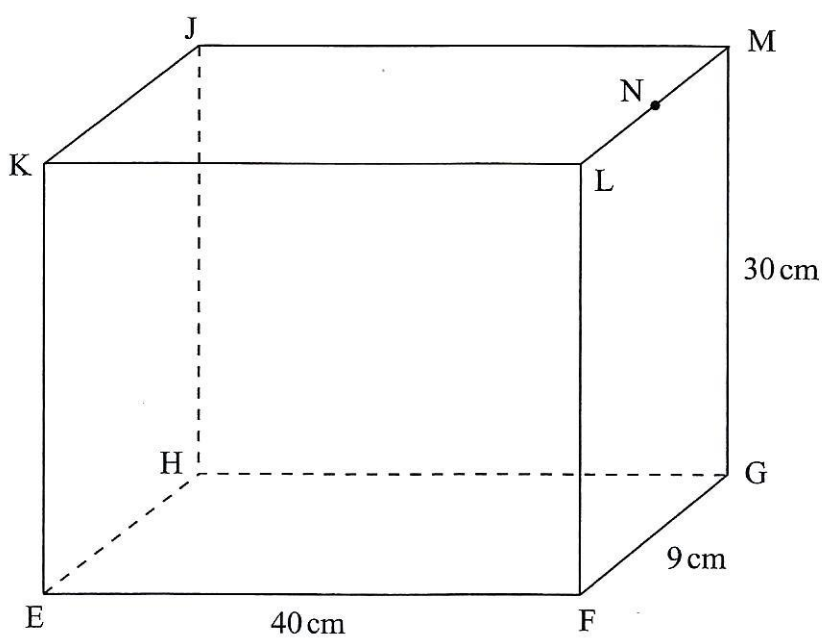


Calculate the angle between line PW and plane PQRS, correct to 2 decimal places. (3marks)

25. **2015 Q20 P2**

The figure below represents a cuboid EFGHJKLM in which EF = 40cm, FG=9cm

and GM=30 cm. N is the midpoint of LM.



Calculate correct to 4 significant figures a)The length of GL: (1 mark)

b)The length of FJ (2 marks)

c)The angle between EM and the plane EFGH; (3 marks)

d)The angle between eh planes EFGH and ENH; (2 marks)

e)the angle between the lines EH and GL (2 marks)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