**1.1 WORKING with SURDS**

**1.** Express each of the following in its simplest form:

 **(g)** √60 **(h)** √72 **(i)**  √300 **(j)**  √27 **(k)** √96 **(l)**  √48

**2**. Simplify:

 **(g)**  3√27 **(h)**  10√48 **(i)**  2√108 **(j)**  3√45 **(k)**  2√63 **(l)**  4√20

**3.** Express each of the following in its simplest form:

 **(d)** 5√6 – 2√6 + √6 **(e)** 4√3 + 5√3 **(f)** 8√6 ­− 2√6

**4.** Express each of the following in its simplest form:

 **(d)** √2 + √98 **(e)** √80 + √20 **(f)** √24 + √54

**(g)** √180 − √45 **(h)** √1000 − √90 **(i)** √50 – √8

**5.** Simplify:

 **(d)** √*a* × √*a* **(e)** √6 × √6 **(f)** √*c* × √*c*

**(g)** √*k* × √*k* **(h)** √3 × √6 **(i)** √8 × √2

**6.** **(e)** √5 × 3√2 **(f)** 2√6 × 3√3 (**g)** 8√2 × √12 **(h)** 5√3 × 3√5

 **7.** Simplify:

 **(e)**  **(f)**  **(g)**  **(h)** 

**8.** Expand and simplify:

 **(d)** √2(5 + √2) **(e)** √2(3 + √6) **(f)**  2√3(√8 + 1)

**9.** Expand and simplify where possible:

 **(d)** (√3 + 1)(√3 – 1) **(e)** (2 + √5)(2 – √5) **(f)** (√3 + √2)(√3 – √2)

**10.** Express each of the following with a *rational denominator*  and simplify where possible:

 **(e)**  **(f)**  **(g)**  **(h)** 

**11.** Express each of the following with a ***rational denominator***and simplify where possible:

 **(e)**  **(f)**  **(g)**  **(h)** 

**12**. Express each of the following in its simplest form with a rational denominator.

 **(e)**   **(f)**  **(g)**  **(h)** 

**13.** Express each of the following with a ***rational denominator***and simplify where possible:

 **(e)**  **(f)**  **(g)**  **(h)** 

**14.** Rationalise the denominator, in each fraction, using the appropriate conjugate surd.

 **(e)**  **(f)**  **(g)**  **(h)** 

**1.2 INDICES**

**1**. Write each of the following in its simplest index form.

 **(e)** 76 × 7 **(f)** 54 × 54 **(g)** 96 × 92 **(h)** 68 × 65

 **(i)** *x*3 × *x*5 **(j)** *c*2 × *c*9 **(k)** *a*2 × *a*12 **(l)** *y*5 × *y*5

**2**. Write each of the following in its simplest index form.

 **(e)** 205 ÷ 20 **(f)** 88 ÷ 84 **(g)** 318 ÷ 33 **(h)** 415 ÷ 413

 **(q)**  **(r)**  **(s)**  **(t)** 

**3**. Write each of the following in its simplest index form.

 **(e)** (45)3 **(f)** (17)2 **(g)** (123)3 **(h)** (55)5

 **(i)** (*x*4)2 **(j)** (*y*8)5 **(k)** (*a*3)7 **(l)** (*m*4)4

**4**. Write the following without brackets.

 **(e)** (*ab*)4 **(f)** (*xy*)7 **(g)** (*wz*)5 **(h)** (*st*)3

 **(m)** (10*x*2)3 **(n)** (2*c*4)5 **(o)** (3*ab*2)3 **(p)** (4*m*2*k*)2

**5**. Simplify these expressions.

 **(e)** 3*y* × (2*y*2)3 **(f)** (4*q*3)2 × 5*q*4 **(g)** (4*c*3)3 ÷ 8*c*2 **(h)** 72*z*12 ÷ (3*z*4)2

 **(m)**  **(n)**  **(o)**  **(p)** 

**6**. Write down the value of

 **(f)** ½ 0 **(g)**  *a*0 **(h)** *k*0 **(i)** (*mn*)0 **(j)** (*ab*2)0

**7**. Rewrite the following with positive indices.

 **(g)** *a*−5 **(h)** *x*−2 **(i)** *p*−7 **(j)** *y*−10 **(k)** 2*b*−3 **(l)** 10 *q*−*x*

**8**. Rewrite the following with negative indices.

 **(g)**  **(h)**  **(i)**  **(j)**  **(k)**  **(l)** 

**9**. Simplify the following expressions.

 **(e)** (*y*3)−4 **(f)** (*c*−5)3 **(g)** (*q*3)−5 **(h)** (*w*−2)−4

 **(i)** 4*b*−4 × 5*b*5 **(j)** 3*x*6 × 9*x*−6 **(k)** 4*k*3 ÷ 2*k*−2 **(l)**  18*d* ÷ 12*d*4

**10**. Find the value of

 **(g)**  **(h)**  **(i)**  **(j)**  **(k)**  **(l)** 

**11**. Simplify the following expressions, giving your answers with positive indices.

 (f) ()10 **(g)** ()1 **(h)**  **(i)** 

 **(m)**  ×  **(n)**  ×  **(o)**  ×  **(p)**  × 

 **(u)**  ÷  **(v)** 2 ÷  **(w)** 8 ÷ 2 **(x)** 6 ÷ 4

**12**. Write the following in surd form.

 **(e)**  **(f)**  **(g)**  **(h)** 

**13**. Write the following in index form.

 **(e)**  **(f)**  **(g)**  **(h)** 

**1.2 CALCULATIONS USING SCIENTIFIC NOTATION**

**1**. Rewrite these sentences with the numbers written out in full

 **(b)** The diameter of the earth is 1∙268 × 104 kilometres.

 **(c)** A Building Society has £2.15 × 109 in its funds.

**(d)** The radius of the orbit of an electron is 5 × 10−8 mm.

**(e)** A space probe reached a speed of 1∙49 × 105 m.p.h.

**(f)** The earth weighs 6∙6 × 1021 tonnes.

**(g)** A film of oil is 8 × 10−7 mm thick.

**2**. Use your calculator to answer the following, giving your answers in Standard Form.

 **(c)** (1∙8 × 103) × (2∙3 × 104) **(d)** (9∙1 × 106) × (1∙5 × 1012)

 **(i)** (8∙7 × 105) × (7∙3 × 10−10) **(j)** (5∙05 × 10−21) × (1∙8 × 10−17)

**2.4 REDUCING an ALGEBRAIC FRACTION to SIMPLEST FORM**

**1**. Express these fractions in their simplest form:

 **(e)**  **(f)**  **(g)**  **(h)** 

 **(i)**  **(j)**  **(k)**  **(l)** 

**2**. Simplify by first finding the common factor:

 **(e)**  **(f)**  **(g)**  **(h)** 

**3**. Simplify the following by first factorising the numerator and/or denominator:

 **(e)**  **(f)**  **(g)**  **(h)** 

**2.5 APPLYING the FOUR OPERATIONS to ALGEBRAIC FRACTIONS**

**1**. Express each sum as a fraction in its simplest form:

**(e)  (f)  (g)  (h) **

**2**. Express each difference as a fraction in its simplest form:

 **(e)  (f)  (g)  (h) **

**3**. Express each product as a fraction in its simplest form:

 **(e)  (f)  (g)  (h) **

**4**. Express as a single fraction:

 **(e)  (f)  (g)  (h) **

**5**. Express each sum as a fraction in its simplest form:

 **(e)  (f)  (g)  (h) **

**6**. Express each difference as a fraction in its simplest form:

 **(e)  (f)  (g)  (h) **

**7**. Express each product as a fraction in its simplest form

 **(e)  (f)  (g)  (h) **

 **(t)  (u)  (v) **

**8**. Express as a single fraction:

 **(d)  (e)  (f) **

 **(m)  (n)  (o) **

**9.** Simplify the following:

 **(d)  (e)  (f) **

 **(j)** ** (k)  (l) **

**1.1 WORKING with SURDS**

**Rules of surds (use when simplifying)**

Multiplying $\sqrt{a}$ x $\sqrt{b}$ = $\sqrt{a x b} $ = $\sqrt{a}$ x $\sqrt{b}$

Dividing $\frac{\sqrt{a}}{\sqrt{b}}$ = $\sqrt{\frac{a}{b}}$ = $\frac{\sqrt{a}}{\sqrt{b}}$

Addition/subtraction 3$\sqrt{2}$ + 4$\sqrt{2}$ = 7$\sqrt{2}$

(you must make the bases the same by using the multiplication rule with a square number)

Rationalising the denominator$\frac{1}{\sqrt{2}}$ x $\frac{\sqrt{2}}{\sqrt{2}}$ = $\frac{\sqrt{2}}{2}$ $\frac{1}{(1 + \sqrt{2}) }$ x $\frac{(1 -\sqrt{2}) }{(1- \sqrt{2}) }$ = $\frac{(1- \sqrt{2}) }{-1}$ = - (1 - $\sqrt{2}) $

**1.2 INDICES**

**Laws of indices (use when simplifying)**

an , a = base, n = index

Multiplying a3 x a4 = a3 + 4 = a7

Dividing *a*8 ÷ *a*3 = *a* 8 - 3 = *a* 5

Power of a power (*x*2 ) 3 = *x* 2 \* 3 = *x* 6

Power of 1 = itself, power of 0 = 1

Negative power a-4 = $\frac{1}{a^{4}}$

Fractional power $a^{\frac{m}{n}}$ = ($\sqrt[n]{a} $)m