Subject: **MATHEMATICS**   Max:

Date: Score:

Q1. Tick (✓) all algebraic expressions:

$$x + 4 \qquad 3(x + y) \qquad \frac{3m}{n} \qquad (4 + a)(2 - a)$$

Q2. Use algebra to write an expression in terms of h (*average height*) for:
a. a height 12 cm shorter than average
b. a height 2x taller than average
c. a height twice the average height
d. a height half the average height.

Q3. Rewrite each expression in its *simplest form*.
   a. $4 \times x + 5 \times y$
   b. $a \times 7 - 2 \times b$
   c. $2 \times x \times (x - 4)$
   d. $3 \times (x + 1) \div 2 \times x$
   e. $2 \times (x + 4) \div 3$
   f. $(4 \times x) \div (2 \times x + 4 \times x)$

Q4. A CD and a DVD cost *x* dollars.
a. If the CD costs \$10 what does the DVD cost?
b. If the DVD costs three times the CD, what does the CD cost?
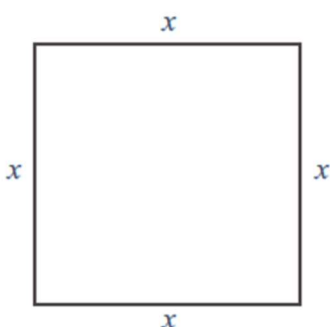c. If the CD costs $\$(x - 15)$, what does the DVD cost?

Q5. A woman is *m* years old.
a. How old will she be in ten years' time?
b. How old was she ten years ago?
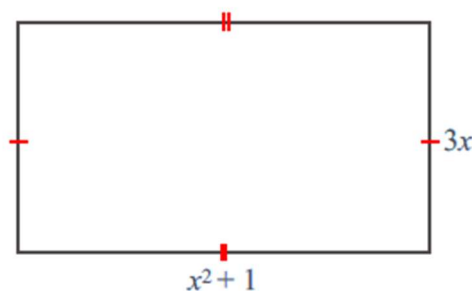c. Her son is half her age. How old is the son?

Q6. For each of the shapes in the diagram below:
i. Write an expression for the perimeter of each shape.
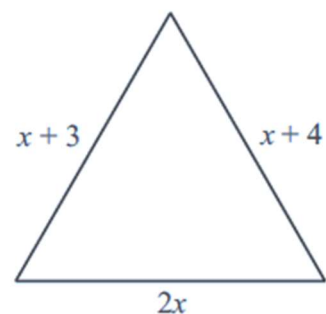ii. Find the perimeter in cm if *x* = 4.

Q7. Evaluate the following expressions for $x = 3$.

g $x^2 + 7$

h $x^3 + x^2$

i $2(x - 1)$

j $\dfrac{4x}{2}$

k $\dfrac{6x}{3}$

l $\dfrac{90}{x}$

m $\dfrac{10x}{6}$

n $\dfrac{(4x + 2)}{7}$

Q8. What is the value of each expression when a = 3 and b = 5 and c = 2?

a abc

b $a^2 b$

c $4a + 2c$

d $3b - 2(a + c)$

e $a^2 + c^2$

f $4b - 2a + c$

g $ab + bc + ac$

h $2(ab)^2$

i $3(a + b)$

j $(b - c) + (a + c)$

k $(a + b)(b - c)$

l $\dfrac{3bc}{ac}$

m $\dfrac{4b}{a} + c$

n $\dfrac{4b^2}{bc}$

o $\dfrac{2(a + b)}{c^2}$

Q9. Work out the value of y in each formula when:

$x = 0$ $x = 3$ $x = 4$ $x = 10$ $x = 50$

d $y = \dfrac{x}{2}$

e $y = x^2$

f $y = \dfrac{100}{x}$

g $y = 2(x + 2)$

h $y = 2(x + 2) - 10$

i $y = 3x^3$

Q10. A sandwich costs \$3 and a drink costs \$2.
a. Write an expression to show the total cost of buying x sandwiches and y drinks.
b. Find the total cost of *four* sandwiches and *three* drinks

Q11. Simplify: (Hint: Adding and subtracting like terms)

a. 4a + 2a + 3a
b. 4a + 6b + 3a
c. 5x + 2y − 7x
d. 2p + 5q + 3q − 7p
e. 2ab + 3a²b − ab + 3ab²

Q12. Simplify:

j $9x - 2y - x$
k $12x^2 - 4x + 2x^2$
l $12x^2 - 4x^2 + 2x^2$
m $5xy - 2x + 7xy$
n $xy - 2xz + 7xy$
o $3x^2 - 2y^2 - 4x^2$
p $5x^2y + 3x^2y - 2xy$
q $4xy - x + 2yx$
r $5xy - 2 + xy$

Q13. Simplify as far as possible:

d $y^2 + 2y + 3y - 7$
e $x^2 - 4x - x + 3$
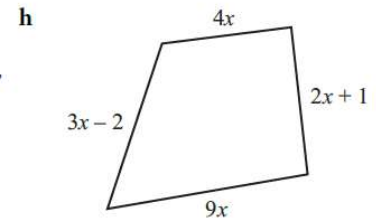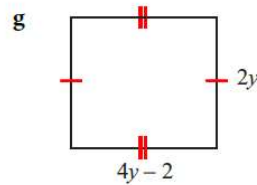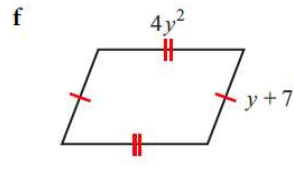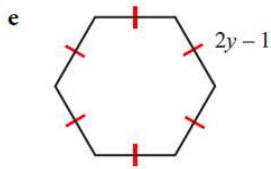**f** $x^2 + 3x - 7 + 2x$
g $4xyz - 3xy + 2xz - xyz$
h $5xy - 4 + 3yx - 6$
i $8x - 4 - 2x - 3x^2$

Q14. Write an expression for the perimeter (P) of each of the following shapes and then simplify it to give P in the simplest possible terms.   **P = Perimeter**

Q15. Multiply:

m $2a \times 4ab$
n $3ab \times 4bc$
o $6abc \times 2a$
p $8abc \times 2ab$
q $4 \times 2ab \times 3c$
r $12x^2 \times 2 \times 3y^2$

Q16. Simplify:

e $\dfrac{14xy}{2y}$
f $\dfrac{18x^2 y}{9x^2}$
g $\dfrac{10xy}{40x}$
h $\dfrac{15x}{60xy}$

i $\dfrac{7xyz}{14xy}$
j $\dfrac{6xy}{x}$
k $\dfrac{x}{4x}$
l $\dfrac{x}{9x}$

m $7xy \times 2xz \times 3yz$
n $4xy \times 2x^2y \times 7$
o $9 \times xyz \times 4xy$
p $3x^2y \times 2xy^2 \times 3xy$
q $9x \times 2xy \times 3x^2$
r $2x \times xy^2 \times 3xy$

Q17. Simplify these as far as possible.

i $5y \times \dfrac{2x}{5}$
j $4 \times \dfrac{2x}{3}$
k $\dfrac{x}{6} \times \dfrac{3}{2x}$
l $\dfrac{5x}{2} \times \dfrac{4x}{10}$

Q18. Expand:

m $5(2x - 2y)$ **n** $6(3x - 2y)$ **o** $3(4y - 2x)$
p $4(y - 4x^2)$ **q** $9(x^2 - y)$ **r** $7(4x + x^2)$

Q19. Remove the brackets to expand these expressions.

m $2x^2y(y - 2x)$ **n** $4xy^2(3 - 2x)$ **o** $3xy^2(x + y)$
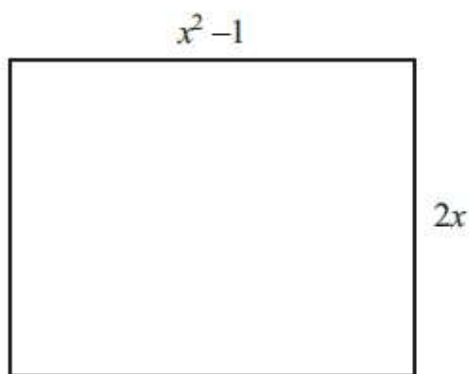**p** $x^2y(2x + y)$ **q** $9x^2(9 - 2x)$ **r** $4xy^2(3 - x)$
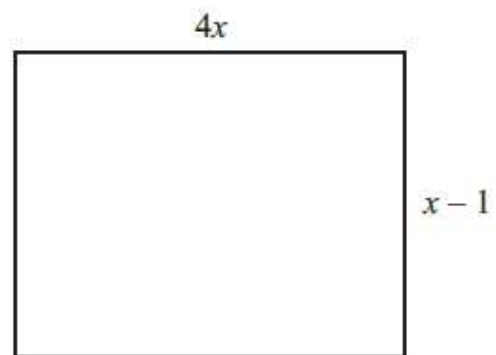
Q20. Given the formula for area, A = *length* × *breadth*, write an expression for A in terms of x for each of the following rectangles. Expand the expression to give A in simplest terms.

b

$x^2 - 1$

$2x$

c

$4x$

$x - 1$

Q21. Expand and simplify:

m $2x(x + 4) - 4$ **n** $2y(2x - 2y + 4)$ **o** $2y(5 - 4y) - 4y^2$
p $3x(2x + 4) - 9$ **q** $3y(y + 2) - 4y^2$ **r** $2(x - 1) + 4x - 4$

Q22. Simplify these expressions by removing brackets and collecting like terms.

m $4(x - 2) + 3x(4 - y)$ **n** $x(x + y) + x(x - y)$ **o** $2x(x + y) + 2(x^2 + 3xy)$
p $x(2x + 3) + 3(5 - 2x)$ **q** $4(2x - 3) + (x - 5)$ **r** $3(4xy - 2x) + 5(3x - xy)$

Q23. Write each expression using *index notation*.

11×11×11
10 ×10 ×10 ×10 ×10
8 × 8 × 8 × 8 × 8
$x × x × x × x × x × y × y × y$
$x × y × x × y × y × x × y$
$a × b × a × b × a × b × c$

Q24. Evaluate:

k $5^2 \times 3^8$ l $4^5 \times 2^6$ m $2^6 \times 3^4$ n $2^8 \times 3^2$ o $5^3 \times 3^5$

Q25. Express the following as products of prime factors, in *index notation*.

a 64   b 243   c 400   d 1600   e 16 384

Q25. Simplify:

i $3x^4 \times 2x^3$ j $3y^2 \times 3y^4$ k $2x \times x^3$ l $3x^3 \times 2x^4$

m $5x^3 \times 3$ n $8x^4 \times x^3$ o $4x^6 \times 2x$ p $x^3 \times 4x^5$

$\dfrac{x^6}{x^4}$ $\dfrac{6x^5}{2x^3}$ $\dfrac{9x^7}{3x^4}$ $\dfrac{12y^2}{3y}$ $\dfrac{3x^4}{6x^3}$

$\dfrac{15x^3}{5x^3}$ $\dfrac{9x^4}{3x^3}$ $\dfrac{3x^3}{9x^4}$ $\dfrac{16x^2 y^2}{4xy}$ $\dfrac{12xy^2}{12xy^2}$

$(3x^2 y^2)^2$ $(x^4)^0$ $(5x^2)^3$ $(x^2 y^2)^3$ $(x^2 y^4)^5$

$(xy^4)^3$ $(4xy^2)^2$ $(3x^2)^4$ $(xy^6)^4$ $\left(\dfrac{x^2}{y}\right)^0$

Q26. Use the appropriate laws of indices to simplify these expressions.

g $x^2(4x - x^3)$ h $x^8 \div (x^3)^2$ i $7x^2 y^2 \div (x^3 y)^2$

j $\dfrac{(4x^2 \times 3x^4)}{6x^4}$ k $\left(\dfrac{x^4}{y^2}\right)^3$ l $\dfrac{x^8 \times (xy^2)^4}{(2x^2)^4}$

m $(8x^2)^0$ n $4x^2 \times 2x^3 \div (2x)^0$ o $\dfrac{(4x^2 y^3)^2}{(2xy)^3}$

Q27. Evaluate / True or False / Re-write each expression

  1 Evaluate:

   a 4^{-1} b 3^{-1} c 8^{-1} d 5^{-3} e 6^{-4} f 2^{-5}

  2 State whether the following are true or false.

   a $4^{-2} = \dfrac{1}{16}$ b $8^{-2} = \dfrac{1}{16}$ c $x^{-3} = \dfrac{1}{3x}$ d $2x^{-2} = \dfrac{1}{x}$

  3 Write each expression so it has only positive indices.

   a x^{-2} b y^{-3} c $(xy)^{-2}$ d $2x^{-2}$
   e $12x^{-3}$ f $7y^{-3}$ g $8xy^{-3}$ h $12x^{-3} y^{-4}$

Q28. Simplify. Write your answer using only positive indices.

a $x^{-3} \times x^4$

b $2x^{-3} \times 3x^{-3}$

c $4x^3 \div 12x^7$

d $\dfrac{x^{-7}}{x^4}$

e $(2x^2)^{-3}$

f $(x^{-2})^3$

g $\dfrac{x^{-3}}{x^{-4}}$

h $\dfrac{x^{-2}}{x^3}$

Q29. Evaluate / Simplify

1 Evaluate:

a $8^{\frac{1}{3}}$

b $32^{\frac{1}{5}}$

c $8^{\frac{4}{3}}$

d $216^{\frac{2}{3}}$

e $256^{0.75}$

2 Simplify:

a $x^{\frac{1}{3}} \times x^{\frac{1}{3}}$

b $x^{\frac{1}{2}} \times x^{\frac{2}{3}}$

c $\left(\dfrac{x^4}{x^{10}}\right)^{\frac{1}{2}}$

d $\left(\dfrac{x^6}{y^2}\right)^{\frac{1}{2}}$

e $\dfrac{x^{\frac{6}{7}}}{x^{\frac{2}{7}}}$

f $\dfrac{7}{8}x^{\frac{1}{2}} \div \dfrac{1}{2}x^{-\frac{3}{2}}$

g $\dfrac{2x^{\frac{2}{3}}}{x^{\frac{8}{3}}}$

h $\dfrac{9x^{\frac{1}{3}}}{12x^{\frac{4}{3}}}$

i $\dfrac{1}{2}x^{\frac{1}{2}} \div 2x^2$

j $-\dfrac{1}{2}x^{\frac{3}{4}} \div -2x^{-\frac{1}{4}}$

k $\dfrac{3}{4}x^{\frac{1}{2}} \div \dfrac{1}{2}x^{-\frac{1}{4}}$

l $-\dfrac{1}{4}x^{\frac{3}{4}} \div -2x^{-\frac{1}{4}}$

Q30. Find the value of x in each of these equations.

a $2^x = 64$

b $196^x = 14$

c $x^{\frac{1}{5}} = 7$

d $(x-1)^{\frac{3}{4}} = 64$

e $3^x = 81$

f $4^x = 256$

g $2^{-x} = \dfrac{1}{64}$

h $3^{x-1} = 81$

i $9^{-x} = \dfrac{1}{81}$

j $3^{-x} = 81$

k $64^x = 2$

l $16^x = 8$

m $4^{-x} = \dfrac{1}{64}$

Examination practice

Exam-style questions

1 Write an expression in terms of n for:
    a   the sum of a number and 12
    b   twice a number minus four
    c   a number multiplied by x and then squared
    d   the square of a number cubed.

2 Simplify:
    a $9xy + 3x + 6xy - 2x$ b $6xy - xy + 3y$

3 Simplify:
    a $\dfrac{a^3 b^4}{ab^3}$ b $2(x^3)^2$ c $3x \times 2x^3 y^2$

    d $(4ax^2)^0$ e $4x^2 y \times x^3 y^2$

4 What is the value of x, when:
    a $2^x = 32$ b $3^x = \dfrac{1}{27}$

5 Expand each expression and simplify if possible.
    a $5(x-2) + 3(x+2)$ b $5x(x + 7y) - 2x(2x - y)$

6 Find the value of $(x+5) - (x-5)$ when:
    a $x = 1$ b $x = 0$ c $x = 5$

7 Simplify and write the answers with positive indices only.
    a $x^5 \times x^{-2}$ b $\dfrac{8x^2}{2x^4}$ c $(2x-2)^{-3}$

8 If $x \neq 0$ and $y \neq 0$, simplify:
    a $3x^{\frac{1}{4}} \times 5x^{\frac{1}{2}}$ b $(81y^6)^{\frac{1}{2}}$ c $(64x^3)^{\frac{1}{3}}$

Past paper questions

1 Simplify.

$$\left(\frac{1}{2} x^{\frac{2}{3}} \right)^3$$

[2]

2   a   Simplify $\left(3125t^{125}\right)^{\frac{1}{5}}$. [2]

    b   Find the value of p when $3^p = \dfrac{1}{9}$. [1]

    c   Find the value of w when $x^{72} + x^w = x^8$. [1]

Summary of index laws

$x^m \times x^n = x^{m+n}$ When multiplying terms, add the indices.

$x^m \div x^n = x^{m-n}$ When dividing, subtract the indices.

$(x^m)^n = x^{mn}$ When finding the power of a power, multiply the indices.

$x^0 = 1$ Any value to the power 0 is equal to 1

$x^{-m} = \dfrac{1}{x^m}$ (when $x \neq 0$).

$\sqrt{x} \times \sqrt{x} = x$

So, $x^{\frac{1}{2}} = \sqrt{x}$

$\sqrt[3]{y} \times \sqrt[3]{y} \times \sqrt[3]{y} = y$

So $y^{\frac{1}{3}} = \sqrt[3]{y}$

So, $x^{\frac{1}{m}} = \sqrt[m]{x}$.

In general terms: $x^{\frac{m}{n}} = x^{m \times \frac{1}{n}} = (x^{\frac{1}{n}})^m = (\sqrt[n]{x})^m$

$x^{\frac{2}{3}} = (x^{\frac{1}{3}})^2$ $\frac{1}{3} \times 2$ is $\frac{2}{3}$

$y^{\frac{3}{4}} = (y^{\frac{1}{4}})^3$ $\frac{1}{4} \times 3 = \frac{3}{4}$

$(x^{\frac{1}{3}})^2 = (\sqrt[3]{x})^2$ and $(y^{\frac{1}{4}})^3 = (\sqrt[4]{y})^3$

So, $(x^{\frac{2}{3}}) = (\sqrt[3]{x})^2$ and $(y^{\frac{3}{4}}) = (\sqrt[4]{y})^3$.

Example

If $2^x = 128$ find the value of x.

$2^x = 128$ Remember this means $2 = \sqrt[x]{128}$.

$2^7 = 128$ Find the value of x by trial and improvement.

$\therefore x = 7$