2026 Paper 1: checked answers

Mathematics 4052/01 | 28 questions | 90 marks | Independent worked solutions

Quick answers first; full methods and reasons follow. Non-exact numerical answers use 3 significant figures and angles use 1 decimal place. Exact values are retained where helpful.

Q	Answer	Q	Answer
1	(a) 15 - 4a (b) (c + 1)(d - 1)	15	x = -2, y = -3/2
2	(a) $2^3 \times 3 \times 5$ (b)(i) pqr^3; (ii) 720 (iii) $2^4 \times 3^2 \times 5^2$	16	$(11c - 12) / (2c - 3)^2$
3	(a) 104°; (b) 52° Reasons on page 2.	17	S$1 = £0.624 (3 s.f.)
4	7/2, independent of x and y	18	90.25π cm² = 284 cm² (3 s.f.)
5	5 and 9	19	(a) 0.63; (b) 15/38
6	(a)(i) 5x/36 hours (ii) 14.4 km/h (b) 10/3 m/s (= 3.33 m/s, 3 s.f.)	20	(a) 124° (b) 26.7 km; (c) 20.6 km
7	99.4°	21	(4x - 5) / (2x - 5)
8	(a) 18; (b) 30; (c) 9/16	22	x = -1/4
9	(a) 1.23×10^{-5} (b) 1.6×10^2	23	$(1/81)x^{-8}y^4z^{12}$
10	(a) 36.4 minutes (b) Decreases: midpoint 35 < 36.4.	24	(a) AA similarity; see page 8. (b) 8.75 m
11	$360	25	(a) 15 cm (b) 324π cm³ = 1.02×10^3 cm³ (3 s.f.)
12	20-year-olds: lower median (384 vs 412 ms), smaller IQR (72 vs 84 ms). See page 4.	26	Multiply every number by 2, then add 15.
13	-10, -9, -8, -7, -6, -5	27	300%
14	(a) (-3, 6) (b) y = -(5/2)x - 3/2 (c) $2\sqrt{41} = 12.8$ (3 s.f.)	28	b = -6, c = -2

Checked against the supplied scan. All 28 questions were solved and checked; diagram readings, units, denominator restrictions and rounding were reviewed. This booklet is an independent solution set, not an official marking scheme. Written reasons still matter: use the worked pages for Q3, Q10, Q12 and Q24.

Questions 1-4

Algebra, prime factors and circle reasoning

1. Simplifying and factorising [3]

(a) 6a - 5(2a - 3) = 6a - 10a + 15 = **15 - 4a**.

(b) cd - c + d - 1 = c(d - 1) + (d - 1) = **(c + 1)(d - 1)**.

2. Prime factorisation, HCF and LCM [5]

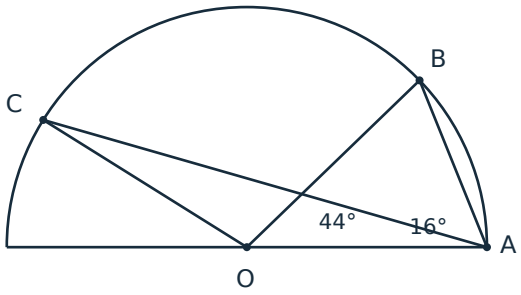
(a) 120 = **$2^3 \times 3 \times 5$**.

(b)(i) For A = pq^2r^4 and B = p^2qr^3, take the smaller power of each prime:
HCF = pqr^3.

(ii) $pqr^3 = 120 = 5 \times 3 \times 2^3$. Since p > q > r, p = 5, q = 3 and r = 2.
$A = 5 \times 3^2 \times 2^4$ = **720**.

(iii) Take the larger prime powers: LCM = $p^2q^2r^4$ = **$2^4 \times 3^2 \times 5^2$**.

3. Angles in a semicircle [4]



OA = OC (radii)

AOC = 148°

BOC = 148° - 44°

(a) OA = OC because both are radii. Thus ∠OCA = ∠OAC = 16° (base angles of an isosceles triangle).
∠AOC = 180° - 16° - 16° = 148° (angles in a triangle).
∠BOC = 148° - 44° = **104°**.

(b) ∠BAC = 104° ÷ 2 = **52°**, because the angle at the centre is twice the angle at the circumference subtended by the same arc BC.

4. A constant algebraic expression [2]

(5x - 3y + 16x + 17y) / (5x - 3y + x + 7y)
= (21x + 14y) / (6x + 4y)
= 7(3x + 2y) / [2(3x + 2y)] = **7/2**.

Since x and y are positive, 3x + 2y is non-zero. The simplified value contains neither variable, so it is the same for all allowed x and y.

Questions 5-9

Data, rates, trigonometry, sets and standard form

5. Two missing integers [2]

There will be eight numbers, so the median is the mean of the 4th and 5th numbers. To make it 9, add another 9 and one number at or below 9. The maximum stays 12, so the required minimum is 12 - 7 = 5.

The integers are 5 and 9.

Check: 5, 8, 8, 9, 9, 10, 11, 12 has median (9 + 9)/2 = 9 and range 12 - 5 = 7.

6. Average speed over equal distances [4]

(a)(i) Total time = x/18 + x/12 = **5x/36 hours**.

(ii) Average speed = total distance / total time
= 2x / (5x/36) = 72/5 = **14.4 km/h**.

(b) 12 km/h = (12 × 1000)/3600 = **10/3 m/s** (= 3.33 m/s to 3 s.f.).

7. The obtuse sine solution [1]

The acute reference angle is $\sin^{-1}(0.9867) = 80.644953...°$.
$x = 180° - 80.644953...° = 99.355047...° = \mathbf{99.4°}$.

8. Venn diagram and probability [4]

(a) Theatre only = x - 4; both = x; cinema only = x + 10; neither = 12.
(x - 4) + x + (x + 10) + 12 = 72
3x + 18 = 72, so **x = 18**.

Theatre only	Both	Cinema only	Neither
14	18	28	12

(b) (T ∩ C) ∪ (T ∪ C)′ means “both or neither”.
Number = 18 + 12 = **30**.

(c) Select only from the theatre visitors: n(T) = 14 + 18 = 32.
Required probability = 18/32 = **9/16**.

9. Standard form [3]

(a) 0.0000123 = $\mathbf{1.23 \times 10^{-5}}$.

(b) $5B/A = (5 \times 4.8 \times 10^{n+1}) / (1.5 \times 10^{n})$
$= 16 \times 10 = 160 = \mathbf{1.6 \times 10^{2}}$.

Questions 10-13

Grouped mean, linked ratios, box plots and inequalities

10. Estimated mean and a new data value [2]

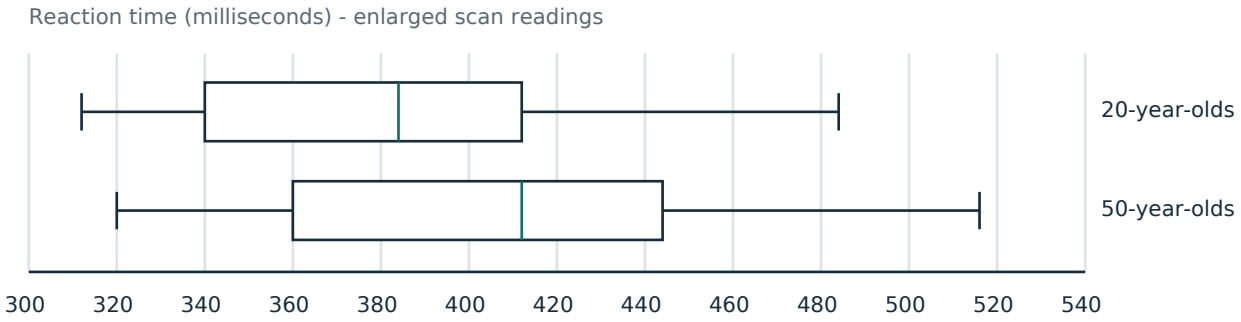
(a) The class midpoints are 15, 22.5, 27.5, 35 and 55.
Estimated mean = [1(15) + 2(22.5) + 8(27.5) + 7(35) + 7(55)] / 25
= 910/25 = **36.4 minutes**.

(b) Decreases. The 39-minute time enters the $30 < t \leq 40$ class, whose midpoint is 35. As 35 is below the current estimated mean of 36.4, adding this entry to the grouped table decreases the estimate.
Do not compare 39 directly with 36.4: the question asks about the estimated mean calculated from the grouped table.

11. Combining ratios [3]

Brian : Amal = 3 : 4 = 12 : 16.
Brian : Priya = 4 : 7 = 12 : 21.
Hence Brian : Amal : Priya = 12 : 16 : 21.
21 - 16 = 5 parts represent \$150, so one part is \$30.
Brian receives 12 × \$30 = **\$360**.

12. Comparing reaction times [3]



Comment 1: The 20-year-olds generally react faster, as their median reaction time is about **384 ms**, compared with about **412 ms** for the 50-year-olds.

Comment 2: The 20-year-olds' reaction times are more consistent, as their interquartile range is **412 - 340 = 72 ms**, smaller than **444 - 360 = 84 ms** for the 50-year-olds.

Use group comparisons, not claims about every individual. The figures are readings from the plotted scale; the original scan was enlarged to check them.

13. Integers satisfying a compound inequality [3]

$21 < 5 - 4x \leq 47$
$16 < -4x \leq 42$
Dividing by -4 reverses both inequality signs: $-10.5 \leq x < -4$.
Integers: -10, -9, -8, -7, -6, -5.

Questions 14-17

Coordinates, equations, fractions and currency conversion

14. Translation, a line equation and a distance [6]

(a) H = (5 - 8, -14 + 20) = **(-3, 6)**.

(b) Gradient of GH = (6 - (-14))/(-3 - 5) = 20/(-8) = -5/2.
Using G(5, -14): y + 14 = -(5/2)(x - 5).
Therefore **y = -(5/2)x - 3/2**.

(c) FG = √[(5 - (-3))² + (-14 - (-4))²]
= √(8² + (-10)²) = √164 = **2√41 = 12.8** (3 s.f.).

Check: both G(5, -14) and H(-3, 6) satisfy the line equation.

15. Simultaneous linear equations [3]

2x + 6y = -13 ... (1)
3x - 8y = 6 ... (2)
3 × (1): 6x + 18y = -39
2 × (2): 6x - 16y = 12
Subtract: 34y = -51, so **y = -3/2**.
Substitute into (1): 2x - 9 = -13, so **x = -2**.

Check: 2(-2) + 6(-3/2) = -13 and 3(-2) - 8(-3/2) = 6.

16. A single algebraic fraction [2]

3c/(2c - 3)² + 4/(2c - 3)
= [3c + 4(2c - 3)] / (2c - 3)²
= **(11c - 12) / (2c - 3)²**.

The original expression requires c ≠ 3/2.

17. Exchange rate before the fee [3]

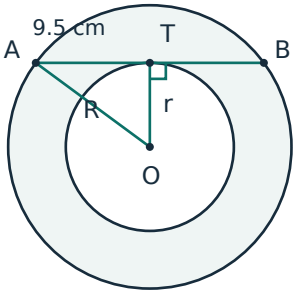
The S$141.56 includes a 2.75% fee, so it is 102.75% of the converted amount.
Converted amount before the fee = 141.56/1.0275 = S$137.7712895...
Exchange rate in UK pounds per Singapore dollar
= 86/137.7712895... = 0.6242229443...
S$1 = £0.624 (3 s.f.).

Check the direction of the rate: the requested unit is pounds per Singapore dollar. With the unrounded rate, £86 ÷ 0.6242229443... × 1.0275 gives the original S$141.56 charge.

Questions 18-20

Circle geometry, probability and bearings

18. The shaded annulus [2]



OT is perpendicular to AB.

T bisects the 19 cm chord.

$R^2 - r^2 = 9.5^2$

Redrawn in a rotated orientation; not to scale.

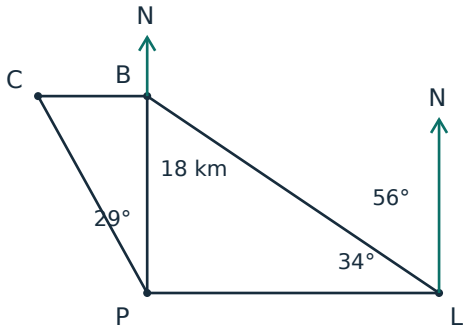
Let T be the point of tangency, with outer radius R and inner radius r. OT is perpendicular to AB, and the perpendicular from the centre bisects the chord, so AT = 19/2 = 9.5 cm.
By Pythagoras, $R^2 = r^2 + 9.5^2$.
Shaded area = $\pi(R^2 - r^2) = 90.25\pi$ = **284 cm²** (3 s.f.).

19. Marbles and counters [3]

(a) P(blue or yellow) = 1 - P(pink) = 1 - 0.37 = **0.63**.

(b) There are 10 red and 10 non-red counters. Exactly two reds can occur as RRN, RNR or NRR, without replacement.
P(exactly two red) = 3 × (10/20) × (9/19) × (10/18) = **15/38**.

20. Bearings and distances [5]



$PL = 18 \tan 56°$

$PC = 18 / \cos 29°$

Bearings use north.
The 34° angle uses west.

(a) Reverse bearing = 304° - 180° = **124°**.

(b) ∠BLP = 90° - 56° = 34°.
tan 34° = 18/PL, so PL = 18/tan 34° = 26.686097... = **26.7 km**.

(c) ∠BPC = 360° - 331° = 29°.
cos 29° = 18/PC, so PC = 18/cos 29° = 20.580373... = **20.6 km**.

Questions 21-23

Factorisation, a fractional equation and fractional indices

21. Factorise before cancelling [3]

Use the difference of two squares in the numerator:
$(3x - 2)^2 - (x - 3)^2$
$= [(3x - 2) - (x - 3)][(3x - 2) + (x - 3)]$
$= (2x + 1)(4x - 5)$.

Factorise the denominator:
$4x^2 - 8x - 5 = (2x + 1)(2x - 5)$.

Therefore $[(3x - 2)^2 - (x - 3)^2] / (4x^2 - 8x - 5)$
$= [(2x + 1)(4x - 5)] / [(2x + 1)(2x - 5)]$
$=$ **$(4x - 5) / (2x - 5)$**.

The original expression is undefined at $x = -1/2$ and $x = 5/2$; these restrictions remain after cancellation.

22. Clearing fractions [3]

$(2x + 5)/3 - (2x^2 - 1)/(3x - 1) = 1$, where $x \neq 1/3$.
Multiply throughout by $3(3x - 1)$:
$(2x + 5)(3x - 1) - 3(2x^2 - 1) = 3(3x - 1)$.

$6x^2 + 13x - 5 - 6x^2 + 3 = 9x - 3$
$13x - 2 = 9x - 3$
$4x = -1$, so **$x = -1/4$**.

Substitution check: when $x = -1/4$, the first fraction is $3/2$ and the second fraction is $1/2$. Their difference is 1, as required. The quadratic terms cancel, so this is a linear-equation question after simplification.

23. Negative and fractional powers [3]

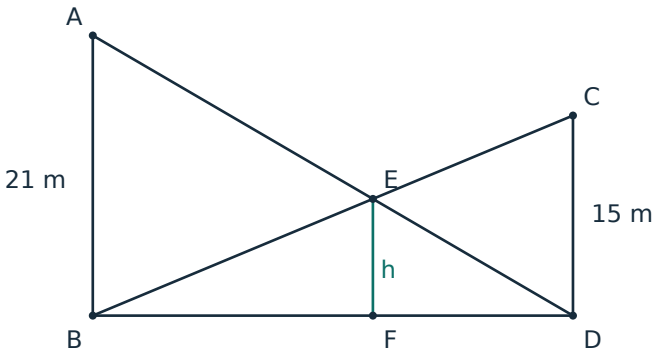
$(27x^6y^{-3}/z^9)^{-4/3}$
$= 27^{-4/3} \times x^{6(-4/3)} \times y^{(-3)(-4/3)} \times z^{(-9)(-4/3)}$
$= 3^{-4} \times x^{-8} \times y^4 \times z^{12}$
$=$ **$(1/81)x^{-8}y^4z^{12}$**.

Thus $a = 1/81$, $p = -8$, $q = 4$ and $r = 12$. The question asks for the form $ax^py^qz^r$, so leave the negative power of x in that form.

Questions 24-25

Similarity and the sector-to-cone relationship

24. Three vertical posts [5]



BE : EC = 7 : 5

BE / BC = 7 / 12

EF / CD = 7 / 12

Post spacing is illustrative.

(a) AB is parallel to DC because both posts are vertical.
∠BAE = ∠CDE (alternate angles, with AD as transversal).
∠AEB = ∠DEC (vertically opposite angles).
Therefore △**ABE is similar to** △**DCE by AA**.

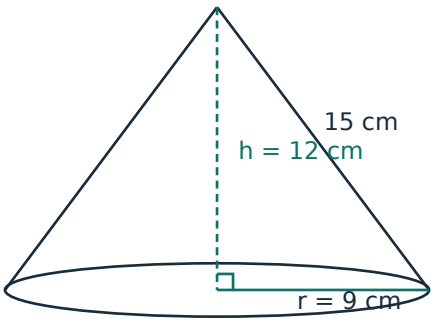
(b) From this similarity, BE/CE = AB/DC = 21/15 = 7/5.
Hence BE/BC = 7/(7 + 5) = 7/12.
Since EF is parallel to CD, △BFE is similar to △BDC.
EF/CD = BE/BC = 7/12, so EF = 15 × 7/12 = **8.75 m**.

25. A major sector folded into a cone [6]



Arc = 18π cm

fold



Axial height is perpendicular to the base.

(a) Let the sector radius be R. Arc length = (216/360) × 2πR = 18π.
R = 18 × 360 / (216 × 2) = **15 cm**.

(b) The sector radius becomes the cone's **slant height**, l = 15 cm.
The major arc becomes the base circumference: 2πr = 18π, so r = 9 cm.
The perpendicular height is h = √(15² - 9²) = √144 = 12 cm.
Volume = (1/3)πr²h = (1/3)π(9²)(12) = **324π cm³**
= 1017.876… cm³ = **1.02 × 10³ cm³** (3 s.f.).

Geometry check: sector area = (216/360)π(15²) = 135π cm², matching the cone's curved surface area πrl = π(9)(15).

Questions 26-28

Data transformations, proportional change and a quadratic minimum

26. Changing the mean and standard deviation [1]

Multiply every number by 2, then add 15.

Multiplication by 2 changes the mean from 30 to 60 and the standard deviation from 10 to 20.
Adding 15 changes the mean from 60 to 75 and leaves the standard deviation unchanged.
In symbols, replace each value x with **2x + 15**.

27. Frequency and tension [3]

$f \propto \sqrt{T}$, so $f = k\sqrt{T}$ for a constant k.
A 100% increase in frequency means the new frequency is 2f.
Since T is proportional to f^2, the new tension is $2^2T = 4T$.
Percentage increase = $[(4T - T)/T] \times 100\% =$ **300%**.

Four times as large is 400% of the original, but it is a 300% increase. The word "increase" asks for the extra amount, not the final total as a percentage.

28. Recovering a quadratic from its minimum [3]

The coefficient of x^2 is 1 and the minimum point is (3, -11).
Therefore the vertex form is $y = (x - 3)^2 - 11$.
Expanding: $y = x^2 - 6x + 9 - 11 = x^2 - 6x - 2$.
Comparing with $y = x^2 + bx + c$ gives **b = -6 and c = -2**.

Check: $(x - 3)^2$ is non-negative, so its least value is 0 at x = 3. The minimum value of y is therefore -11, as given.

How the answers were checked

Every question was checked against the scan. Algebraic answers were expanded or substituted back, units and rounding were reviewed, and the box-plot readings were checked on an enlarged image. Circle angles and bearings were also checked using coordinates. The probability in Q19(b) was verified using ordered draws, combinations and an exhaustive count of possible selections.

For Q24, the height was checked by finding the intersection of both cables. For Q25, the cone's radius, slant height, perpendicular height, volume and curved surface area were checked for consistency. The grouped-mean conclusion in Q10 was also verified by recalculating the updated table, although the student answer only needs the midpoint explanation.

Source: the user-supplied scan of Mathematics 4052/01, October/November 2026, 20 PDF pages. The printed question allocations total 90 marks. These independently prepared solutions do not assign official method marks or specify official marking tolerances.