

# **‘O’ LEVEL MATHS**

## **Revision guide**

### **STUDY PACK**

***500 marks***

#### **Instructions to candidates**

- Answer all questions
- Omission of essential working will result in loss of marks
- Decimal answers which are not exact should be given correct to three significant figures unless stated otherwise.
- Write neatly and legible.
- Electronic calculators can only be used on the topic show that and practice.

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**MUSENDO POWER**

## **DECIMALS, SIGNIFICANT FIGURES AND PERCENTAGES**

1. Express 1548

- (a) One significant figure (1)      (b) The nearest ten (1)

2. Express 0,00349 to

- (a) One significant figure (1)      (b) Two significant figure (1)  
(c) Three decimal places (1)      (d) Four decimal places (1)

3. Express 0,016 in standard form (1)

4. Express the following as percentages (1)

- (a) 0,094 (1)  
(b)  $1\frac{1}{3}$  (1)  
(c) 0,0043 (1)

## **FRACTIONS**

1.  $3\frac{1}{8} \div 8\frac{1}{3}$  (2)      2.  $3\frac{2}{5} \div 1\frac{7}{10} \times \frac{2}{5}$  (3)      3.  $\frac{1}{3} \div (\frac{1}{4} + \frac{1}{6})$  (3)

4.  $\frac{9}{13} - \frac{7}{11}$  (2)      5.  $2\frac{2}{11}(4\frac{1}{4} - 3\frac{1}{3})$  (3)      6.  $1\frac{3}{4} \div 1\frac{1}{6}$  (2)

7.  $\frac{1}{3} \div (\frac{1}{4} + \frac{1}{6})$  (3)      8.  $(3\frac{1}{8} - 2\frac{1}{3}) \div (4\frac{1}{2} + 1\frac{5}{6})$  (4)      9.  $\frac{7}{9}$  Of  $(\frac{2}{3} - \frac{5}{12})$  (3)

## **STANDARD FORM**

1. Given that  $x = 3 \times 10^6$        $y = 4 \times 10^9$

Find the value of:

(a)  $x^2$  (2)      (b)  $xy$  (2)      (c)  $\frac{x}{y}$  (2)

2. Given that  $x = 8,4 \times 10^3$        $y = 9 \times 10^2$        $z = 2 \times 10^{-5}$

Find (a)  $xy$  (2)      (b)  $yz$  (2)      (c)  $\frac{xy}{z}$  (2)

3. Evaluate  $(4 \times 10^2) + (6 \times 10^3) + (1 \times 10^5)$

Giving your answer in standard form. (2)

## **NUMBER BASES**

Find the values of

1.  $312_5 + 43_5$  (1)      2.  $214_5 + 132_5$  (3)

2. Given that  $110_3 = 14_x$  find  $x$  (3)      4.  $120_3 = 13_x + 10_x$  find  $x$  (3)

5.  $4015_7 + 3604_7$  (3)      6.  $1012_3 - 221_3$  (1)

7.  $23_x = 21_{10}$  find  $x$  (3)      8.  $503_8 - (226_8 + 167_8) =$  (3)

9.  $3^4 + 3^3 + 3$  as a number in base 3 (1)

10.  $2n2_5$  is a number in base 5 and that  $2n2_5 = 133_6$  find  $n$  (3)

## **EXPAND AND SIMPLIFY**

1.  $(x - 3)^2$  (2)      2.  $5(4x - 7) - 6(3x - 2)$  (2)

3.  $4rt^2(3r - t^3)$  (2)      4.  $3(6x - 5) - 2(4x - 7)$  (2)

5.  $(3x + 2y)(2x - y)$  (2)      6.  $3(x + 2y) - 2(x - y)$  (2)

7.  $3(2y - 5) - 2(7 - 2y)$  (2)      8.  $3(a + 2c) - 4(2a - c)$  (2)

9.  $3p - 2(2p + 3)$  (2)      10.  $4(2a + b) + 2(3a - 2b)$  (2)

## **SUBJECT OF THE FORMULA (all questions 3 marks)**

1.  $S = \pi r^2 + \pi r h$  (h)      2.  $S = ut + \frac{1}{2}at^2$  (a)

3.  $m(x + y) = x + 5m - 5$  (m)      4.  $y = \frac{t-3}{1-t}$  (t)

5.  $A = \pi r^2$  (r)      6.  $\frac{x}{a} + \frac{y}{b} = 1$  (b)

7.  $T = W + Wv^2$  (W)      8.  $A = \pi r (h^2 - r^2)$  (h)

9.  $V = \pi(R^2 - r_2)$  (R)      10.  $a(x - 1) = b$  (x)

### **SIMPLIFY THE FOLLOWING**

1.  $\frac{a^2-b^2}{ab+a^2} \div \frac{ab-a^2}{2a^3}$  (4)

2.  $\frac{x^2-25}{x^2-2x-15}$  (3)

3.  $\frac{x^2+7x+6}{x^2-36}$  (3)

4.  $\frac{a^2x^3y-a^2x^3}{a^4x^2y-a^4x^2}$  (3)

5.  $\frac{25-x^2}{10-2x}$  (2)

6.  $\frac{n-3}{6} \div \frac{n^2-9}{4}$  (3)

7.  $\frac{(-m)}{(-m)^2 \times (-m)^2}$  (2)

8.  $\frac{a^2-2a}{a^2-6a+9} \div \frac{4-2a}{a-3}$  (4)

### **STATISTICS**

1. Given the numbers 3;5;4;2;7;3;11

Find (i) the mode (1) (ii) the median (1) (iii) mean (1)

2. The numbers 4;7;8;k;10;11;14;18 are in ascending order :

(a) Given that the mode is 8, find the value of k (1)

(b) Hence, find the (i) median (1) (ii) mean (1)

3. The following entries show the numbers of bicycles sold per day in nine days

6;10;12;9;14;10;15;10;12

Find (a) the mode (1)

(b) the median (1)

(c) the next entry if the new mean on the tenth day is 12 (3)

### **SOLVE THE FOLLOWING EQUATIONS**

1.  $\frac{3}{m} - \frac{5}{4m} = 2$  (2)

2.  $\frac{1}{n} = 2 - \frac{2}{3n}$  (3)

3.  $x(3x+2) = 0$  (3)

4.  $\frac{x+1}{3} + \frac{2x-1}{2} = \frac{7}{6}$  (4)

5.  $(x-1)^2 = 9$  (2)

6.  $\frac{x}{3} = \frac{27}{x}$  (2)

7.  $3x(x+4) + 45 = 3(x^2+1)$  (4)

8.  $\frac{3y}{5} - \frac{1}{4} = 0$  (3)

## **GRADIENT**

1.  $A = (1, -2)$   $B = (3, 4)$  find (a) the gradient of AB (2)

(b) the equation of AB (2)

2.  $A = (1, 2)$   $P = (4, -2)$  lie on line Z

(a) find the gradient of line Z (2)

(b) find the equation of line Z (2)

A point  $B(k, 6)$  lies on line Z

(c) find the value of  $k$  (2)

3. The equation of a line is  $3x - 7y + 14 = 0$

(a) find the gradient of the line. (2)

(b) find  $y$  - intercept. (2)

(c) find the coordinates of the  
point where the line crosses the  $x$  - axis (2)

## **SOLVE THE SIMULTANEOUS EQUATIONS**

1.  $3x + y = 11\frac{1}{2}$

$x - 2y = 5$  (3)

2.  $8x + 15y = 11$

$4x - y = 31$  (3)

3.  $6x + 4y = 3$

$4x + 6y = 5$  (3)

4.  $2x + 3y = 6$

$6x + 4y = 5$  (3)

## **MATRICES**

1.  $C = \begin{pmatrix} 2 & -3 \\ 0 & 4 \end{pmatrix} D = \begin{pmatrix} 5 & -2 \\ -7 & 1 \end{pmatrix}$  find (a)  $C - 2D$  (2)

(b)  $D^2$  (2)

2.  $A = \begin{pmatrix} -1 & 0 \\ 2 & 3 \end{pmatrix} B = \begin{pmatrix} x & 2 \\ 8 & x \end{pmatrix}$  find (a)  $AB$  in terms of  $x$  (2)

(b) find  $x$  such that  $B$  is singular matrix. (2)

3.  $M = \begin{pmatrix} 1 & -1 \\ -1 & 3 \end{pmatrix} N = \begin{pmatrix} 1 & -2 \\ x & 6 \end{pmatrix}$  find: (a)  $M^2$  (2)

(b)  $x$ , given that  $N$  has no inverse. (2)

4. If  $\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} N = \begin{pmatrix} 7 & 0 \\ 2 & -1 \end{pmatrix}$  find  $N$  (3)

## **COLUMN VECTORS**

1.  $A = (1; -3)$   $AB = \begin{pmatrix} 6 \\ 8 \end{pmatrix}$   $BC = \begin{pmatrix} 2 \\ -2 \end{pmatrix}$

find (a)  $|AB|$  (2)

(b)  $|AC|$  (2)

(c) The coordinates of  $B$  (2)

2.  $A = (5; 2)$   $B = (-3; 8)$

find (a)  $AB$  as a column vector. (1)

(b) the length of line  $AB$  (1)

3.  $AB = \begin{pmatrix} 2 \\ 4 \end{pmatrix}$   $BC = \begin{pmatrix} -8 \\ 6 \end{pmatrix}$

find (a)  $AC$  (1)

(b)  $|AC|$  giving your answer in surd form. (2)

4.  $P = (4; 8)$        $R = (-4; -2)$

find (a)  $PR$  as a column vector (1)

(b)  $|PR|$  leaving your answer in surd form (2)

5.  $OP = \begin{pmatrix} 4 \\ 3 \end{pmatrix}$        $OQ = \begin{pmatrix} 6 \\ -1 \end{pmatrix}$

Calculate (a)  $|OP|$  (2)

(b)  $PQ$  (2)

(c)  $QP$  (2)

### **VARIATION**

1. It is given that  $C = a + KN^2$

Find the two possible value of  $N$  given that  $C = 102$ ,  $a = 27$  and  $K = 3$   
(3)

2.  $y$  varies directly as  $v$  and inversely as  $(x + 2)$

(i) Express  $y$  in terms of  $v$ ,  $x$  and a constant  $k$  (2)

(ii) Given that when  $y = \frac{3}{2}$ ,  $x = 8$  and  $v = 5$ , find the value of  $k$  (2)

(iii) Find  $y$  when  $x = -11$  and  $v = 2$  (2)

3.  $A$  is partly constant and partly varies as  $C$

(a) Express  $A$  in terms of  $C$  and constant  $h$  and  $k$  (1)

(b) Given that  $A = 1$  when  $C = 8$  and that  $A = 3$  when  $C = 12$ , calculate the value of:

(i)  $h$  (2)

(ii)  $k$  (2)

(c) Find the value of  $A$  when  $C = 30$  (2)

## **SINGLE FRACTION**

**Express as single fraction**

1.  $\frac{3}{x-2} - \frac{2}{x}$  (3)

2.  $\frac{5m}{8} - \frac{2m+3}{4}$  (3)

3.  $\frac{3}{x-2} - \frac{2}{x}$  (3)

4.  $\frac{y}{4y-1} + \frac{3}{5}$  (3)

5.  $\frac{4}{p} - \frac{3}{1-5p}$  (3)

6.  $n + \frac{2n}{6n+5}$  (3)

7.  $\frac{1}{x-1} + \frac{2}{x+1}$  (3)

8.  $\frac{2a-5}{a-4} - \frac{1}{2}$  (3)

9.  $\frac{n}{5} + \frac{2n}{6n} + 5$  (3)

10.  $\frac{1}{2x-5} + \frac{2}{3}$  (3)

11.  $\frac{1}{x} + \frac{1}{2x}$  (3)

12.  $\frac{x}{2} - \frac{x-1}{2}$  (3)

## **INEQUALITIES**

1. Solve  $y - 4 < 3y + 2 \leq 6 - y$  and list all the integral

values of  $y$  that satisfy the inequality. (4)

3 (a). Solve:  $5x - 6 < 2x - 3 \leq 3x + 1$  giving your answer in the

form  $a \leq x < b$  where  $a$  and  $b$  are integers. (4)

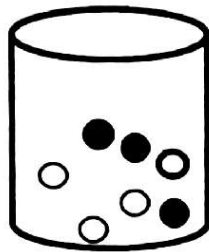
(b) illustrate the solution on a number line. (1)

3. Solve :  $3n - 25 < 2$  (2)

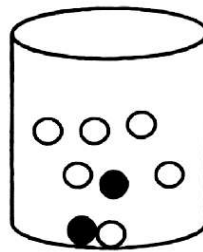
4. List the interger values of  $6 \leq 2x + 1 \leq 11$  (3)



## **PROBABILITY**



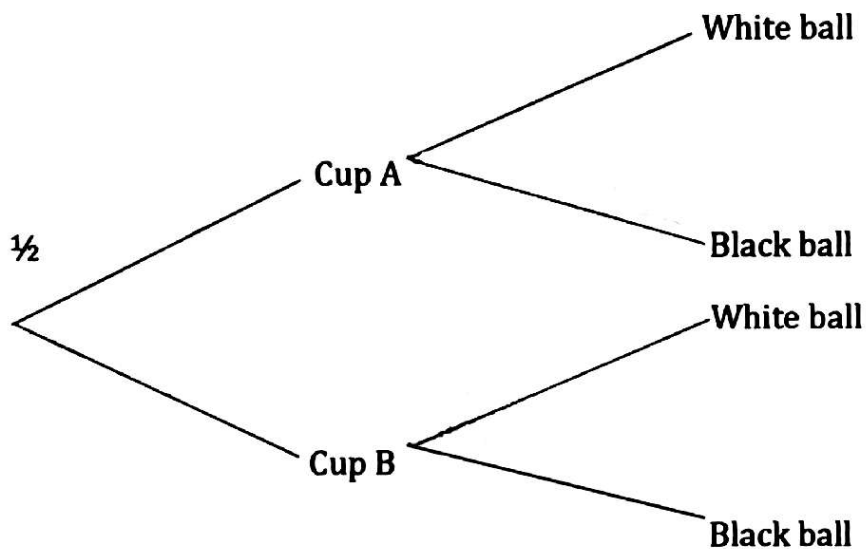
Cup A



Cup B

Shumi must choose a cup from which he should pick a ball. The probability that he chooses cup A =  $\frac{1}{2}$

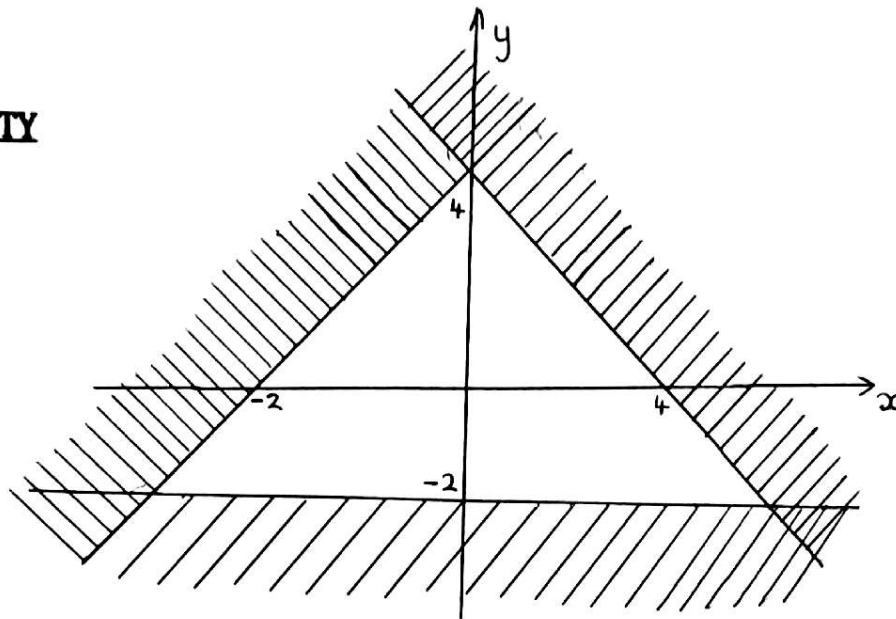
Cup A contains 5 white and 3 black balls. Cup B contains 6 white and 2 black balls. The tree diagram below shows some of this information.



- Complete the probability tree diagram shown above (3)
- Find the probability that Shumi chooses Cup A and then a white ball (2)
- Find the probability that Shumi picks a white ball (2)

## INEQUALITY

a.



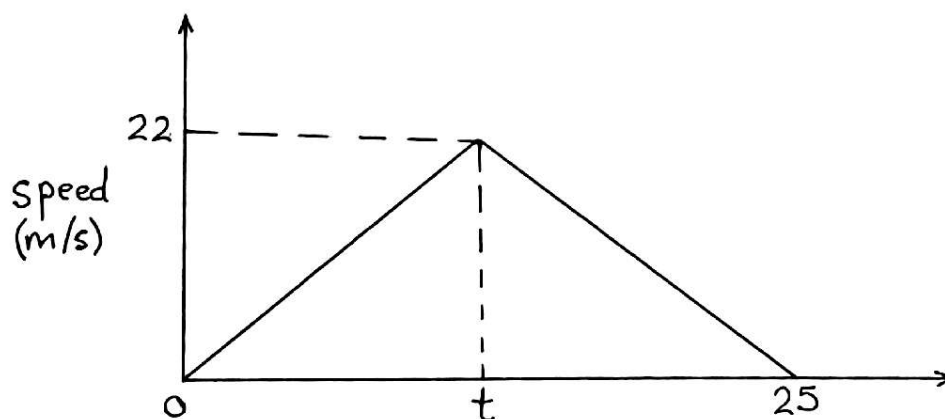
Find the three inequalities which define the unshaded part/region in the diagram above (5)

b. Given that  $-5 \leq x \leq 1$  and  $6 \leq y \leq 17$ , find

- The greatest value of  $x$
- The least value of  $x^3 - y$  (3)

## TRAVEL GRAPHS

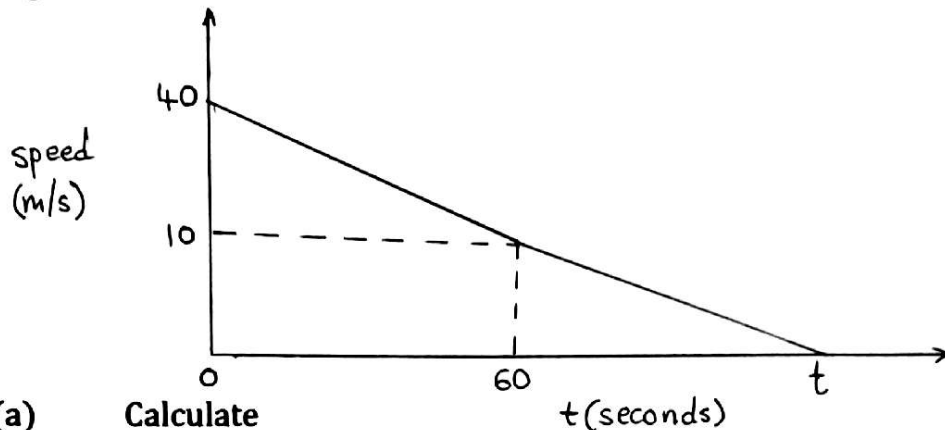
1. The diagram below shows a speed time graph of a motor cycle.



- a. Given that the acceleration during the first  $t$  seconds is  $2\frac{1}{5}\text{m/s}^2$ , calculate the value of  $t$  (2)

- b. Calculate : 1. The total distance travelled during the 25 seconds (3)  
2. the average speed for the whole journey (2)

2. The diagram shows a velocity time graph of a train which retards in two stages.



- (a) Calculate
- The retardation of the train during the first 60 seconds (2)
  - The distance that the train covers in the first 60 seconds (2)
  - Given that the train covers a total distance of 3000m during the period of retardation. Calculate the value of  $t$  (3)

## **FUNCTIONS**

1.  $f(x) = 3x^2 - x$

find  $f(-2)$  (1)

3.  $f(x) = x^2 - 9$

(a) find  $f(7)$  (1)

(b) find the value of  $x$

for which  $f(x) = 16$  (2)

2.  $f(x) = 2k - 3$

find  $k$  when  $f(k) = -21$  (2)

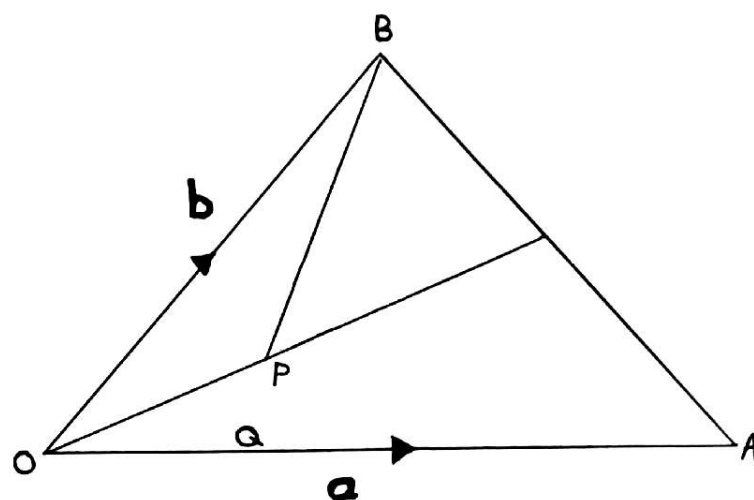
4. Given that  $f(x) = 27^x$

find (a)  $f\left(\frac{4}{3}\right)$  (2)

(b)  $f\left(-\frac{1}{3}\right)$  (2)

(c)  $x$  if  $f(x) = 9$  (2)

## VECTORS



$$OA = \mathbf{a}$$

$$OB = \mathbf{b}$$

M is the midpoint of AB and P is the midpoint of OM

(a) Express the following vectors in the form of  $\mathbf{a}$  and  $\mathbf{b}$

(i)  $\overrightarrow{AB}$  (1)

(ii)  $\overrightarrow{AM}$  (1)

(iii)  $\overrightarrow{OM}$  (2)

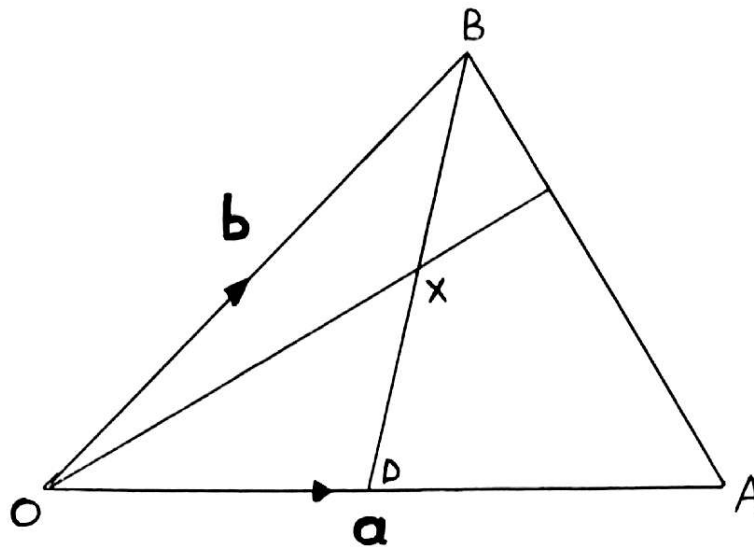
(iv)  $\overrightarrow{OP}$  (2)

(v)  $\overrightarrow{BP}$  (2)

(b) Given that Q lies on OA such that  $OQ:QA = 1:2$ . Express  $\overrightarrow{BQ}$  in terms of  $\mathbf{a}$  and  $\mathbf{b}$  (2)

(c) Given that  $BP = k BQ$  find the value of  $k$  (2)

## **VECTORS**



*In the diagram  $OA = a$  ,  $OB = b$*

*The point  $C$  is such that  $AC = 3CB$  and the point  $D$  is such that  $OD = DA$*

*(a) Express in terms of  $a$  and /or  $b$  the vectors*

*(i)  $AB$       (1)*

*(ii)  $OD$       (1)*

*(iii)  $AC$       (1)*

*(iv)  $OC$       (1)*

*(b)  $OC$  and  $BD$  meet  $X$ . Given that  $BX = kBD$ , express  $BX$  in terms of  $a$ ,  $b$  and  $k$*

*Hence show that  $OX = \frac{1}{2} ka + (1 - k)b$     (3)*

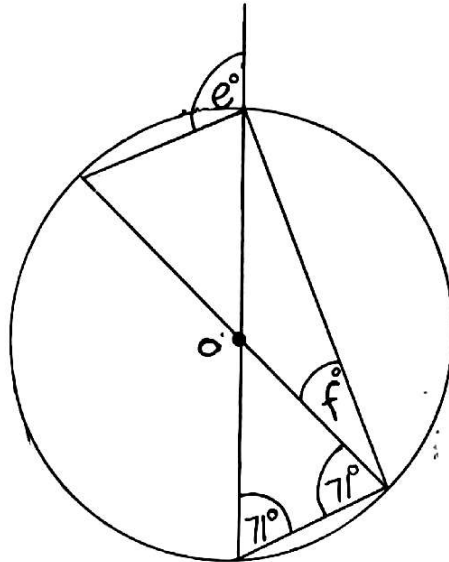
*(c) Given also that  $OX = h OC$ , express  $OX$  in terms of  $a$ ,  $b$  and  $h$       (1)*

*(d) Using these two expressions for  $OX$ , find the value of  $h$  and  $k$       (3)*

*(e) Find the numerical value of the ratio  $BX:XD$       (1)*

# CIRCLE GEOMETRY

1.

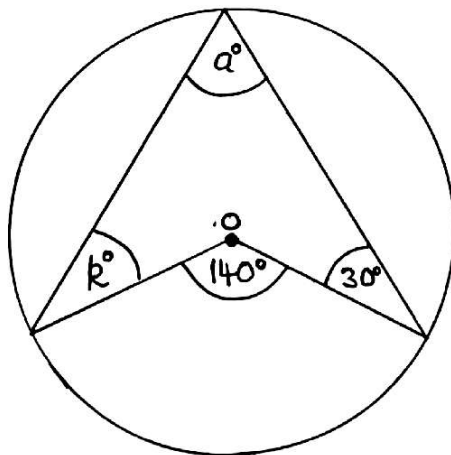


Find all marked angles

e (2)

f (2)

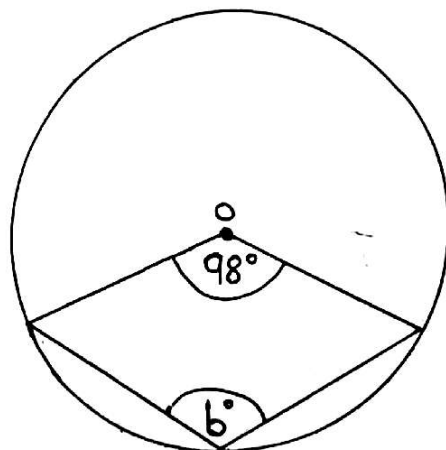
2.



a (2)

k (2)

3.

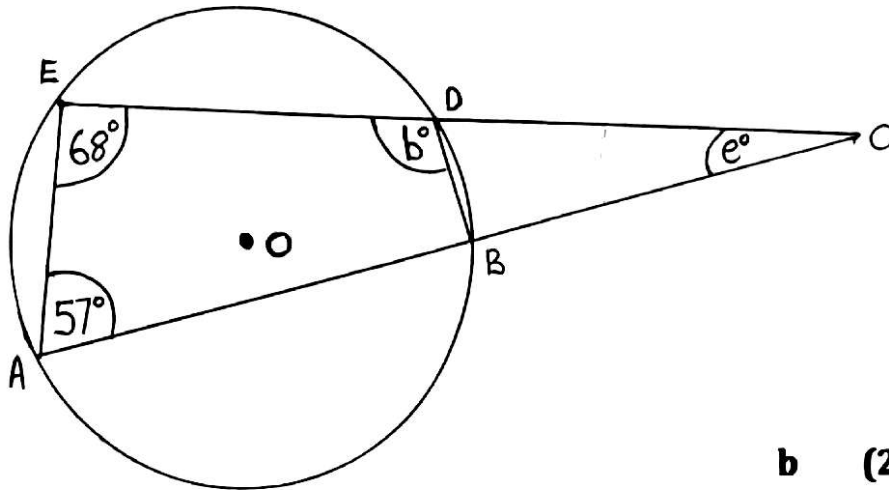


b (2)

# CIRCLE GEOMETRY

4.

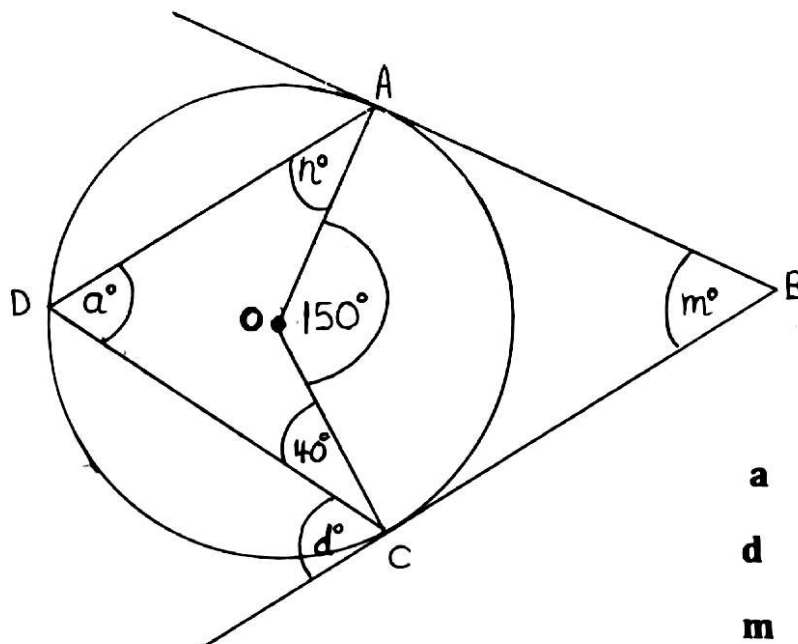
Find all marked angles.



**b (2)**

**e (2)**

5.



**a (2)**

**d (2)**

**m (2)**

**n (2)**

### **SHOW THAT?**

1. (a) Given that  $2^{2(x^2-3)} \times 2^{3x} = 16$  show that it can be reduced to

$$2x^2 + 3x - 10 = 0 \quad (3)$$

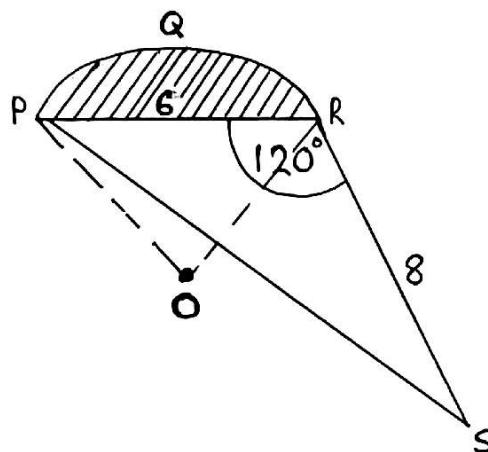
(b) solve  $2x^2 + 3x - 10 = 0$  giving your answers correct to 2 decimal places (5)

2. (a) Show that the equation

$$\frac{1}{2x-5} + \frac{2}{3} = \frac{1}{x+3} \text{ reduces to } 4x^2 - x - 6 = 0 \quad (3)$$

(b) Solve the equation  $4x^2 - x - 6 = 0$  giving your answer correct two decimal places (5)

3.



$$\pi = 3.142$$

In the diagram PQR is a segment of a circle of radius 6cm and centre O.

PR = 6cm ; RS = 8cm ; PS =  $(3x + 4)$  cm  $\angle PRS = 120^\circ$ .

- Calculate the area of the triangle. (4)
- Form an equation in x and show that it reduces to  $3x^2 + 8x - 44 = 0$ . (3)
- Solve the equation  $3x^2 + 8x - 44 = 0$ , giving your answer correct to 2 decimal places. (5)



## **FURTHER PRACTICE**

1. (i) Express  $\frac{x}{3} + \frac{x-4}{5}$  as a single fraction in its simplest form.

(ii) Hence or otherwise solve the equation  $\frac{x}{3} + \frac{x-4}{5} = 4$  (4)

2. At Power High School, 15% of the total enrolment transferred due to transport costs and 40% of the remainder transferred due to increases in school levies.

If there were only 612 students left, calculate the enrolment of the school before the students transferred. (3)

3. Forty pupils took part in a race and the distances to the nearest metre, that they covered in a certain time interval, are given in the frequency table below.

Distance (in m)	$10 \leq x < 20$	$20 \leq x < 50$	$50 \leq x < 60$	$60 \leq x < 70$	$70 \leq x < 80$	$80 \leq x < 100$
Frequency (f)	4	6	8	4	13	5
Frequency density	0,4	A	0,8	b	c	0,25

- State the modal class (1)
- If the information is to be represented on a histogram, find the values of a, b and c. (3)
- Calculate the mean distance covered (3)
- Two of the pupils are selected at random to make a report on the race.  
Find the probability that both pupils had covered 70m or more in the race. (2)

**4. Answer the whole of the question on a sheet of graph paper.**

Triangle W has vertices at (1 ; 1), (7 ; -1) and (4 ; 4). Using a scale of 2cm to represent 2 units on both axes , draw the x and y-axes for  $-10 \leq x \leq 10$  and  $-10 \leq y \leq 10$ .

a) Draw and label clearly triangle W. (1)

b) Triangle X is the image of triangle W under a reflection in the line  $y = x + 2$ .

Draw and label clearly,

(i) The line  $y = x + 2$

(ii) Triangle X (3)

c) (i) Draw and label clearly triangle Y, the image of triangle W under an enlargement of scale factor  $-\frac{1}{2}$  with the origin as the centre.

(ii) Write down the matrix which represents this transformation. (4)

d) Triangle Z with vertices at (1 ; -3), (1 ; -9) and ( 6; -6), is the image of triangle W under a certain transformation.

(i) Draw and label clearly triangle Z.

(ii) Describe **fully** the **single** transformation which maps triangle W onto triangle Z.

(4)

5. Given that  $A = \begin{pmatrix} 1 & 2 \\ 0 & 1 \end{pmatrix}$ ,  $B = \begin{pmatrix} 3 & 1 \\ 2 & 0 \end{pmatrix}$ , find

(i)  $2A + B$

(ii)  $B - A$

(iii)  $B^{-1}$

(iv)  $BA$

(v)  $B^2$

(10)

6. Mrs Mushowe decides to erect a durawall around her rectangular stand measuring 20m by 11m. Three metres are to be left for a gate.

- (a) Find the perimeter of the durawall. (3)  
She has two options, A or B, to consider for erecting the durawall.

**Option A**

She could engage a contractor who charges \$12 per metre on a fix and supply basis.

- (b) Calculate the total cost of erecting the durawall using option A. (2)

**Option B**

She could buy the following materials as shown in the table below and engage a builder who charges \$100 for the job.

Item	quantity	cost per unit
Bricks	5 000	\$80,00 for 1 000
Cement	10 x 50 kg bag	\$10 per bag
brick force	5 bundles	\$5 per bundle
pit sand	2 loads	\$30 per loads

- (c) Calculate the total cost of erecting the durawall using option B. (3)  
(d) Mrs Mushowe decides to use the cheaper option. Calculate the amount she saves by using that option. (2)

7. A school clerk works from 0800 to 1200 in the mornings and from 1300 to 1630 in the afternoons. If the rate of pay is \$2,40 per hour, calculate

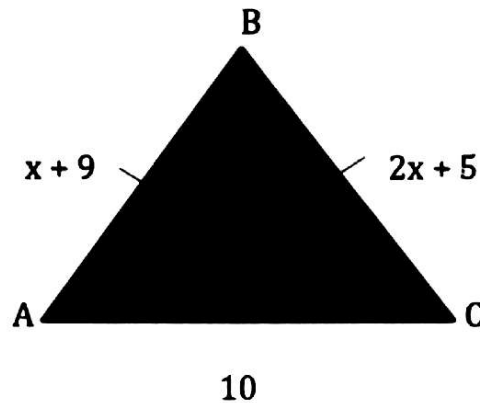
- (a) the weekly wage of the clerk (3)  
(b) the annual pay of the clerk (2)

8. Find how much \$343,20 amounts to in 3 years at  $12\frac{1}{2}\%$ . (3)

9. A man walked 12 km at 3km/h and cycled 18km at 9km/h. What was his average speed for the whole journey?

10. It is given that  $\Sigma = S \{1; 2; 3; \dots; 8; 9; 10\}$ , with subsets A and B such that A is a set of perfect squares and B is a set of multiples of 3.  
i. Draw a venn diagram to represent the sets above.  
ii. Find  $n(A \cup B)$  (4)

11.



In the diagram, ABC is an isosceles triangle with  $AB = BC$ .

$AB = (x + 9)\text{cm}$ ,  $BC = (2x + 5)\text{cm}$  and the base,  $AC = 10\text{cm}$ .

- i. Form an equation in terms of  $x$  and solve it. (3)
- ii. Write down the length of  $AB$ . (1)
- iii. Calculate the area of the triangle  $ABC$ . (2)
- iv. given that all the lengths of the sides of  $\Delta ABC$  were given to the nearest centimetre, calculate the least possible perimeter of the triangle. (3)

12. The trapezium PQRS, in which QR is parallel to PS, is such that  $PS = 11\text{cm}$ ,  $PQ = 5\text{cm}$  and  $\hat{QPS} = 90^\circ$ . If the area of the trapezium is  $45\text{ cm}^2$ , Find the length of QR. (3)

13. Study the number pattern below:

2; 3; 5; 9; 17; .....

Write down

- i. the next two numbers,
- ii. the formula that is used to get the next number, ( $r^{\text{th}}$  term) in terms of  $r$ . (4)

***Answers are available on request***