St. Patrick's School – Preliminary Examination 2026
Mathematics 4052 Paper 1 – Worked Solutions

Qn	Answer	Mark
1	$$\sqrt[3]{15.6^2 - \frac{9.4}{0.028}} = \sqrt[3]{-92.35}$$ $$= -4.52$$	[1]
2(a)	$$2p^4 \times 6p^{-5} = 12p^{-1}$$ $$= \frac{12}{p}$$	[1]
2(b)	$$4(3x-2)-5 = 12x-8-5$$ $$= 12x-13$$	[1]
3(a)	$$0.00047 = 4.7 \times 10^{-4}$$	[1]
3(b)	1 km = $1{\times}10^3$ m 0.4 nm = $4{\times}10^{-10}$ m $$\text{Percentage} = \frac{1 \times 10^3}{4 \times 10^{-10}} \times 100\%$$ $$= 2.5 \times 10^{14}\ \%$$	[1]
4	F = k/d^2. Halving d multiplies the force by 4. $$\text{New force} = 4 \times 0.8$$ $$= 3.2 \text{ N}$$ $$\text{Increase} = 3.2 - 0.8$$ $$= 2.4 \text{ N}$$	[2]
5	2x = y + 10 and 4x + 3y = 220 $$4x + 3(2x-10) = 220$$ $$10x - 30 = 220$$ $$x = 25$$ $$y = 2(25) - 10$$ $$= 40$$	[3]
6	Smallest cube side = LCM(24, 16, 10). $$\text{Side} = 240 \text{ mm}$$ $$\text{Number of blocks} = \frac{240^3}{24 \times 16 \times 10}$$ $$= 3600$$	[3]

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7	Make the number of boys equal (LCM of 5 and 7 = 35): Class A → 35 : 14, Class B → 35 : 20 $$\begin{aligned}\text{Total girls} &= 14 + 20\\ &= 34\\ \text{Total children} &= 70 + 34\\ &= 104\\ \text{Fraction} &= \frac{34}{104}\\ &= \frac{17}{52}\end{aligned}$$	[3]
8	$$\begin{aligned}x &= \frac{7 \pm \sqrt{(-7)^2 - 4(3)(1)}}{2(3)}\\ &= \frac{7 \pm \sqrt{37}}{6}\end{aligned}$$ x = 2.18 or x = 0.15	[3]
9	In △AMB and △CMD: AM = CM (M is the midpoint of AC) BM = DM (M is the midpoint of BD) ∠AMB = ∠CMD (vertically opposite angles) ∴ △AMB ≅ △CMD (SAS) ∴ ∠BAM = ∠DCM (corresponding angles of congruent triangles) These are equal alternate angles, so AB ∥ CD.	[3]
10(a)(i)	Midpoints: 35, 45, 55, 65 $$\begin{aligned}\text{Mean} &= \frac{6(35) + 10(45) + 16(55) + 8(65)}{40}\\ &= \frac{2060}{40}\\ &= 51.5 \text{ min}\end{aligned}$$	[1]
10(a)(ii)	$$\begin{aligned}\text{s.d.} &= \sqrt{\frac{109800}{40} - 51.5^2}\\ &= \sqrt{92.75}\\ &= 9.63 \text{ min}\end{aligned}$$	[1]
10(b)	Adding 5 to every value increases the mean by 5, to 56.5 min. The standard deviation is unchanged (9.63 min): adding a constant does not change the spread.	[2]
11(a)	P(even score) = 12/16 = 3/4, P(odd score) = 4/16 = 1/4. 3/4 ≠ 1/4, so Aisha is more likely to win — the game is unfair.	[1]
11(b)	P(Aisha) = 3/4, P(Ben) = 1/4. 3/4 = 3 × 1/4, so Aisha is three times as likely to win, not twice. ∴ Aisha is incorrect.	[2]

Qn	Answer	Mark
12	$\frac{1}{2}(9.8)(15)\sin\angle PQR = 67.67$ $\sin\angle PQR = 0.9207$ $\angle PQR = 67.0^\circ$ or 113.0°	[3]
13	Let the sphere radius be r. Then cylinder radius = r and height = 4r. $\text{Cylinder} = \pi r^2(4r) = 4\pi r^3$ $\text{Two spheres} = 2 \times \frac{4}{3}\pi r^3 = \frac{8}{3}\pi r^3$ $\text{Fraction empty} = \dfrac{4\pi r^3 - \frac{8}{3}\pi r^3}{4\pi r^3} = \dfrac{1}{3}$	[3]
14(a)	∠ABC = 90° (angle in semicircle) ∠DBC = 180° − 90° = 90° (angles on straight line ABD) $\angle DCB = 180^\circ - 90^\circ - 60^\circ = 30^\circ$ (angle sum of △BDC)	[2]
14(b)	If DC were a tangent at C, then ∠DCB would equal ∠BAC = 28° (tangent–chord, alternate segment). But ∠DCB = 30° ≠ 28°, so DC is not a tangent.	[1]
15(a)	Figure 4: shaded = 16, unshaded = 20.	[1]
15(b)	Unshaded in Figure n = $(n+2)^2 - n^2$ = 4n + 4.	[1]
15(c)	$4n + 4 = 96$ $n = 23$ $\text{Shaded} = 23^2 = 529$	[2]
16	Let OD = r, so OA = 2r. $\text{Perimeter} = 2r(1.2) + r(1.2) + r + r = 5.6r$ $5.6r = 44.8$ $r = 8$ $\text{Area} = \frac{1}{2}(1.2)(16^2) - \frac{1}{2}(1.2)(8^2) = 153.6 - 38.4 = 115.2 \text{ cm}^2$	[4]

Qn	Answer	Mark
17(a)	Write each side as a power of 3: $$3^k \times 3^6 = 3^{-4k}$$ $$k+6 = -4k$$ $$5k = -6$$ $$k = -\tfrac{6}{5}$$	[2]
17(b)	$4725 = 3^3 \times 5^2 \times 7$ LCM(A, B) = p^(r+1) × q^2 × 7 $$q = 5$$ $$p = 3$$ $$r+1 = 3$$ $$r = 2$$	[2]
18	(i) C (depth falls at a constant rate — straight line decreasing) (ii) D (area = πr^2, increasing and concave up) (iii) B (distance increases at a decreasing rate, then levels off)	[3]
19(a)	Interior angles: A = 110°, B = 30°+70° = 100°, E = 40°+80° = 120°, D = 30°+80° = 110°. $$110 + 100 + 120 + 110 + x = 540$$ $$x = 100$$	[2]
19(b)	∠ABE = ∠ADE = 30°, so A, B, D, E lie on a circle (equal angles subtended by AE, angles in the same segment). In △AED: ∠DAE = 180° − 120° − 30° = 30°, so ∠DAB = 110° − 30° = 80°. For ABCD: ∠DAB + ∠BCD = 80° + 100° = 180°, so ABCD is a cyclic quadrilateral. Hence all five points A, B, C, D, E lie on the same circle.	[3]
20(a)	$$-15 < 3x - 3 \leq 15$$ $$-12 < 3x \leq 18$$ $$-4 < x \leq 6$$	[2]
20(b)	Open circle at −4, filled circle at 6, joined by a line.	[1]
20(c)	Smallest $y^2 - x^2$: take smallest y^2 (y = 2) and largest x^2 (x = 6). $$y^2 - x^2 = 2^2 - 6^2$$ $$= -32$$	[1]
21(a)	From A, measure a bearing of 062° and mark F at 6.4 cm (12.8 m).	[1]
21(b)	P is due south of F with AP = 8 cm (16 m). Mark P and draw PA, PF.	[1]

Qn	Answer	Mark
21(c)	PF runs due north–south, so the shortest distance from A to PF is the easterly distance: $$\begin{aligned} d &= 12.8\sin 62^\circ \\ &= 11.30 \text{ m} \\ \text{Greatest angle} &= \tan^{-1}\frac{5.3}{11.30} \\ &= 25.1^\circ \end{aligned}$$	[2]
22(a)	$$\begin{aligned} \tfrac{1}{2}(56)(v) &= 672 \\ v &= 24 \text{ m/s} \end{aligned}$$	[1]
22(b)	$$\begin{aligned} \text{Deceleration} &= \frac{24}{56-24} \\ &= 0.75 \text{ m/s}^2 \end{aligned}$$	[1]
22(c)	0 to 24 s: curve from (0, 0), increasing gradient (concave up), reaching 288 m. 24 to 56 s: curve continues up with decreasing gradient (concave down), reaching 672 m at 56 s.	[2]
23(a)	$$\begin{aligned} B &= (0-3,\ 7+5) \\ &= (-3,\ 12) \end{aligned}$$	[1]
23(b)	$$\begin{aligned} \lvert\mathbf{p}\rvert &= \sqrt{(-3)^2+5^2} \\ &= \sqrt{34} \\ &= 5.83 \end{aligned}$$	[2]
23(c)	$$\begin{aligned} \text{Gradient} &= \frac{12-7}{-3-0} \\ &= -\tfrac{5}{3} \\ y &= -\tfrac{5}{3}x+7 \end{aligned}$$	[2]
24(a)	A ∪ B = {1,2,3,4,6,9,12} so (A ∪ B)’ = {5,7,8,10,11} n(A ∪ B)’ = 5.	[1]
24(b)	A’ ∩ B = {1, 2, 4}.	[1]
24(c)	True. 9 ∈ A (multiple of 3) and 9 ∉ B (not a factor of 12), so 9 ∈ B’; hence 9 ∈ A ∩ B’.	[1]
24(d)	B = {1,2,3,4,6,12}, C = {7,11}, so B ∩ C = ∅. The events cannot occur together, so X and Y are mutually exclusive.	[1]
25(a)	Tuesday: 40(t + 6) litres Wednesday: 60(t − 4) litres	[1]

Qn	Answer	Mark
25(b)	$$40(t+6) = 60(t-4)$$ $$40t + 240 = 60t - 240$$ $$20t = 480$$ $$t = 24 \text{ min}$$	[3]
25(c)	$$\text{Capacity} = 40(24+6) = 1200 \text{ litres}$$	[1]
26(a)	$$\mathbf{P} = \begin{pmatrix} 4.50 \\ 6.00 \end{pmatrix}$$	[1]
26(b)	$$\mathbf{QP} = \begin{pmatrix} 120 & 80 \\ 150 & 60 \end{pmatrix} \begin{pmatrix} 4.50 \\ 6.00 \end{pmatrix} = \begin{pmatrix} 1020 \\ 1035 \end{pmatrix}$$	[1]
26(c)	Each element is the total takings from meal-set sales that day: $1020 on Monday and $1035 on Tuesday.	[1]
26(d)(i)	$$\mathbf{R} = \begin{pmatrix} 0.3 & 0 \\ 0 & 0.4 \end{pmatrix}$$	[1]
26(d)(ii)	$$\mathbf{RP} = \begin{pmatrix} 1.35 \\ 2.40 \end{pmatrix}$$ $$\mathbf{Q}(\mathbf{RP}) = \begin{pmatrix} 120 & 80 \\ 150 & 60 \end{pmatrix} \begin{pmatrix} 1.35 \\ 2.40 \end{pmatrix} = \begin{pmatrix} 354 \\ 346.50 \end{pmatrix}$$ Profit: Monday $354, Tuesday $346.50.	[2]