

Number · Knowledge Test 1

Question 1

$84 = 2^2 \times 3 \times 7$; $210 = 2 \times 3 \times 5 \times 7$. HCF = 42; LCM = 420.

Question 2

$(4/3 + 6/5) \div (8/5) = (38/15)(5/8) = 19/12 = 1 \frac{7}{12}$.

Question 3

120.

Question 4

$4/5$.

Question 5

Let $x = 0.727272\dots$; $100x - x = 72$, so $x = 72/99 = 8/11$.

Question 6

Compound increase = 4.0%.

Question 7

15%.

Question 8

£760.

Question 9

$8x^9y^6$.

Question 10

$(16/81)^{3/4} = (2/3)^3 = 8/27$.

Question 11

$(1/\sqrt{5})^5 = 1/(25\sqrt{5}) = \sqrt{5}/125$.

Question 12

$$3 \times 10^{-5}.$$

Question 13

$$6250 \leq D < 6350.$$

Question 14

For the lower bound, use the smallest numerator and greatest denominator: $k = 3 \times 15^2 / 12.5 = 54$.

Algebra · Knowledge Test 1

Question 1

$$-3x^2 + 17x.$$

Question 2

$$(2x + 3)(x - 4) = 2x^2 - 5x - 12.$$

Question 3

$$(x + 1)(x + 2)(x + 3) = x^3 + 6x^2 + 11x + 6.$$

Question 4

$$2(a + 3b - 5c).$$

Question 5

$$(x - 6)(x - 9).$$

Question 6

$$(3x + 1)(x + 2).$$

Question 7

$$(5 - y)(5 + y).$$

Question 8

Cross multiply: $2(2x + 3) = 5(x - 1)$; $4x + 6 = 5x - 5$, hence $x = 11$.

Question 9

$$42 = \frac{1}{2}(x + 2) \times 12, \text{ so } x + 2 = 7 \text{ and } x = 5.$$

Question 10

$$(3x + 1)(x + 3) = 0; x = -1/3 \text{ or } -3.$$

Question 11

$$\text{Quadratic formula gives } x = \frac{-7 \pm \sqrt{33}}{2} \approx -0.628 \text{ or } -6.37.$$

Question 12

$$r = \sqrt{A/\pi}.$$

Question 13

$$\text{From } y = (3x + 2)/(x - 1), x = (y + 2)/(y - 3), y \neq 3.$$

Question 14

$$-2 \leq x < 2; \text{ integer solutions } -2, -1, 0, 1.$$

Question 15

$$x < -3 \text{ or } x > -2.$$

Question 16

$$3n + 1.$$

Question 17

$$\text{Region } x \geq -1, y \leq 3, y \leq 4 - x; \text{ solid boundary lines.}$$

Question 18

$$(n + 1)^2.$$

Question 19

$$12, 24, 48.$$

Question 20

$$x = 2, y = -1.$$

Question 21

$$(x, y) = (1, 3) \text{ or } (-3, -1).$$

Question 22

$$(5x - 1)/(x^2 - 1), x \neq \pm 1.$$

Question 23

$$(x + 4)^2 - 12.$$

Question 24

Centre $(3, -1)$, radius 5.

Question 25

Consecutive even numbers $2n$ and $2n + 2$ sum to $4n + 2$.

Question 26

$f(1) = -6$ and $f(2) = 6$, so a root lies between 1 and 2. $x^3 + 5x = 12$ rearranges to $x = 12/(x^2 + 5)$. From $x_0 = 1.6$: $x_1 = 1.5873016$, $x_2 = 1.5958452$, $x_3 = 1.5900944$; estimate 1.5901.

Question 27

$g^{-1}(x) = (x + 3)/2$. Solve $(2x - 3)^2 + 1 = 2(x^2 + 1) - 3$: $x = 3 \pm \sqrt{14}/2 \approx 1.129, 4.871$.

Ratio and Proportion · Knowledge Test 1

Question 1

132 medals.

Question 2

A: 2.4 kg for £6.60 = £2.75/kg. B: 2.88 kg for £8.80 $\approx$ £3.06/kg. A is better value.

Question 3

24000 cm².

Question 4

10:50.

Question 5

Total mass = $1.12 \times 75 + 0.88 \times 125 = 194$ g; total volume 200 cm³; density 0.97 g/cm³.

Question 6

180 N/m².

Question 7

$8 \times 35 = 280$ worker-hours; $280 \div 20 = 14$ hours, so the work can be done within 15 hours.

Question 8

$p = 6q^2$; $150 = 6q^2$, $q^2 = 25$, positive $q = 5$.

Geometry · Knowledge Test 1

Question 1

$\angle EGF = 47^\circ$ and $\angle EFG = 55^\circ$, so $\angle FEG = 78^\circ$. Parallel lines give $\angle AEG = 110^\circ$; $\angle AEF = 110^\circ - 78^\circ = 32^\circ$.

Question 2

Number of sides = $360^\circ/24^\circ = 15$.

Question 3

Reverse bearing = $075^\circ + 180^\circ = 255^\circ$.

Question 4

Corresponding sides: $18/12 = (x + 6)/x$. Hence $18x = 12x + 72$, $x = 12$.

Question 5

Triangles ABD and ACD are congruent by SAS, using their shared side and corresponding marked sides/angles.

Question 6

216 cm^2 .

Question 7

Area = $14^2 - \pi \times 7^2 = 196 - 49\pi \approx 42.1 \text{ cm}^2$.

Question 8

$h = 5 \text{ cm}$.

Question 9

120° .

Question 10

Side length 5 cm; surface area = $6 \times 5^2 = 150 \text{ cm}^2$.

Question 11

Use the alternate segment theorem and radii to find $\angle OBC = 32^\circ$.

Question 12

Pyramid perpendicular height = 12 cm.

Question 13

Small cone height = 5 cm by similar triangles.

Question 14

$\sqrt{(15.6^2 - 9.2^2)} \approx 12.6$ cm.

Question 15

$BD = 6 \tan 35^\circ$; $\sin 10^\circ = BD/AD$. Thus $AD = 6 \tan 35^\circ / \sin 10^\circ \approx 24.2$ cm.

Question 16

$\tan 60^\circ = \sqrt{3}$.

Question 17

Base diagonal $CH = \sqrt{(4^2 + 15^2)} = \sqrt{241}$. $\tan \theta = 8/\sqrt{241}$, $\theta \approx 27.3^\circ$.

Question 18

$\angle ACB = 57^\circ$. $BC = 9 \sin 71^\circ / \sin 57^\circ \approx 10.147$ cm. Cosine rule: $CD^2 = BC^2 + 12^2 - 2 \times BC \times 12 \cos 48^\circ$; $CD \approx 9.17$ cm.

Question 19

With centre $(-1, -3)$ and factor $-1/2$, vertices $(-5, -5)$, $(-1, -5)$, $(-3, -1)$ map to $(1, -2)$, $(-1, -2)$, $(0, -4)$.

Question 20

$M = a + (3/2)b$; $N = (5/7)a + 3b$. Therefore $MN = N - M = -(2/7)a + (3/2)b$.

Question 21

Area = $\frac{1}{2} \times 8 \times 11 \times \sin 42^\circ = 44 \sin 42^\circ \approx 29.4$ cm².

Probability · Knowledge Test 1

Question 1

$P(\text{yellow}) = 1 - 0.3 - 0.25 - 0.1 = 0.35$. Total = $7/0.35 = 20$.

Question 2

Evening members = $180 - 95 = 85$; evening yoga = $60 - 20 = 40$. Remaining 45 are split spin:weights = 1:2, so evening weights = 30.

Question 3

(a) First branches rain 0.3/no rain 0.7; second branches 0.6/0.4 after rain and 0.2/0.8 after no rain. (b) $P(\text{rain tomorrow}) = 0.3 \times 0.6 + 0.7 \times 0.2 = 0.32$.

Question 4

Exactly two = $(18 - 5) + (15 - 5) + (12 - 5) = 30$.

Question 5

(a) $N \approx 80 \times 100/25 = 320$ beetles. (b) Marked beetles mixed evenly with the population and catches are representative.

Question 6

Number of distinct pairs = $25 \times 24/2 = 300$.

Statistics · Knowledge Test 1

Question 1

Plot frequency polygon points (5, 4), (15, 8), (25, 12), (35, 10), (45, 6) and join successive points.

Question 2

Positive correlation: longer revision time tends to accompany higher test score. Circle the outlier (1 hour, 90%). At 3 hours, a line of best fit suggests about 60%.

Question 3

Group A median = 58 and IQR = $65 - 52 = 13$. Group B median = 59 and IQR = 12; B has slightly higher typical score and smaller spread.

Question 4

No. Equal sector angles give equal proportions within each school; the schools may have different total numbers of students.

Question 5

Using midpoints 45, 55, 65, 75: $58(26 + x) = 8 \times 45 + 15 \times 55 + 65x + 3 \times 75$. Thus $1508 + 58x = 1410 + 65x$ and $x = 14$. It is an estimate because grouped values are represented by midpoints.

Question 6

One valid set: 7, 11, 14, 18, 22.

Question 7

Girls' estimated mean = 150 cm.

Question 8

Frequency densities: 2.4, 3, 2.6, 1.6, 0.8 for the successive classes. Divide each frequency by class width.

Question 9

Cumulative points: (0,0), (10,8), (20,22), (30,41), (40,57), (50,68), (60,75). Read off at 24: approximately 30.

Question 10

Upper quartile = 11.8 kg. Box plot: min 4.5, lower quartile 7.2, median 8.8, upper quartile 11.8, max 14.3 kg. A median of 8.8 does not prove half are strictly heavier than 8.8; some may equal it.

Graphs · Knowledge Test 1

Question 1

For $y = 2x + 1$ at $x = -3, -2, -1, 0, 1, 2, 3$: $y = -5, -3, -1, 1, 3, 5, 7$. Plot these on one straight line.

Question 2

$y = -x^2 - 3x + 4$: at $x = -5, -4, -3, -2, -1, 0, 1, 2$ the values are $-6, 0, 4, 6, 6, 4, 0, -6$. Turning point $(-1.5, 6.25)$; roots -4 and 1 ; $y = 2$ when $x = (-3 \pm \sqrt{17})/2$.

Question 3

$a = 1$.

Question 4

Gradient $= (6 - 3)/(4 - (-2)) = 1/2$; intercept 4. Equation $y = \frac{1}{2}x + 4$.

Question 5

Solve $5y = 7x + 15$ and $2x + 3y = 15$: $x = 30/31$, $y = 135/31 \approx (0.97, 4.35)$.

Question 6

Perpendicular gradient to -2 is $1/2$. Through $(2, 4)$: $y - 4 = \frac{1}{2}(x - 2)$, so $y = \frac{1}{2}x + 3$.

Question 7

Sketch $y = \sin x$ through $(0,0)$, $(90^\circ, 1)$, $(180^\circ, 0)$, $(270^\circ, -1)$, $(360^\circ, 0)$, with smooth curve.

Question 8

$y = -x^2 + 4$: B; $y = -x^3 + 2$: F; $y = 6^x$: A; $y = 3/x$: E.

Question 9

Gradient of tangent at $3 \text{ s} \approx 2.1 \text{ m/s}$, the instantaneous speed.

Question 10

Gradient of tangent at $2 \text{ s} \approx 0.45 \text{ m/s}^2$, the instantaneous acceleration.

Question 11

The original maximum is $(-3, 0)$. (a) $y = 2f(x) + 6$: $(-3, 6)$. (b) $y = 3f(x - 9)$: $(6, 0)$. (c) $y = f(x + 1) - 2$: $(-4, -2)$.