AQA Level 2 Further mathematics Further algebra

Section 2: Further equations

Section test

Questions 1 and 2 are about the simultaneous equations

$$x + 3y = 5$$
$$3x - y = 5$$

1) The correct value of x for the solution is

(a) $x = 2$
(b) $x = -1$
(c) $x = 1$
(d) $x = -2$
(e) I don't know

2) The correct value of y for the solution is

(a) $y = -1$
(b) $y = 1$
(c) $y = 2$
(d) $y = -2$
(e) I don't know

3) For the simultaneous equations

$$5a + 7b = 17$$
$$a = 1 - 3b$$

the correct value of a for the solution is

(a) $a = -\frac{3}{2}$
(b) $a = -\frac{7}{2}$
(c) $a = 2$
(d) $a = \frac{11}{2}$
(e) I don't know

4) For the simultaneous equations

$$2x = 5y - 2$$
$$6y = 1 + 4x$$

the correct value of x for the solution is

(a) $x = \frac{7}{8}$
(b) $x = \frac{3}{4}$
(c) $x = -\frac{3}{8}$
(d) $x = \frac{17}{8}$
(e) I don't know

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5) For the simultaneous equations

$$s^2 + 2t^2 = 6$$
$$3s - t = 5$$

the values of t for the solutions are

(a) t = -11 and $t = -\frac{161}{19}$
(b) t = 1 and $t = -\frac{29}{19}$
(c) t = -11 and $t = -\frac{29}{19}$
(d) t = 1 and $t = -\frac{161}{19}$
(e) I don't know

6) For the simultaneous equations

$$x^2 + 2y = 5$$
$$2x - 3y = 12$$

the values of y for the solutions are

(a) y = -6 and $y = -\frac{62}{9}$
(b) y = -2 and $y = -\frac{10}{9}$
(c) y = -2 and $y = -\frac{62}{9}$
(d) y = -6 and $y = -\frac{10}{9}$
(e) I don't know

7) Which of the following is a factor of $x^3 + x^2 + 2x + 8$?

(a) $x + 1$
(b) $x - 1$
(c) $x + 2$
(d) $x - 2$
(e) I don't know

8) $x - 2$ is a factor of $x^3 - 5x^2 + ax + 2$.
The value of a is

(a) -5
(b) 5
(c) -13
(d) 13
(e) I don't know

9) $(x - 1)$ is a factor of $x^3 + x^2 - 5x + 3$. This expression can be written in the form

(a) $(x - 1)(x^2 - 2x + 3)$
(b) $(x - 1)(x^2 + x - 2)$
(c) $(x - 1)(x^2 + 2x - 3)$
(d) $(x - 1)(x^2 - x + 2)$
(e) I don't know

10) Factorise $x^3 - x^2 - 34x - 56$

(a) $(x - 2)(x - 4)(x + 7)$
(b) $(x + 2)(x + 4)(x - 7)$
(c) $(x - 1)(x - 7)(x - 8)$
(d) $(x + 1)(x + 7)(x - 8)$
(e) I don't know

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Solutions to section test

1) The correct answer is (a)

$x + 3y = 5 \quad (1)$
$3x - y = 5 \quad (2) \times 3$

$x + 3y = 5$
$9x - 3y = 15$

Adding: $10x = 20$

$x = 2$

2) The correct answer is (b)

Substituting $x = 2$ into equation (1): $2 + 3y = 5$

$3y = 3$

$y = 1$

3) The correct answer is (d)

$5a + 7b = 17 \quad (1)$
$a = 1 - 3b \quad (2)$

Substituting (2) into (1): $5(1 - 3b) + 7b = 17$

$5 - 15b + 7b = 17$

$-8b = 12$

$b = -\frac{3}{2}$

Substituting $b = -\frac{3}{2}$ into (2): $a = 1 - 3 \times -\frac{3}{2} = 1 + \frac{9}{2} = \frac{11}{2}$

4) The correct answer is (a)

$2x = 5y - 2 \quad (1)$
$6y = 1 + 4x \quad (2)$

Substituting (1) into (2): $6y = 1 + 2(5y - 2)$

$6y = 1 + 10y - 4$

$-4y = -3$

$y = \frac{3}{4}$

Substituting $y = \frac{3}{4}$ into (1): $2x = 5 \times \frac{3}{4} - 2 = \frac{15}{4} - 2 = \frac{7}{4}$

$x = \frac{7}{8}$

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5) The correct answer is (b)

$s^2 + 2t^2 = 6 \quad (1)$

$3s - t = 5 \quad (2)$

$(2) \Rightarrow t = 3s - 5$

Substituting into (1): $s^2 + 2(3s-5)^2 = 6$

$s^2 + 2(9s^2 - 30s + 25) = 6$

$s^2 + 18s^2 - 60s + 50 = 6$

$19s^2 - 60s + 44 = 0$

$(19s - 22)(s - 2) = 0$

$s = \frac{22}{19}$ or $s = 2$

When $s = 2, t = 3 \times 2 - 5 = 1$

When $s = \frac{22}{19}, t = 3 \times \frac{22}{19} - 5 = \frac{66}{19} - 5 = -\frac{29}{19}$

So the values of t are $t = 1$ and $t = -\frac{29}{19}$

6) The correct answer is (c)

$x^2 + 2y = 5 \quad (1)$

$2x - 3y = 12 \quad (2)$

$(2) \Rightarrow x = \dfrac{12 + 3y}{2}$

Substituting into (1): $\left(\dfrac{12+3y}{2}\right)^2 + 2y = 5$

$\dfrac{144 + 72y + 9y^2}{4} + 2y = 5$

$144 + 72y + 9y^2 + 8y = 20$

$9y^2 + 80y + 124 = 0$

$(9y + 62)(y + 2) = 0$

$y = -\frac{62}{9}$ or $y = -2$

7) The correct answer is (c)

$f(x) = x^3 + x^2 + 2x + 8$

$f(-1) = (-1)^3 + (-1)^2 + 2 \times -1 + 8 = -1 + 1 - 2 + 8 = 6$ so (x + 1) is not a factor

$f(1) = 1^3 + 1^2 + 2 \times 1 + 8 = 1 + 1 + 2 + 8 = 12$ so (x – 1) is not a factor.

$f(-2) = (-2)^3 + (-2)^2 + 2 \times -2 + 8 = -8 + 4 - 4 + 8 = 0$ so (x + 2) is a factor

$f(2) = 2^3 + 2^2 + 2 \times 2 + 8 = 8 + 4 + 4 + 8 = 24$ so (x - 2) is not a factor

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8) The correct answer is (b)

$f(x) = x^3 - 5x^2 + ax + 2$

$f(2) = 2^3 - 5 \times 2^2 + a \times 2 + 2$

$= 8 - 20 + 2a + 2$

$= 2a - 10$

$x - 2$ is a factor, so $f(2) = 0$.

$2a - 10 = 0$

$a = 5$

9) The correct answer is (c)

$x^3 + x^2 - 5x + 3 = (x - 1)(x^2 + px + q)$

$= x^3 - x^2 + px^2 - px + qx - q$

$= x^3 + (p - 1)x^2 + (q - p)x - q$

Equating constant terms $\Rightarrow c = -3$

Equating coefficients of $x^2 \Rightarrow p - 1 = 1 \Rightarrow p = 2$

Check: coefficient of $x = q - p = -3 - 2 = -5$

$x^3 + x^2 - 5x + 3 = (x - 1)(x^2 + 2x - 3)$

10) The correct answer is (b)

$f(x) = x^3 - x^2 - 34x - 56$

$f(1) = 1 - 1 - 34 - 56 \neq 0$

$f(-1) = -1 - 1 + 34 - 56 \neq 0$

$f(2) = 8 - 4 - 68 - 56 \neq 0$

$f(-2) = -8 - 4 + 68 - 56 = 0$

so $(x + 2)$ is a factor

$x^3 - x^2 - 34x - 56 = (x + 2)(x^2 - 3x - 28)$

$= (x + 2)(x + 4)(x - 7)$