

SUBSTITUTION

Rules:

Same Signs

a) neg(-) x neg(-) = pos(+)
 c) pos(+) x pos(+) = pos(+)

Different Signs

b) neg(-) x pos(+) = neg(-)
 d) pos(+) x neg(-) = neg(-)

- 1) [June/82/1]
 Calculate the value of V in the formula
- $$V = \pi^2 \left(\frac{R-r}{2} \right)^2 (R+r)$$
- where $R = 22.8, r = 7.50, \pi = 3.14$
 [7 mks]

- 2) [G/Jun/92]
 Given that $x = 2, y = -5$ and $z = 3$, find the value of
- (a) $x - 2y$
 (b) xz^2
 (c) $\frac{7x + 2z}{y}$ [5 mks]

- 3) [G/Dec/92/3]
 Given that $p = 2, q = -3$ and $r = -1$ find the value of
- (a) $5p - 2q$
 (b) $pq + pr$
 (c) pr^2 [5 mks]

- 4) Jun/94/1
 Given that $a = 4, b = -2$ and $c = 3$

Calculate the value of $\frac{a^2 - bc}{b + c}$
 [2 mks]

- 5) [Jun/97/2]
 Given that $m = -3, n = 2, p = -1$

find the value of $\frac{m(p-n)^2}{3p+m}$
 [4 mks]

- 6) [Jan/00/1]
 If $l = -2, n = -3$ and $m = 4$, calculate the value of $\frac{m + nl}{n - m}$ [2 mks]

- 7) [Jan/92/2]
 Given that $a = 4, b = -3$ and $c = 12$
 Calculate the value of $a^2(2b - c)$
 [2 mks]

- 8) [Jun/96/2]
 Given that $l = -2, m = 3, n = 7$
 calculate the value of $lm(m - n)$
 [2 mks]

- 9) [Jan/98/2]
 Find the value of p, if 3 is a root of $5x^2 - px - 18 = 0$
 [3 mks]

- 10) [Jan/02/2]
 If $a = 4, b = -2$ and $c = 3$
 calculate the value of $\frac{a(b - c)}{bc}$
 [2 mks]

- 11) [Jun/03/2]
Given $a = 2$, $b = -3$ and $c = 0$, evaluate
(i) $4a - 2b + 3c$
(ii) a^c [3 mks]

- 17) [G/Dec/91]
Given that $(x + y) = 7$ and $(x - y) = -3$
find the value of $(x^2 - y^2)$
[2 mks]

- 12) [Jan/04/2]
If $p = 5$, $q = 0$ and $r = -3$, calculate using the formula
i) $4p - qr$
ii) $2r^3$

- 18) [Jun/97/2]
Given that $4p^2 - 4q^2 = 2r$ and that
 $p + q = r$ show that $p - q = \frac{1}{2}$

- 13) [Jan/05/2a]
Given that $r = \frac{2p^2}{q - 3}$

Calculate the value of r when $p = 6$ and $q = 12$
[2 mks]

- 14) [Jun/05/4]
Using the formula
$$t = \sqrt{\frac{5m}{12n}}$$

Calculate the value of t when $m = 20$ and $n = 48$

- 15) [Jan/89/9]
Given that $x^2 - y^2 = 144$
and $x + y = 9$
determine the values of
(i) $x - y$
(ii) $x^2 + y^2 - 2xy$

- 16) [G/Jun/91/22]
Given that $a^2 - b^2 = 96$ and $a + b = 16$
find the value of $a - b$. [2 mks]

SUBJECT OF THE FORMULA

14)

- 1) [Jun/79/1]
Make p the subject of the formula

$$r = \sqrt{\frac{4 + 3p^2}{s}}$$

- 2) [Jun/83/1]
Make R the subject of the formula

$$A = \pi \left(\frac{R - r}{2} \right)^2 \quad [4 \text{ marks}]$$

- 3) [Jun/84/6]

Given $m = \frac{\sqrt{1 - n^2}}{n}$, express n in terms of m .
[5 marks]

- 4) [Jun/86/3b]

If $\frac{1}{R} = \frac{1}{v} - \frac{2}{T}$, Express v in terms of R and T

- 5) [Jan/89/4b]

Given that $\frac{4}{x} + \frac{3}{y} = \frac{7}{t}$, express t in terms of x and y .

- 6) [Jun/89/2a]

Given that $x = \frac{y - 2}{y - 3}$, express y in terms of x .

- 7) [Jan/92/2]

Given that $C = 2\pi r$ and $V = \frac{1}{3}\pi r^2 h$, Express V in terms of C , π and h , and simplify your answer.

- 8) [Jun/94/1c]

Given that $\frac{2x}{3} + \frac{4}{y} = 1$, express y in terms of x .

15)

- 9) [Resit/95/2c]

- a) Make a the subject of the formula
[3 marks]

$$b = \frac{3a + 2}{a + 3}$$

- b) Calculate the value of a when $b = 2$
[3 marks]

- 10) [Jan/96/2c]

Make y the subject of the formula

16)

$$\sqrt{\frac{ym}{t}} = 3b$$

- 11) [Jun/96/2]

If $\frac{p}{s} = \frac{q}{s} + r$ express s in terms of p , q and r

17)

- 12) [Jan/99/2a]

Given that $l = \sqrt{\frac{3m}{5}}$, express m in terms of l

[3 marks]

- 13) [Jan/02/2]

If $a = 4$, $b = -2$ and $c = 3$

calculate the value of $\frac{a(b - c)}{bc}$

[2 marks]

14) [Jan/03/2]

Given that $s - 3t = rt$,

- (i) express t in terms of r and s
(ii) calculate the value of t when $r = 2$ and $s = 15$ [4 mks]

15) [Jan/05/]

The temperature, C , in degrees Celsius, is calculated using the formula

$$C = \frac{5}{9}(F - 32)$$

Where F is the temperature in degrees Fahrenheit.

- a) Make F the subject of the formula
b) The temperature in London is 15°C .
Use the formula derived in (a) above to convert this temperature to degrees Fahrenheit. [5 marks]

16) [Jun/04/4]

Using the formula $t = \sqrt{\frac{5m}{12\pi}}$

Express m as subject of the formula above. [3 marks]

17) [Jun/05/2]

Given that $r = \frac{2p^2}{q-3}$

Rearrange the formula to make q the subject. [2 mks]

SIMPLIFYING EXPRESSIONS

Instruction: Simplify the following

- 1) [Jun/98/4] [3mks]
 $2(5x - y) - 3(3x - y)$
- 2) [Jan/02/2] [2 mks]
 $2(3x + 1) - (x + 2)$
- 3) [Jan/01/2] [2mks]
 $2y + 3(y - 1)$
- 4) [Jun/02/2] [2mks]
 $3m - 2(m + 1)$
- 5) [Jan/02/2] [2mks]
 $2(3x + 1) - (x + 2)$
- 6) [Jun/05/2] [2 mks]
Expand and simplify
 $(2x + 5)(3x - 4)$
- 7) [Jan/91/2] [3mks]
 $\frac{9x^2 - y^2}{9x + 3y}$
- 8) [Jan/97/2] [3 mks]
 $\frac{2x + 3}{5} - \frac{x + 2}{3}$
- 9) [Jan/01/2] [3mks]
 $\frac{m + 2}{2} - \frac{m}{3}$
- 10) [Jun/04/2b] [2 mks]
Express as a single fraction:
 $\frac{3p}{2} + \frac{q}{p}$
- 11) [Jan/94/2] [3mks]
 $\frac{5}{y} - \frac{7}{y} + \frac{1}{2}$
- 12) [G/Jun/91] [3 mks]
 $\frac{2}{3} + \frac{a - 2}{2a}$
- 13) [Jun/02/2] [5mks]
 $\frac{3}{y} - \frac{2}{y - 2}$
- 14) [Jun/03/2] [2 mks]
 $\frac{2}{a - 3} + \frac{3}{a}$
- 15) [Jan/05/5] [3 mks]
Write as a single fraction in its simplest form
 $\frac{3}{x} + \frac{4}{x + 1}$
- 16) [Jan/00/3] [3 mks]
 $\frac{2}{x - 1} - \frac{3}{x + 1}$
- 17) [Jan/92/2] [3 mks]
Express as a single fraction
 $\frac{4}{x - 1} - \frac{3}{x^2 - 1}$

SIMPLIFYING EXPRESSIONS

Instruction: Simplify the following

1) [Jun/8/4] [3mks]
 $2(5x - y) - 3(3x - y)$

2) [Jan/02/2] [2 mks]
 $2(3x + 1) - (x + 2)$

3) [Jan/01/2] [2mks]
 $2y + 3(y - 1)$

4) [Jan/02/2] [2mks]
 $3m - 2(m + 1)$

5) [Jan/02/2] [2mks]
 $2(3x + 1) - (x + 2)$

6) [Jun/05/2] [2 mks]
Expand and simplify
 $(2x + 5)(3x - 4)$

7) [Jan/91/2] [3mks]
 $\frac{9x^2 - y^2}{9x + 3y}$

8) [Jan/97/2] [3 mks]
 $\frac{2x + 3}{5} - \frac{x + 2}{3}$

9) [Jan/01/2] [3mks]
 $\frac{m + 2}{2} - \frac{m}{3}$

10) [Jun/04/2b] [2 mks]
Express as a single fraction:

$$\frac{3p}{2} + \frac{q}{p}$$

11) [Jan/94/2] [3mks]
 $\frac{5}{y} - \frac{7}{y} + \frac{1}{2}$

12) [G/Jun/91] [3 mks]
 $\frac{2}{3} + \frac{a - 2}{2a}$

13) [Jun/02/2] [5mks]
 $\frac{3}{y} - \frac{2}{y - 2}$

14) [Jun/03/2] [2 mks]
 $\frac{2}{a - 3} + \frac{3}{a}$

15) [Jan/05/5] [3 mks]
Write as a single fraction in its simplest form
 $\frac{3}{x} + \frac{4}{x + 1}$

16) [Jan/00/3] [3 mks]
 $\frac{2}{x - 1} - \frac{3}{x + 1}$

17) [Jan/92/2] [3 mks]
Express as a single fraction
 $\frac{4}{x - 1} - \frac{3}{x^2 - 1}$

18) [Jan/93/2] [3 mks]

$$\frac{2x}{x-3} + \frac{6}{3-x}$$

19) [G/Jun/92] [3 mks]

$$\frac{3}{3t-1} - \frac{2}{2t+1}$$

20) [G/Dec/92] [3 mks]

$$\frac{b}{b-5} - \frac{2}{b+3}$$

21) [G/Jun/93] [3mks]

$$\frac{1}{p-2} - \frac{2}{4p+3}$$

22) [Jan/90/2] [3 mks]

$$\frac{4}{x} + \frac{5}{2x} - \frac{x}{2}$$

Word Problems

- 23) [Jan/97/2]
 In a multiple choice test of 30 items, each candidate is given a bonus mark of 30. A candidate earns 3 marks for each correct answer and loses 1 mark for each incorrect or omitted answer.

Assuming that a candidate gets x correct answers, show that the total number of marks received must be divisible by 4. [6 marks]

- 24) [G/Jun/91]
 A ticket for an adult visiting an exhibition costs x cents.

A ticket for a child costs 30 cents less than an adult's ticket.

- (a) Write down, in terms of x , the cost of a child's ticket.

- (b) Mr Smith takes his three children to the exhibition.

Find, as simply as possible in terms of x , the total cost in cents of the four tickets.

25) [Jan/93/2]

- i) Alice has t tapes and Ben has 10 tapes more than Alice.
 Express, in terms of t , the number of tapes Ben has.

- ii) Alice gives Ben 14 of her tapes. Ben now has twice as many tapes as Alice now has.

- Write an algebraic expressions to represent the amount each person now has. [3 mks]

26) [Jun/05/2]

Adam, Imran and Shakeel were playing a card game.

Adam scored x points
 Imran scored 3 points fewer than Adam
 Shakeel scored twice as many points as Imran
 Together they scored 39 points.

- i) Write down, in terms of x , an expression for the number of points scored by Shakeel. [2 marks]
- ii) Write an equation which may be used to find the value of x . [2 marks]

INDICES

- 1) [Jun/82/4(0)]
 a) Simplify $(x^{\frac{1}{2}})^3 \times \sqrt{x^9}$
 b) Find the value of y^6 when $y = 16^{-\frac{1}{2}}$
- 2) [Jun/84/6(1)]
 Simplify the expression $4a^{-\frac{1}{2}}(a^{\frac{1}{2}} - a^{-\frac{1}{2}})$
 State your answer using positive indices [3 marks]
- 3) [Jun/87/2b]
 Solve the equation $2^{4x} = 64$
 [2 marks]
- 4) [Jun/88/4(iii)]
 Simplify $81^{\frac{1}{2}} \times 27^{-\frac{1}{3}}$ [2 marks]
- 5) [Jun/90/3b]
 Solve the equation $9^{2x} = \frac{1}{27}$
- 6) [Jan/93/2(a)]
 Evaluate $5^3 \times 5^{-2}$ [1 mark]
- 7) [Jun/93/2(a)]
 Simplify $\left(\frac{27}{8}\right)^{\frac{1}{3}}$ [3 marks]
- 8) [Jan/99/2(b)]
 Evaluate $27^{-\frac{1}{3}} \times 9^{\frac{1}{2}}$ [3 marks]
- 9) [Jan/02/2]

$$\frac{4c^2 \times 3c^4}{c^3}$$
 [2 marks]
- 10) [Jan/05/5c]
 Calculate the values of
 $\frac{1}{9^2} \times \frac{2}{8^3} \times 4^0$ [3 marks]
- 11) [G/Jun/91]
 Evaluate a) $18^3 \div 18^2$
 b) 8^0
 c) $25^{\frac{1}{2}}$
- 12) [G/Dec/92]
 Evaluate a) $4^{\frac{1}{2}}$
 b) $\left(\frac{5}{3}\right)^{-2}$
 c) $2^0 \times 2$
- 13) [G/Dec/92]
 Evaluate a) 5^{-2}
 b) $49^{\frac{1}{2}}$
 c) $6^{\frac{2}{3}} \times 6^{\frac{1}{3}} \times 6^{\frac{1}{3}}$
- 14) [G/Jun/93]
 Evaluate a) $15^4 \div 15^3$
 b) 6^0
 c) $16^{-\frac{1}{2}}$

14) [Jun/90/1]

Some years ago, US\$1.00 (United States dollar) was equivalent to J\$3.50 (three dollars and fifty cents, Jamaican currency). Calculate the amount in US currency that was equivalent to J\$8400.

After devaluation J\$1.00 was worth 70% of its original value. Calculate the new rate of exchange for US\$1.00 that would be equivalent to US\$2400.

15) [Jan/93/6a]

The journey to town along Route A takes 3 hours by bus OR 1h. 20 min. by car. The journey along Route B takes 1h. 12 min. by car.

Calculate the time the bus will take along route B assuming the bus and car travel along route B at the same rate as along Route A.

[2 mks]

Variations

16) [Jun/93/3b]

Given that y varies inversely as x^2 and that $y = 3$ when $x = 2$, calculate the value of y when $x = 3$
[3 marks]

17) [Resit/95/3]

If m varies directly as v^2 , and $m = 2$ when $v = 3$, Calculate the value of m when $v = 6$ [4 mks]

18) [Jun/98/1]

If S varies directly as $(r + 1)$, and $S = 8$ when $r = 3$ Calculate the value for r when $S = 20$

19) [Jun/99/2]

Given that q varies directly as p , using the values of p and q in the table to calculate values of a and b .

p	2	8	a
q	6.1	b	1.2

20) [Jan/052c]

Given that y varies inversely as x , use the values of x and y from the following table to calculate the values of a .

x	2	32
y	8	a

[2 marks]

21) [Jun/04/9a]

The table below show corresponding values for p and

P	m	4	62.5
r	0.2	2	n

Given that P varies directly as r^3 , calculate the values of m and n .

22) [G/Jun91]

The cost of printing birthday cards is given by the

$$\text{formula } y = \frac{3000}{x} + k$$

where y cents is the cost per card, x is the number of cards printed and k is a constant.

- (a) Given that $y = 11$ when $x = 500$, calculate the cost per card when 300 cards are printed.
- (b) How many cards should be printed if the cost per card is to be 7 cents?

FACTORISATION

Reminder: Always seek to identify the nature of the work to be done. In factorisation the work to be done include, to factorise

- a) simple expressions
- b) expressions requiring grouping
- c) quadratic expressions
- d) expressions with a combination



1) [Jun/87/2(a)]

Factorise

$$a^2 - ab - ac + bc \quad [2 \text{ marks}]$$

2) [Jun/89/2(b)]

Factorise completely

$$x^2 - y^2 - 4x + 4y \quad [3 \text{ marks}] \quad 15)$$

3) [Jan/91/2(c)]

Factorise the expression

$$6y^2 + 13y - 8$$

Hence, or otherwise, solve the equation

$$6y^2 + 13y - 8 = 0 \quad [4 \text{ marks}]$$

4) [Jan/89/4a]

Factorise

$$3a + at - 6p - 2pt \quad [3 \text{ mks}] \quad 17)$$

5) [Jun/91/2a]

Factorise completely

i) $1 - (a + b)^2$

ii) $(2x^2 + xy - y^2) + 2x - y$
[3 marks]

6) [G/Dec/91]

Factorise completely

$$4x^2 - 8x$$

$$4y^2 - 8y - 21$$

8) [G/Jun/91]

Factorise $6x^2 + x - 2$

7) [Jun/92/3b]

Factorise completely

i) $1 - 9x^2$

ii) $3x^2 - 7x - 6$ [3 marks]

9) [Jan/93/2a]

Factorise completely $4x^2 - 16$ [2mks] 11)

10) [Jan/94/2a]

i) $3x^2 - 21x$

Factorise completely ii) $4a^2 - 1$ [5marks]

iii) $6x^2 + x - 2$

- 10) [Jan/96/1b]
 Factorise
 i) $9a^2 - b^2$
 ii) $3x - 8y - 4xy + 6$
 [3 marks]

- 12) [Jan/95/3a]
 Factorise completely
 i) $16 - a^2$
 ii) $5x - xy + 2y - 10$
 [3 marks]

- 13) [Jan/95/2a]
 Factorise completely
 i) $9 - 25m^2$
 ii) $2x^2 - x - 15$
 iii) $x + y - ax - ay$

- 14) [Resit/95/2b]
 Factorise completely
 i) $x^2 - xy$
 ii) $e^2 - 1$
 iii) $5p^2 + 9pq - 2q^2$
 [4 marks]

- 15) [Jan/96/2b]
 Factorise
 i) $4g^2 - f^2$
 ii) $am - 3r + 2pm - 6p$
 [3 marks]

- 16) [Jun/96/2c]
 Factorise completely
 i) $8h^2 - 4h$
 ii) $4a^2 - 1$
 [3 marks]

- 17) [Jan/97/2a]
 Factorise i) $4p^2 - 4q^2$
 ii) Given that $4p^2 - 4q^2 = 2r$
 and that $p + q = r$, show that
 $p - q = \frac{1}{2}r$

- 18) [Jun/97/2b]
 Factorise completely
 i) $15x^2y - 20xy^2$
 ii) $3 - 12b^2$
 [4 marks]

- 19) [Jan/98/2a]
 Factorise completely
 i) $x^2 + 3x + 2$
 ii) $(x + 3)(x - 2) + ax + 3a$
 [4marks]

- 20) [Jun/98/2a]
 Factorise completely
 i) $2y^2 + 3y$
 ii) $81 - m^2$
 iii) $2x^2 - x - 15$
 [4 marks]

- 21) [Jan/99/2a]
 Factorise completely
 $4x^2 - 9$
 [1 mark]

- 22) [Jun/99/2a]
 Factorise completely
 i) $y^2 - 3y$
 ii) $9x^2 - 1$
 iii) $8a^2 - 2a - 1$
 [4 marks]

23) [Jan/00/2b]
Factorise completely

i) $p^3 - p$

ii) $6nx - 9mx - 4ny + 6my$ [4 marks]

24) [Jun/00/2a]

i) $3xy - x$

ii) $(x - y)^2 - x + y$

iii) $4a^2 - 9$ [3 marks]

25) [Jan/02/2]
Factorise completely

$3pq + q + 6p + 2$ [2 mks]

26) [Jun/01/2a]

Factorise completely

$4y^2 + y$ [3 mks]

$6x^2 - 13x - 5$

30) [Jun/04/2a]

Simplify:

i) $\frac{x^2 - 1}{x - 1}$

ii) $\frac{4ab^2 + 2a^2b}{ab}$ [4 mks]

27) [Jan/01/2a]
Factorise completely

$a^2 - 9$ [3 mks]

$6ap + 15a - 4p - 10$

31) [Jan/05/2b]

Factorize completely

(i) $3g - 3t + 2mg - 2mt$

(ii) $3x^2 + 2x - 8$ [5 mks]

(iii) $3x^2 - 27$

28) [Jan/03/2b]
Factorise completely:

(i) $4x^2 - y^2$

(ii) $6m + 4n - 9km - 6kn$

(iii) $2a^2 + a - 6$ [5 mks]

32) [Jun/05/2a]

Factorise

(i) $5a^2b + ab^2$ [2 mks]

(ii) $9k^2 - 1$ [2 mks]

(iii) $2y^2 - 5y + 2$ [2 mks]

29) [Jun/03/2b]
Factorise completely

(i) $7mp^2 + 14m^2p$

(ii) $2y^2 - 11y + 15$

SIMPLE EQUATIONS

Reminder: Always clear fractions, by multiplying each term by the LCM
Always apply **BOMDAS**

Instruction: Solve the following equations

1) [Jan/92/2] [3 mks]
 $5x - 1 = 8x + 1$

2) [G/Jun/91] [2 mks]
 $3(x - 2) = 15$

3) [G/Jun/93] [2 mks]
 $5(x + 6) = 20$

4) [Jun/02/2] [3 mks]
 $2(x - 1) = \frac{5}{2}$

5) [Jan/94/2] [4 mks]
 $5x - 3(x - 1) = 39$

6) [Jun/95/2] [3 mks]
 $\frac{p-1}{2} - \frac{p-2}{3} = 1$

7) [Resit/95/2] [3 mks]
 $8x - 2(3x - 8) = 24$

8) [Jun/01] [3 mks]
 $6x - 8(x + 3) = 10$

9) [G/Jun/92] [4 mks]
 $7(2p + 1) - 4(3p + 2) = 0$

10) [Jan/02/2c] [4 mks]
 $2(3x + 1) - (x + 2)$

11) [G/Jun/93] [3 mks]
 $\frac{1}{t} + 3 = 5$

12) [Jan/01/2c] [3 mks]
 $\frac{x}{4} + 16 = 2x$

13) [Jun/91/2] [4 mks]
 $\frac{x}{5} - 5 = \frac{x}{15} + 4$

14) [Jun/92/2] [4 mks]
 $\frac{2x-1}{2} - \frac{x+5}{3} = 2$

15) [Jun/96/2] [3 mks]
 $\frac{4x+5}{4} - \frac{9+2x}{3} = 0$

16) [Jan/99/2] [4 mks]
 $\frac{2x-3}{2} - \frac{x+4}{4} = 1$

17) [Jan/03/2a] $\frac{x+2}{2} - \frac{x-1}{3} = 2$ [3 mks]

18) [Jun/97/2] $\frac{3x+1}{3} - \frac{x-2}{2} = 2 + \frac{2x-3}{3}$ [5 mks]

19) [Jun/89/2] $3\frac{(x-2)}{2} - \frac{x-3}{4} = 4$ [4 mks]

Word Problems

20) [Jun/90/6] The ratio of the prices of two different sheets of glass is 2 : 5. The total bill for 20 sheets of the cheaper glass and 10 sheets of the more expensive one is \$1080. If d dollars represent the cost of one sheet of the cheaper glass,

determine

- (i) an expression in d for the cost of ONE sheet of the more expensive glass.
- (ii) the value of d
- (iii) the cost of ONE sheet of the more expensive glass. [6 mks]

21) [Jan/93/2] Alice has t tapes and Ben has 10 tapes more than Alice.

Express, in terms of t , the number of tapes Ben has.

Alice gives Ben 14 of her tapes. Ben now has twice as many tapes as Alice now has.

Write an algebraic equation to represent this new information. calculate the value of t . [6mks]

22) [Jan/95/3] A farmer shared 496 tomatoes among her three workers, Paula, Greta and Gertrude. Greta received 16 more than Paula. Gertrude received three times as many as Paula.

Calculate the number of tomatoes Paula received. [4mks]

23) [Jan/96/2] The width, (w), of a rectangular lawn is 3 metres less than half its length (l). The perimeter is 42 metres.

- (i) Show that $w + l = 21$
- (ii) Write an equation for the width, w , in terms of the length, l .
- (iii) Calculate in metres the width, (w), of the lawn. [5mks]

24) [Jan/01/5] In a box there are n red balls and three times as many black balls.

- (i) Write an expression in n to represent the total number of balls in the box.

Eight balls are removed from the box. There are 20 balls remaining.

- (ii) Write an equation in n to show this.
- (iii) using your equation, calculate the number of black balls in the box at start. [5mks]

25) [Jan/97/1] A piece of rope 117 cm long is cut into two pieces so that one piece is 27 cm longer than the other. Calculate the length of the longer piece of rope. [3mks]

- 26) **[Jun/98/2]**
Ninety tickets were sold for a concert. x tickets were sold for \$3.00 each and the rest of the tickets were sold for \$4.00 each.

Write an expression in x to represent the number tickets sold at

- (i) \$3.00 each
- (ii) \$4.00 each
- (iii) If the total sales on all tickets amounted to \$300.00, how many of the tickets costing \$3.00 were sold?

[4 mks]

- 27) **[G/Dec/91]**
John is x years old and his sister Mary is $(5x - 12)$ years old. Given that Mary is twice as old as John,

- (a) Write down, in terms of x , an equation connecting their ages and find their ages.

- 28) **[G/Jun/93]**
Alice runs at a rate of 170 metres in one minute, and walks at the rate of 90 metres in one minute. From the instant she leaves home, Alice takes 6 minutes, by running and walking, to reach a bus stop.

Given that she runs for t minutes,

- (i) find, in terms of t , expressions for
 - (a) the number of minutes she walks,
 - (b) the distance she runs
 - (c) the distance to the bus stop.
- (ii) Given also that the distance to the bus stop is 740 metres, find the value of t .

- 29) **[Jan/02/5]**
A man travelled a total distance of 8 km in 54 minutes by running and walking. He ran x Km at 10 kmh^{-1} and walked the remaining distance at 5 kmh^{-1} .

- (i) Write an expression in x for the time, in hours, that

(a) he ran

(b) he walked

- (ii) (a) Form an equation in x for the total time, in hours, spent travelling.

(b) Calculate the value of x .

(c) Hence, calculate the distance the man walked. [6 mks]

- 30) **[G/Dec/95]**
(a) An aircraft flew a distance of 3000 km from Berlin to Cairo at an average speed of v km/h

Write down an expression for the time, in hours, that it took for the journey.

- (b) The aircraft returned non-stop by the same route at an average speed of $2v$ km/h.

- (c) Write down an expression for the time, in hours that it took for the return journey.

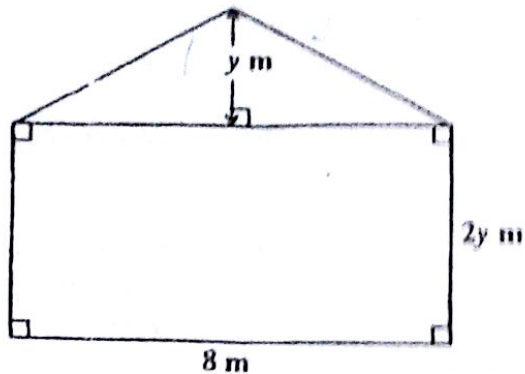
Given that the difference in these two times is 4 hours, form an equation in v and solve it.

[5mks]

31)

[Jan/05/3b]

The diagram below, not drawn to scale, shows the vertical cross section of a shed.



- (i) Write an expression in terms of y for the area of the figure shown.
- (ii) Calculate the values of y if the area of the figure is 28 m^2 [4 mks]

32)

[Jun/05/2c]

Adam, Imran and Shakeel were playing a card game.

Adam scored x points

Imran scored 3 points fewer than Adam

Shakeel scored twice as many points as Imran

Together they scored 39 points.

Write down, in terms of x , an expression for the number of points scored by Shakeel. [2 marks]

Write an equation which may be used to find the value of x . [2 marks]

SIMULTANEOUS EQUATIONS

1) [Jan/92]
 $3x + y = 2$
 $4x + 3y = 3$

[4mks]

2) [Jan/92/3]
 $4x - 4y = 2$
 $7x + 2y = 17$

[4mks]

3) [Jan/95/3]
 $3x - 4y = 32$
 $5x + 2y = 10$

[4 mks]

4) [Jan/02/2]
 $2x + 3y = 11$
 $4x + 2y = 10$

[4mks]

5) [Jan/00/3]
 $3a - 2b = 12$
 $2a + b = 1$

[4 mks]

6) [G/Jan/91]
 $3x + 2y = 1$
 $4x - y = 16$

[4 mks]

7) [G/Jan/92]
 $3x + 2y = 8$
 $x - 3y = -23$

[4 mks]

8) [Jan/04/2c]

$$2x + 3y = 18$$

$$x + 5y = 23$$

[4 mks]

9) [Jan/91/2]
 $3a - \frac{1}{2}b = 4$
 $9a + 2b = -2$

[5 mks]

10) [Jun/86/3]
 $\frac{3x}{7} + 2y = 1$
 $x - 3y = 10$

[6 mk]

Word Problems

11) [Jun/87/3]
 At a hardware store, 7 chairs and 9 desks cost \$1200;
 13 chairs and 6 desks cost \$1200.

(a) Using c to represent the cost (in dollars) of one chair and D to represent the cost (in dollars) of one desk,

write down a pair of simultaneous equations to represent the information above.

(b) Hence, determine
 (i) the cost of a chair
 (ii) the cost of a desk.

[8 mks]

12) [Jan/90]
 Mary paid \$2100 for four parrots and three dogs. If she had bought one more dog and two fewer parrots, she would have paid \$200 more.

Calculate the cost of
 (i) a dog
 (ii) a parrot

[5 mks]

- 13) [Jun/93/3]
The cost of four chairs and a small table is \$684. The cost of six chairs and a large table is \$1196. The cost of the large table is TWICE the cost of the small table.

Given that a is the cost, in dollars, of a chair and b is the cost, in dollars, of a small table.

- (i) write a pair of simultaneous equations to represent the information given.
- (ii) calculate the cost of the large table. [5mks]

- 14) [Jun/99/2]
7 pencils and 5 erasers cost \$11.60, whereas 5 pencils and 3 erasers cost \$7.60. Calculate the cost of 8 erasers. [4 mks]

- 15) [Jun/01/2]
A restaurant bill of \$350 was paid using \$5 notes and \$50 notes. The total number of notes used was 16.

Let x represent the number of \$5 notes.
Let y represent the number of \$50 notes.

- (i) Write TWO equations in x and y to represent the information given.
- (ii) Hence, calculate the number of \$5 notes and the number of \$50 notes. [6 mks]

- 16) [Jun/81/3]
If 5 is added to both the numerator and the denominator of a fraction, the result is equivalent to $\frac{3}{4}$. If 3 is subtracted from both the numerator and the denominator of the original fraction, the new result is equivalent to $\frac{1}{4}$. Find the original fraction

- 17) [Jan/03/6]
At a school shop, pens are sold at x dollars each and ruler at y dollars each. Mr. James bought 4 pens and 5 rulers for \$24. Mrs. Singh bought 7 of the same pens and 7 of the same rulers for \$21.

- (i) Write TWO equations in x and y to represent the information given above.
- (ii) Solve the equations
- (iii) Calculate the TOTAL cost for 1 pen and ruler. [6 mks]

- 13) [Jun/93/3]
The cost of four chairs and a small table is \$684. The cost of six chairs and a large table is \$1196. The cost of the large table is TWICE the cost of the small table.

Given that a is the cost, in dollars, of a chair and b is the cost, in dollars, of a small table.

- (i) write a pair of simultaneous equations to represent the information given.
- (ii) calculate the cost of the large table.
[5mks]

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- 17) [Jan/03/6]
At a school shop, pens are sold at x dollars each and ruler at y dollars each. Mr James bought 4 pens and 5 rulers for \$24. Mrs. Singh bought 2 of the same pens and 7 of the same rulers for \$21.

- (i) Write TWO equations in x and y to represent the information given above.
- (ii) Solve the equations
- (iii) Calculate the TOTAL cost for 1 pen and ruler.
[6 mks]

QUADRATIC EQUATIONS

Reminder: Expand and simplify all equations to drive the general formula $ax^2 + bx + c = 0$
 Solve using

- i) factorisation
- ii) the Quadratic formula $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ or
- iii) Completing the squares

Instruction: Solve the following equations

- | | |
|---|--|
| <p>1) [Jun/81/3]
 $3(y^2 + 3) = 28y$ [5mks]</p> | <p>9) [Resit/95/9]
 Show that the roots of the equation
 $x^2 - 3x + 1 = 0$ are $\frac{3}{2} \pm \frac{1}{2}\sqrt{5}$</p> |
| <p>2) [Jan/90/2]
 $(3x - 1)(x + 5) = 4x + 3$ [5 mks]</p> | <p>10) [Jun/87/9]
 Show that
 $(x + 2)^2 + (x - 3)(x + 3) - 2 \equiv 2x^2 + 4x - 7$</p> |
| <p>3) [Jun/83/1]
 $(2x + 3)(x - 7) = 4(x - 7)$ [5 mks]</p> | <p>11) [Jan/90/10]
 $(x + y + z)^2 - (x + y)^2 \equiv 2(x + y)z + z^2$
 For all real values of x, y and z. [3 mks]</p> |
| <p>4) [Jun/89/3]
 $6x^2 + 17x - 14 = 0$ [4 mks]</p> | <p>12) [Jun95/10]
 If $x = 1$ is one root of the equation
 $(x - c)^2 = 4(x + c + 2)$.
 Calculate to 2 decimal places, the possible values
 of the constant c. [7 mks]</p> |
| <p>5) [G/Jun/91]
 $y^2 + y - 6 = 0$ [2 mks]</p> | <p>13) [Jun/05/8b]
 Show that
 $(a - b)^2(a + b) + ab(a + b) = a^3 + b^3$
 [3mks]</p> |
| <p>6) [Jun/92/10]
 $3x^2 + 5x = 6$</p> | <p>14) [Jan/05/9]
 By simplifying, show that
 $(2x - 3)(2x + 3) - (x - 4)^2 \equiv 3x^2 + 8x - 25$
 [2 mks]</p> |
| <p>7) [Jun04/2c]
 Solve for x, given
 $3x^2 - 7x + 2 = 0$
 [4 mks]</p> | |
| <p>8) [Jun/90/3]
 $3(x + 2)^2 = 7(x + 2)$ [5 mks]</p> | |

15) [Jun/85/2]
Find the values of x to 2 significant figures in the equation $2x^2 + 5x = 9$ [6 mks]

16) [Jun/88/4]
Calculate correct to one decimal place the values of x for which $2x^2 + 2x - 8 = 3x - 6$ [6mks]

17) [G/Jun/94]
Solve $\frac{9}{u} = \frac{u}{4}$ [2mks]

18) [Jun/93/3]
Solve $\frac{2p}{5} + \frac{5}{p} = 3$ [4mks]

19) [G/Dec/94]
 $(2x + 3)^2 = 25$ [2 mks]

20) [G/Dec/95]
 $2y^2 = 5y$ [2mks]

21) [Jun/03/9a]
Given that $m * l = m^2 - lm$
(i) Evaluate $5 * 3$
(ii) solve for g given that $g * 4 = -3$ [5 mks]

Word Problems

22) [Jun/79/3]
If each side of a square is increased by 3cm, its area is increased by 45 cm^2 . Find the length of a side of the original square.

23) [Jun/80/5]
Find the values of a and k such that $x^2 + x + k$ is equal to $(x + a)^2$ for all values of x .

24) [Jun/86/5]
A square has an area $A \text{ cm}^2$ and perimeter cm .

Given that $A = (x^2 + 2x + 1)$, Find

- (a) P in terms of x
(b) the numerical value of A , if A is always equal to $(11x - 2)$ [13mks]

25) [Jun/82/4]
The area of a rectangle is 270 cm^2 . If the shorter side was reduced by 2 cm and the longer side increased by 4 cm then the area would increase by 16 cm^2 . Find the length of the sides of the original rectangle. [11mks]

26) [Jun/83/9]
A BWIA tri-star jet travels 80 km/h faster than the 747 jet liner. The Tri-star takes one hour less than the 747 jet to travel a journey of 6280 km . Denoting the speed of the 747 jet liner by $x \text{ km/h}$

- a) write down in terms of x expressions for the time taken by
(i) the 747 jet liner
(ii) the Tri-star jet
b) Form an equation to connect these times and show that it simplifies to $x^2 + 80x - 502400 = 0$
c) Hence find the speed of both aircraft to the nearest km/h . [9 mks]

27) [Jun/94/3]
i) The width of a rectangular field is w metres. The length is 6 metres more than twice the width. Write in terms of w , algebraic expressions for

- the length of the field
 - the area of the field
- ii) The area of the field is 360 m^2 .
Write an algebraic equation for the area of the field.
Determine the value of w . [6mks]

28) [Jun/00/2]

The floor of a room is in the shape of a rectangle. The room is c metres long. The width of the room is 2 metres less than its length.

- i) State in terms of c
- (a) the width of the floor
 - (b) the area of the floor.
- ii) If the area of the floor is 15 m^2 , write down an equation in c to show this information.
- iii) Use the equation to determine the width of the floor. [7 mks]

29) [Jan/89/4]

The side of a square is x metres. The length of a rectangle is 5 metres more than the side of the square. The width of the rectangle is 4 metres more than the side of the square.

- (i) Write, in terms of x , expressions for the lengths and widths of the rectangle.

The area of the rectangle is 47 m^2 more than the area of the square.

- (ii) Determine the area of the rectangle

30) [G/Dec/917]

A dealer bought x toys for \$27.

26(a) Write an expression, in terms of x , for the price, in dollars, he paid for each toy.

- (b) He proposed to sell each toy at a profit of 50cents. Show that his proposed selling price for each toy was $\$ \frac{54 + x}{2x}$.

(c) He found that he was only able to sell 8 toys at his price. Write down expressions in terms of x for

- (i) the total money, in dollars, he received for the 8 toys
- (ii) the number of toys that remained

(d) The dealer sold the remaining toys for \$2 each. Write down an expression in term of x for the total money, in dollars, he received for them.

(e) Given that the dealer received \$30 altogether, form an equation in x and show that it reduces to $x^2 + 21x + 108 = 0$

(f) Solve this equation to find the possible values of x .

31) [Jun/04/9]

In the diagram below, not drawn to scale, AKLM and ASTJ are both rectangles.

Given that $AS = 3x \text{ cm}$, $AJ = 2x \text{ cm}$, $SK = 3 \text{ cm}$ and $JM = 5 \text{ cm}$

(i) Obtain an expression, in terms of x , for the area of rectangle AKLM27

(ii) Given that the area of rectangle AKLM is 60 cm^2 , show that $2x^2 + 7x - 15 = 0$

(iii) Hence, calculate the values of x and state the length of AK and AM.

LINEAR & NON-LINEAR EQUATIONS

Remember:	Step 1. Step 2. Step 3. Step 4. Step 5.	Clear all fractions by multiplying each term by the LCM Make one of the variables (x or y) the subject in the linear eqn. Substitute the derived expression in the nonlinear eqn. Solve for the unknown(2) in the derived equation Substitute the calculated values in any the linear equation derived in step 2.
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Instruction: Solve the following pairs of simultaneous equations.

1) [Jun/91/2]

$$\begin{aligned} x + y &= 5 \\ xy &= 6 \end{aligned}$$

2) [Jan/95/9]

$$\begin{aligned} 3x + y &= 14 \\ 2x^2 - xy &= 3 \end{aligned}$$

3) [Jun/00/9]

$$\begin{aligned} x + 1 &= 2y \\ x^2 - 3y &= 4 \end{aligned}$$

4) [Jan/05/9]

$$\begin{aligned} x^2 &= 4 - y \\ x &= y + 2 \end{aligned}$$

5) [Jun/03/10a]
Solve for p and r given

$$\begin{aligned} 3p + 2r &= 7 \\ p^2 - 2r &= 11 \end{aligned}$$

6) [Jun/95/10]

$$\begin{aligned} x^2 + 9y^2 &= 37 \\ x - 2y &= -3 \end{aligned}$$

7) [Jan/99/9]

$$\begin{aligned} 2x^2 + y^2 &= 33 \\ x + y &= 3 \end{aligned}$$

8) [Jun/00/9]

$$\begin{aligned} 8x^2 + 3y^2 &= 50 \\ 2x + y &= 5 \end{aligned}$$

9) [A/Jun/92]

$$\begin{aligned} x^2 - xy + y^2 &= 7 \\ 2x - y &= 5 \end{aligned}$$

10) [A/Dec/64]

$$x^2 + xy + y^2 = 2x + 3y = 7$$

11) [A/Dec/88]

$$\begin{aligned} \frac{x}{y} + \frac{6y}{x} &= 5 \quad \text{and} \\ 2y &= x - 2 \end{aligned}$$

12) [A/Jun/96]

$$\begin{aligned} \frac{x^2}{6} - \frac{y}{4} &= 1 \\ x + y &= 5 \end{aligned}$$

5 marks]

[5mks]

Words Problems

13) [Jun/82/4]

The area of the rectangle is 270 cm^2 . If the shorter side was reduced by 2 cm and the longer side increased by 4 cm then the area would be increased by 16 cm^2 . Find the lengths of the side of the original rectangle. [11 mks]

14) [Jun/95/9]

Two rectangular plots are equal in area. The length of the first plot is one and a half times its width. The length of the second plot is 7 metres less than three times its width.

- a) Denoting the width of the first plot by x metres and the width of the second plot by y metres, derive a relation between x and y .
- b) If $y = x + 1$, calculate the values of x and y . [10mks]