National 5 Maths
SQA 2023 Paper 1
Full Solutions

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1. $2\frac{1}{6} \div \frac{8}{9} = \frac{13}{6} \times \frac{9}{8}$

$= \frac{13}{6} \times \frac{9}{8}$

$= \frac{13}{2} \times \frac{3}{8}$

$= \frac{39}{16}$

$= 2\frac{7}{16}$

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2. $(x+7)^2 + 6(x^2 - 10) = (x+7)(x+7) + 6x^2 - 60$

$= x^2 + 14x + 49 + 6x^2 - 60$

$= 7x^2 + 14x - 11$

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3. $2x + 3y = 8$ ①

$5x + 2y = -2$ ②

$4x + 6y = 16$ ① × 2 → ③

$15x + 6y = -6$ ② × 3 → ④

$11x = -22$ ④ − ③

$x = \frac{-22}{11}$

$x = -2$

Substitute into ①:

$2(-2) + 3y = 8$

$-4 + 3y = 8$

$3y = 12$

$y = 4$

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4. (a) $a = -3$

(b) $b = 2$

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

When $x = 0$, $y = (0-3)^2 + 2$

$= (-3)^2 + 2$

$= 9 + 2$

$= 11$

So $c = 11$

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5. $a = 4,\ b = 6$ and $c = -1$

so $b^2 - 4ac = 6^2 - 4\times4\times-1$

$= 36 + 16$

$= 52$

Since $b^2 - 4ac > 0$, there are two distinct real roots.

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6. Cosine rule:

$AB^2 = 5^2 + 6^2 - 2\times5\times6\times\frac{1}{5}$

$AB^2 = 25 + 36 - 2\times6$

$AB^2 = 25 + 36 - 12$

$AB^2 = 49$

$AB = \sqrt{49}$

$AB = 7\ m$

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7. (a) Using the points $(5, 20\,000)$ and $(25, 50\,000)$:

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

$$= \frac{50\,000 - 20\,000}{25 - 5}$$

$$= \frac{30\,000}{20}$$

$$= 1500$$

Using (a, b) = $(5, 20\,000)$:

$$y - \mathrm{b} = \mathrm{m}(x - \mathrm{a})$$

$$y - 20\,000 = 1500(x - 5)$$

$$y - 20\,000 = 1500x - 7500$$

$$y = 1500x - 7500 + 20\,000$$

$$y = 1500x + 12\,500$$

$$P = 1500T + 12\,500$$

(b) When $T = 8$,

$$P = 1500 \times 8 + 12\,500$$

$$= 12\,000 + 12\,500$$

$$= 24\,500$$

The employee's salary is £24 500.

8.

$$\frac{12}{\sqrt{15}} = \frac{12}{\sqrt{15}} \times \frac{\sqrt{15}}{\sqrt{15}}$$

$$= \frac{12\sqrt{15}}{15}$$

$$= \frac{4\sqrt{15}}{5}$$

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9. (a) In ascending order, the ten ages are:

$31 \;\; 33 \;\; 35 \;\; 36 \;\; 38 \;\; : \;\; 41 \;\; 41 \;\; 42 \;\; 47 \;\; 55$

$$\text{Median} = \frac{38+41}{2}$$

$$= \frac{79}{2}$$

$$= 39.5 \text{ years}$$

$Q_1 = 35$ and $Q_3 = 42$

so $IQR = 42 - 35$

$= 7$ years

(b) On average, the readers of the newspaper are older.
The ages of the newspaper readers are more varied.

(or equivalent statements)

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10. Using x for the distance from the centre C to the midpoint of the chord AB:

$$x^2 = 50^2 - 30^2$$

$$= 2500 - 900$$

$$= 1600$$

$$x = \sqrt{1600}$$

$$= 40$$

Width $= 40 + 50 = 90$ cm

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11. $330 = 360 - 30$ so $330°$ is the angle in quadrant 4 (C) that is related to $30°$.

From the ASTC quadrant diagram, $sin\, 330^\circ < 0$.

So $sin\, 330^\circ = -sin\, 30^\circ = -0.5$

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12. $\dfrac{5c^{-2}}{c^3 \times c^4} = \dfrac{5c^{-2}}{c^7}$

$= 5c^{-9}$

$= \dfrac{5}{c^9}$

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13. (a) $a = -30$

(b) $b = 1$

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14. $\dfrac{x+1}{3} - 2 > \dfrac{3x}{5}$

$\dfrac{5(x+1)}{15} - \dfrac{30}{15} > \dfrac{9x}{15}$

$5(x+1) - 30 > 9x$

$5x + 5 - 30 > 9x$

$5x - 25 > 9x$

$5x - 9x > 25$

$-4x > 25$

$x < -\dfrac{25}{4}$

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1. 11% depreciation: $100\% - 11\% = 89\% = 0.89$

6% depreciation: $100\% - 6\% = 94\% = 0.94$

$£20\,000 \times 0.89 \times 0.94^2 \quad = \quad £15\,728.08$

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2. $300 \div (6.64 \times 10^{-24}) \quad = 4.51807\ldots \times 10^{25}$

$\approx 4.52 \times 10^{25}$

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3. Arc length $= \frac{\text{angle}}{360} \times \pi d$

$= \frac{106}{360} \times \pi \times 18.3$

≈ 16.9 m

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4. Sine rule:

$$\frac{7}{\sin 25°} = \frac{10}{\sin \text{K}}$$

$7 \sin \text{K} = 10 \sin 25°$

$\sin \text{K} = \frac{10 \sin 25°}{7}$

$\text{K} = \sin^{-1} \frac{10 \sin 25°}{7}$

$\text{K} \approx 37.1°$

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5. Each central angle in the decagon $= 360 \div 10 = 36°$

Each other angle inside the triangles $= (180 - 36) \div 2 = 72°$

Shaded angle $= 360 - 72 - 72 - 90 = 126°$

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6. $100\% + 8\% = 108\%$

108% of the original price $= £94\,500$

1% of the original price $= £94\,500 \div 108 = £875$

100% of the original price $= £875 \times 100 = £87\,500$

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7. $P = \frac{1}{3}mn - r$

$P + r = \frac{1}{3}mn$

$3(P + r) = mn$

$m = \dfrac{3(P + r)}{n}$

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8. $8^2 = 64$

$4^2 + 7^2 = 16 + 49 = 65$

$64 \neq 65$, so by the Converse of Pythagoras, the wall is not perpendicular to the ground.

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9. Volume of large pyramid $= \frac{1}{3}$ A h

$= \frac{1}{3} \times 90^2 \times (60+48)$

$= 291\,600 \text{ cm}^3$

Volume of small pyramid $= \frac{1}{3} \times 40^2 \times 48$

$= 25\,600 \text{ cm}^3$

Volume of block $= 291\,600 - 25\,600$

$= 266\,000 \text{ cm}^3$

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10. $\frac{7}{x-3} - \frac{2}{x} = \frac{7x}{x(x-3)} - \frac{2(x-3)}{x(x-3)}$

$= \frac{7x - 2(x-3)}{x(x-3)}$

$= \frac{7x - 2x + 6}{x(x-3)}$

$= \frac{5x + 6}{x(x-3)}$

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11. $150 = 20\cos x + 147$

$20\cos x = 3$

$\cos x = \frac{3}{20}$

Related acute angle = $cos^{-1}\frac{3}{20} \approx 81.4°$ (to 1 d.p.)

Solutions in 1st (A) and 4th (C) quadrants, so $x = 81.4°$ or $x = 360 - 81.4 = 278.6°$

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12. $\frac{x^2 - 16}{x^2 + x - 20} = \frac{(x-4)(x+4)}{(x-4)(x+5)}$

$= \frac{x+4}{x+5}$

---

13. $2sin^2x + 2cos^2x = 2(sin^2x + cos^2x)$

$= 2 \times 1$

$= 2$

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14. (a) $45 = (x + 7)(x)(2)$

$45 = 2x(x + 7)$

$45 = 2x^2 + 14x$

$0 = 2x^2 + 14x - 45$

$2x^2 + 14x - 45 = 0$

(b) $x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$

$= \frac{-14 \pm \sqrt{14^2 - 4\times2\times-45}}{4}$

$= \frac{-14 \pm \sqrt{196 + 360}}{4}$

$= \frac{-14 \pm \sqrt{556}}{4}$

≈ 2.4 or -9.4 (to 1 d.p.)

Length cannot be negative, so $x = 2.4$ m

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15. Considering triangle ABC:

$\sin A° = \frac{8}{18}$

Now considering triangle ADE:

$Area = \frac{1}{2}\, a\, b \sin C$

$160 = \frac{1}{2} \times (18+6) \times \text{AE} \times \frac{8}{18}$

$160 = \frac{16}{3}\,\text{AE}$

$160 \times 3 = 16\,\text{AE}$

$480 = 16\,\text{AE}$

$\text{AE} = \frac{480}{16} = 30$ cm

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