Algebraic Expressions – Test A (14 mins)

✓ Fundamentals Challenge Expert

Subtopics: Index laws, expanding brackets, factorising, negative and fractional indices, surds, rationalising denominators

1. **Expand** the brackets and **simplify** where necessary:

   a) $2(x+3)$ b) $2x(5-9x)$ c) $(x+1)(x+2)$

   d) $(3+y)(4-y)$ e) $(x+3)(x^2+5x-2)$ f) $(x+1)(x+2)(x+3)$ **[11]**

2. **Factorise** fully:

   a) $3x+6$ b) $12x-x^2$ c) $x^2+7x+10$

   d) x^2-4 e) $2x^2-x-1$ f) x^3+4x^2+3x **[9]**

3. **Simplify** the following expressions:

   a) $x^2 \times x^3$ b) x^0 c) $\left(x^2\right)^{\frac{5}{2}}$

   d) $3x^7 \div x^3$ e) $y^5 \times y^{-3}$ f) $\dfrac{15y^6}{5y^3}$ **[6]**

4. **Simplify** as fully as possible:

   a) $\sqrt{16}$ b) $\sqrt{75}$ c) $3\sqrt{24}$

   d) $\sqrt{12}+\sqrt{27}$ e) $\dfrac{\sqrt{32}}{\sqrt{2}}$ f) $\sqrt{2} \times \sqrt{32}$ **[10]**

5. Simplify:

   a) $\left(\sqrt{x}\right)^2$ b) $\sqrt{y^2} \times \sqrt{y^3}$ c) $\left(3\sqrt{y}\right)^2$ **[5]**

6. Write the following as **fractions** or **integers**:

   a) 22^{-1} b) $27^{\frac{1}{3}}$ c) $9^{\frac{3}{2}}$ **[4]**

7. **Rationalise** the denominator of the following fractions:

   a) $\dfrac{1}{\sqrt{5}}$ b) $\dfrac{3}{\sqrt{2}}$ c) $\dfrac{1}{2+\sqrt{3}}$ **[5]**

TOTAL 50 MARKS

Quadratics – Test A (19 mins)

✓ Fundamentals Challenge Expert

Subtopics: Solving quadratic equations, completing the square, functions, quadratic graphs, discriminants, modelling

1. a) Solve the following equations by **factorisation**:
   i) $x^2 - 2x = 0$ **[2]**
   ii) $x^2 + 3x + 2 = 0$ **[2]**

   b) **Rearrange** the equation $x + \frac{8}{x} = 6$, $x \neq 0$ into the form $x^2 + bx + c = 0$, then **factorise** the quadratic expression and solve. **[3]**

2. Solve $(x-4)^2 = 4$. Start by taking the square root of both sides. **[2]**

3. Solve the following equations of the form $ax^2 + bx + c = 0$ using the **quadratic formula**, $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$, leaving your answers in simplified surd form when necessary:

   a) $x^2 - x - 2 = 0$ b) $2x^2 + 4x - 7 = 0$ c) $3x^2 - 5x - 2 = 0$ **[6]**

4. **Complete the square** for the following expressions by writing them in the form $(x + a)^2 + b$:

   a) $x^2 + 6x$ b) $x^2 - 8x$ c) $x^2 + 14x + 2$ **[6]**

5. Solve the following equations by **completing the square**:

   a) $x^2 + 16x = 0$ b) $x^2 + 6x + 9 = 0$ c) $x^2 + 4x + 3 = 0$ **[8]**

6. The functions f and g are given by $f(x) = 6x - 4$ and $g(x) = x^2 + 12x + 36$.
   a) Find the values of $f(3)$ and $g(2)$ **[2]**
   b) Find the value of x where $f(x) = 14$ **[2]**
   c) Find the root(s) of the function $g(x)$ **[2]**

7. Sketch the following **on separate diagrams**, labelling **all** points where the curves cross the **axes**:

   a) $y = (x+3)(x-4)$ b) $y = x^2 + 3x - 54$

   c) $y = 2 - x^2$ d) $y = (2-x)(x-8)$ **[9]**

8. Calculate the value of the **discriminant** for the following, stating whether the function has two real roots, no real roots or one repeated root:

   a) $f(x) = x^2 + 6x - 2$ b) $g(x) = x^2 - 8x + 3$

   c) $h(x) = 2x^2 - 5x + 7$ d) $j(x) = x^2 + 4x + 4$ **[8]**

9. Fill in the gaps:
   a) The set of all possible **inputs** for a function is called the _____. **[1]**
   b) The set of all possible **outputs** of a function is called the _____. **[1]**

TOTAL 54 MARKS

Simultaneous Equations and Inequalities – Test A (10 mins) ✓Fundamentals Challenge Expert

Subtopics: Linear simultaneous equations, quadratic simultaneous equations, simultaneous equations on graphs, linear inequalities, quadratic inequalities, inequalities on graphs, regions

1. Solve the following simultaneous equations by **elimination:**

$$3x + y = 5$$
$$2x + y = 4$$

[3]

2. Solve the following simultaneous equations by **substitution:**

$$x - y = 4$$
$$3x + y = 16$$

[3]

3. Solve the simultaneous equations:

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

[4]

4. Solve the simultaneous equations:

$$x - y = 5$$
$$x^2 + x + y = -2$$

[5]

5. Solve the following inequalities:
   a) $2x - 3 > 0$ **[1]**
   b) $(x-2)(x+3) \geq 0$ **[3]**
   c) $x^2 - 4x - 5 \leq 0$ **[4]**
   d) $x^2 + 5x - 1 < 2x - 3$ **[4]**

6. a) On **three separate diagrams**, sketch the graphs that represent the boundaries of the following inequalities, labelling **all** points where each graph crosses the **axes:**
      i) $y \geq x$ **[3]**
      ii) $y > (x-2)(x+2)$ **[3]**
      iii) $y \leq x^2 - 5x + 6$ **[4]**
   b) For each graph, shade the region that satisfies the inequality and label it **R.** **[3]**

TOTAL 40 MARKS

Graphs and Transformations – Test A (17 mins) ✓Fundamentals Challenge Expert

Subtopics: Cubic graphs, quartic graphs, reciprocal graphs, points of intersection, translations, stretching, transformations

1. **Sketch** the following cubics, indicating **all** points where the curves cross or touch the **axes**:

   a) $y=x^3$ b) $y=-x^3$ c) $y=(x+2)(x+1)(x-1)$

   d) $y=(x-1)^2(x+3)$ e) $y=(x+4)^3$ f) $y=x(x-1)(x-3)$ **[12]**

2. **Sketch** the following quartics, indicating **all** points where the curves cross or touch the **axes**:

   a) $y=x^4$ b) $y=(x-1)(x-2)(x+2)(x+3)$

   c) $y=-x^4$ d) $y=(x-1)^2(x+3)(x+5)$

   e) $y=(x-2)^2(x+2)^2$ f) $y=-(x-3)(x+1)(x+2)^2$ **[16]**

3. **Sketch** each of the following pairs of curves on the same diagram:

   a) $y=\frac{1}{x}$ and $y=\frac{4}{x}$ b) $y=-\frac{1}{x}$ and $y=-\frac{3}{x}$

   c) $y=\frac{2}{x^2}$ and $y=\frac{5}{x^2}$ d) $y=-\frac{8}{x^2}$ and $y=-\frac{1}{x^2}$ **[8]**

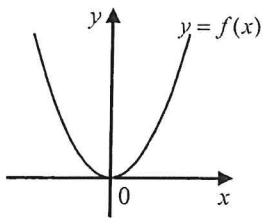
4. a) On the same diagram, **sketch** the curves $y=\frac{2}{x^2}$ and $y=x^2(x-5)$, labelling any points where the curves cross the **axes**. **[3]**

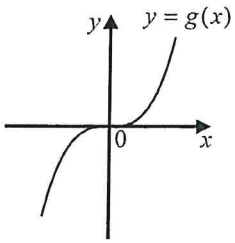
   b) Using your sketch, state the number of **real** solutions to the equation $x^4(x-5)-2=0$. Give a reason for your answer. **[2]**

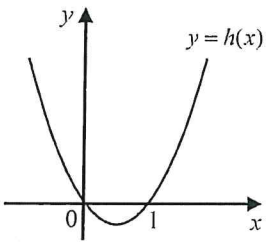
5. a) Give the **vector** that corresponds to the **translation** that takes $y=f(x)$ to $y=f(x)+5$ **[2]**

   b) Give the **vector** that corresponds to the **translation** that takes $y=f(x)$ to $y=f(x+2)$ **[2]**

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







Sketch the following graphs, indicating any points where the curves cross or touch the **axes**:

a) $y=f(x+2)$ b) $y=g(x)-2$ c) $y=\frac{1}{3}f(x+2)$

d) $y=f(2x)$ e) $y=-h(x)$ f) $y=h(-x)$ **[12]**

TOTAL 57 MARKS

Straight Line Graphs – Test A (9 mins)

✓Fundamentals Challenge Expert

Subtopics: Equations of straight lines, parallel and perpendicular lines, length and area, modelling

1. Write down the **gradient** and ***y*-intercept** of these lines:

   a) $y = -4x + 11$ b) $y + 2x + 3 = 0$ c) $6x - 2y + 4 = 0$ **[6]**

2. Work out the **gradient** of the lines joining these pairs of points:

   a) $(-1,-1), (1,1)$ b) $(-1,2), (5,4)$ c) $(-1,-1), (3,1)$

   d) $(8,4), (6,3)$ e) $(0,3c), (6c,0), c \neq 0$ f) $\left(\frac{1}{3},\frac{1}{2}\right), \left(\frac{1}{4},1\right)$ **[12]**

3. Write these lines in the form $ax + by + c = 0$, where a, b, and c are **integers** and $a \geq 0$:

   a) $y = 2x + 1$ b) $y = \frac{4}{5}x$ c) $y = -3x + \frac{5}{8}$ **[3]**

4. Find the equation of the line with **gradient** 3 that passes through the point (2, 1).
   Give your answer in the form $y = mx + c$. **[2]**

5. Find the equation of the line that passes through the points $(3,2)$ and $(5,6)$.
   Give your answer in the form $ax + by + c = 0$, where a, b, and c are **integers** and $a \geq 0$. **[4]**

6. Work out whether the following pairs of lines are **parallel**:

   a) $y = 2x - 1$ b) $y = 4x + 2$ c) $2x - 3y + 8 = 0$

   $y + 2x + 4 = 0$ $8x - 2y + 5 = 0$ $3x - 2y + 8 = 0$ **[9]**

7. Work out whether the following pairs of lines are **perpendicular**:

   a) $y = 3x + 2$ b) $y = 2x + 4$ c) $4x - 2y - 2 = 0$

   $y = -\frac{1}{3}x + 2$ $y + 2x = 4$ $2x + 4y - 6 = 0$ **[9]**

8. Find the **distance** between the following pairs of points. *Leave your answer in simplified surd form.*

   a) $(0,4), (2,6)$ b) $(-1,3), (2,9)$ c) $(-2,-5), (4,1)$ **[6]**

TOTAL 51 MARKS