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Your JEE Guide

ISC Class XII · Mathematics

Sample Question Paper 2 · Session 2026-27

Time allowed: 3 hours (plus 15 minutes reading time) **Maximum marks: 80**

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This is an original practice paper written to the CISCE 2027 specimen paper format; it is not issued by CISCE.

General instructions:

1. You are allowed an additional fifteen minutes for only reading the question paper. You must NOT start writing during the reading time.
2. The paper consists of twenty questions and four sections: Sections A, B, C and D.
3. All questions are compulsory.
4. Section A consists of very short answer questions of 1 mark each. Section B consists of short answer questions of 2 marks each. Section C consists of moderately long answer questions of 3 marks each. Section D consists of long answer questions of 5 marks each.
5. Internal choices have been provided in three questions each in Sections B, C and D.
6. While attempting Multiple Choice Questions in Section A, you are required to write only ONE option as the answer.
7. The intended marks for questions or parts of questions are given in brackets [ ].
8. All workings, including rough work, should be done on the same page as, and adjacent to, the rest of the answer.

Section A (20 marks)

1.	**(i)** The relation R on $\mathbb{Z}$ defined by aRb if and only if a – b is divisible by 5 is: (a) symmetric but not transitive (b) reflexive but not symmetric (c) neither reflexive nor transitive (d) an equivalence relation	1
	(ii) The function f: $\mathbb{R} \to \mathbb{R}$, $f(x) = x^3 - x$ is: (a) neither one-one nor onto (b) one-one and onto (c) onto but not one-one (d) one-one but not onto	1
	(iii) The value of $\tan^{-1}\left(\tan\frac{5\pi}{6}\right)$ is: (a) $\frac{5\pi}{6}$ (b) $-\frac{\pi}{6}$ (c) $-\frac{5\pi}{6}$ (d) $\frac{\pi}{6}$	1
	(iv) The value of $\tan\left(2\tan^{-1}\frac{1}{3}\right)$ is: (a) $\frac{3}{4}$ (b) $\frac{4}{3}$ (c) $\frac{2}{3}$ (d) $\frac{1}{3}$	1

	(v) If $A = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$, then A^{2027} equals: (a) A (b) –A (c) O (d) I	1
	(vi) The value of $\begin{vmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{vmatrix}$ is: (a) 1 (b) 6 (c) –1 (d) 0	1
	(vii) Statement I: f(x) = |x – 3| is differentiable at x = 3. **Statement II:** g(x) = x|x| is differentiable at x = 0. (a) Both the statements are true. (b) Both the statements are false. (c) Statement I is false and Statement II is true. (d) Statement I is true and Statement II is false.	1
	(viii) $\frac{d}{dx}\left(\tan^{-1} x + \cot^{-1} x\right)$ equals: (a) $\frac{2}{1+x^2}$ (b) 0 (c) $\frac{\pi}{2}$ (d) 1	1
	(ix) The slope of the normal to the curve $y = x^3$ at x = 1 is: (a) $-\frac{1}{3}$ (b) $\frac{1}{3}$ (c) 3 (d) –3	1
	(x) $\int \frac{\sec^2 x}{\tan x}\, dx$ equals: (a) $\tan x + C$ (b) $\log\lvert\sec x\rvert + C$ (c) $\frac{\tan^2 x}{2} + C$ (d) $\log\lvert\tan x\rvert + C$	1
	(xi) $\int_1^e \log x\, dx$ equals: (a) e – 1 (b) 0 (c) 1 (d) e	1
	(xii) The order and degree of $\frac{d^2y}{dx^2} + \left(\frac{dy}{dx}\right)^3 = x$ are: (a) 2 and 3 (b) 2 and 1 (c) 1 and 3 (d) 3 and 1	1
	(xiii) $\vec{a}$ is a unit vector with $\lvert\vec{a} \times \vec{b}\rvert = 12$ and $\vec{a} \cdot \vec{b} = 5$. Then $\lvert\vec{b}\rvert$ is: (a) 17 (b) 13 (c) 7 (d) 12	1

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	(xiv) The equation of the plane which makes intercepts 2, 3 and 4 on the x-, y- and z-axes is: (a) 2x + 3y + 4z = 12 (b) 2x + 3y + 4z = 1 (c) 6x + 4y + 3z = 12 (d) 4x + 3y + 2z = 12	1
	(xv) If P(A) = 0.6 and P(B | A) = 0.5, then P(A ∩ B) is: (a) 0.3 (b) 0.5 (c) 0.1 (d) 0.6	1
	(xvi) Assertion: The matrix $\begin{bmatrix}1 & 2\\2 & 4\end{bmatrix}$ is singular. **Reason:** Its determinant is 0. (a) Both Assertion and Reason are true, and Reason is the correct explanation of Assertion. (b) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion. (c) Assertion is true and Reason is false. (d) Assertion is false and Reason is true.	1
	(xvii) Assertion: Every continuous function is differentiable. **Reason:** f(x) = |x| is continuous at x = 0 but not differentiable there. (a) Both Assertion and Reason are true, and Reason is the correct explanation of Assertion. (b) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion. (c) Assertion is true and Reason is false. (d) Assertion is false and Reason is true.	1
	(xviii) Find the values of x for which $\begin{bmatrix}x & 2\\3 & x\end{bmatrix}$ is a singular matrix.	1
	(xix) Using integration, find the area of the region bounded by the line y = 2x, the x-axis and the line x = 3.	1
	(xx) A and B are mutually exclusive events with P(A) = 0.4 and P(B) = 0.3. Find P(neither A nor B).	1

Section B (14 marks)

2.	Show that the relation R on $\mathbb{R}$ defined by aRb if and only if $a \leq b^2$ is neither reflexive nor transitive.	2
3.	Prove that $\tan^{-1}\frac{1}{5} + \tan^{-1}\frac{2}{3} = \frac{\pi}{4}$. **OR** Solve: $\tan^{-1} 2x + \tan^{-1} 3x = \frac{\pi}{4}$.	2
4.	If x = a(θ − sin θ) and y = a(1 − cos θ), find $\frac{dy}{dx}$.	2

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5.	Find $\int \sin^3 x \, dx$. **OR** Find $\int \frac{dx}{\sqrt{9-4x^2}}$.	2
6.	The vectors $\vec{a}$, $\vec{b}$ and $\vec{c}$ satisfy $\vec{a}+\vec{b}+\vec{c}=\vec{0}$, with $\lvert\vec{a}\rvert=5$, $\lvert\vec{b}\rvert=3$ and $\lvert\vec{c}\rvert=7$. Find the angle between $\vec{a}$ and $\vec{b}$.	2
7.	Find the coordinates of the foot of the perpendicular drawn from the origin to the plane 2x + 3y + 4z = 29. **OR** Find the angle between the planes 2x – y + z = 6 and x + y + 2z = 7.	2
8.	A and B are independent events with $P(A)=\frac{1}{3}$ and $P(B)=\frac{1}{4}$. Find the probability that (a) at least one of them occurs, (b) exactly one of them occurs.	2

Section C (21 marks)

9.	Express $A=\begin{bmatrix}3 & 5\\ 1 & -1\end{bmatrix}$ as the sum of a symmetric matrix and a skew-symmetric matrix. **OR** Using determinants, find the area of the triangle with vertices P(2, 1), Q(7, 1) and R(5, 4), and the equation of the line PR.	3
10.	Find the values of a and b such that the function $f(x)=\begin{cases}5, & x\le 2\\ ax+b, & 2<x<10\\ 21, & x\ge 10\end{cases}$ is continuous.	3
11.	If $y=3\cos(\log x)+4\sin(\log x)$, show that $x^2\frac{d^2y}{dx^2}+x\frac{dy}{dx}+y=0$.	3
12.	Find the points of local maxima and local minima of $f(x)=2x^3-21x^2+36x-20$, and the local maximum and minimum values.	3
13.	Find $\int \frac{2x+3}{\sqrt{x^2+4x+5}}\,dx$. **OR** Evaluate $\int_0^{\pi/2}\frac{\sin x\cos x}{1+\sin^4 x}\,dx$.	3
14.	Find the general solution of the differential equation $\frac{dy}{dx}+y=\cos x$.	3

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15.	Two fair dice are thrown. Find the probability that (a) the sum is 8, given that at least one die shows 3; (b) at least one die shows 3, given that the sum is 8. **OR** A random variable X takes the values 0, 1, 2 and 3 with probabilities k, 2k, 3k and 4k. Find k, the mean of X and P(X ≥ 2).	3

Section D (25 marks)

16.	A dietician mixes two foods P and Q. Each kg of P contains 1 unit of vitamin A and 3 units of vitamin C; each kg of Q contains 2 units of vitamin A and 1 unit of vitamin C. The mixture must contain at least 10 units of vitamin A and 15 units of vitamin C. P costs ₹40 per kg and Q costs ₹60 per kg. Formulate a linear programming problem to find the cheapest mixture and solve it graphically.	5
17.	Use the matrix method to solve: x + 2y − z = −2, 2x − y + 3z = 11, x + y + z = 2.	5
18.	Sketch the region enclosed by the parabola $y^2 = 4x$ and the line y = 2x − 4, and find its area using integration. **OR** Using integration, find the area of the triangle with vertices A(0, 1), B(2, 5) and C(4, 3).	5
19.	A rectangle is inscribed in a semicircle of radius 5 cm, with one side along the diameter. Find the dimensions of the rectangle of greatest area, and that area. **OR** A closed cylindrical can is to hold 128π cm³. Find the radius and height that need the least amount of metal, and the least surface area.	5
20.	In a town, 1% of people have a certain disease. A test gives a positive result for 95% of people who have the disease, and also for 2% of people who do not. (a) Find the probability that a person chosen at random tests positive. *[2]* (b) A person tests positive. Find the probability that the person has the disease. *[2]* (c) Comment on your answer to (b). *[1]* **OR** Find the foot of the perpendicular from the point P(4, 7, 6) to the line $\frac{x}{1} = \frac{y-1}{2} = \frac{z-2}{3}$. Hence find the image of P in the line and the perpendicular distance of P from the line.	5

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Answers and Marking Scheme

Marks for each step are shown in brackets. Any correct alternative method gets full credit.

Section A (20 marks)

Question 1

(i) **(d)** an equivalence relation. *Working:* a – a = 0 is divisible by 5; if 5 divides a – b it divides b – a; if 5 divides a – b and b – c it divides their sum a – c.

(ii) **(c)** onto but not one-one. *Working:* f(0) = f(1) = 0, so f is not one-one; a cubic polynomial takes every real value, so f is onto.

(iii) **(b)** $-\frac{\pi}{6}$. *Working:* $\tan\frac{5\pi}{6} = \tan\left(\frac{5\pi}{6} - \pi\right) = \tan\left(-\frac{\pi}{6}\right)$, and $-\frac{\pi}{6}$ lies in $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$.

(iv) **(a)** $\frac{3}{4}$. *Working:* $\tan 2\theta = \frac{2/3}{1 - 1/9} = \frac{3}{4}$.

(v) **(a)** A. *Working:* $A^2 = I$, so $A^{2027} = (A^2)^{1013} A = A$.

(vi) **(d)** 0. *Working:* $R_3 - R_2 = R_2 - R_1 = (3, 3, 3)$, so after $R_3 \to R_3 - 2R_2 + R_1$ the third row is zero.

(vii) **(c)** Statement I is false and Statement II is true. *Working:* At x = 3, |x – 3| has left derivative –1 and right derivative 1, so Statement I is false. For g, $\frac{g(h) - g(0)}{h} = |h| \to 0$ from both sides, so Statement II is true.

(viii) **(b)** 0. *Working:* $\tan^{-1} x + \cot^{-1} x = \frac{\pi}{2}$, a constant.

(ix) **(a)** $-\frac{1}{3}$. *Working:* Slope of tangent $= 3x^2 = 3$; slope of normal $= -\frac{1}{3}$.

(x) **(d)** $\log|\tan x| + C$. *Working:* Put t = tan x, dt = sec²x dx: $\int \frac{dt}{t}$.

(xi) **(c)** 1. *Working:* $[x \log x - x]_1^e = (e - e) - (0 - 1) = 1$.

(xii) **(b)** 2 and 1. *Working:* The highest derivative is the second and it appears to the first power.

(xiii) **(b)** 13. *Working:* $|\vec{a} \times \vec{b}|^2 + (\vec{a} \cdot \vec{b})^2 = |\vec{a}|^2 |\vec{b}|^2$, so $|\vec{b}|^2 = 144 + 25 = 169$.

(xiv) **(c)** 6x + 4y + 3z = 12. *Working:* $\frac{x}{2} + \frac{y}{3} + \frac{z}{4} = 1$; multiply by 12.

(xv) **(a)** 0.3. *Working:* P(A ∩ B) = P(A) P(B | A) = 0.6 × 0.5.

(xvi) **(a)** Both Assertion and Reason are true, and Reason is the correct explanation of Assertion. *Working:* |A| = 4 – 4 = 0, and a square matrix with zero determinant is singular, so the Reason explains the Assertion.

(xvii) **(d)** Assertion is false and Reason is true. *Working:* The Reason is true, and it is a counter-example that shows the Assertion is false.

(xviii) $x^2 - 6 = 0$ (½), so $x = \pm\sqrt{6}$ (½).

(xix) Area $= \int_0^3 2x\,dx$ (½) $= 9$ square units (½).

(xx) P(A ∪ B) = 0.4 + 0.3 = 0.7 (½), so P(neither) = 1 – 0.7 = 0.3 (½).

Section B (14 marks)

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2. $\frac{1}{2} > \frac{1}{4} = \left(\frac{1}{2}\right)^2$, so $\left(\frac{1}{2}, \frac{1}{2}\right) \notin R$: not reflexive (1). (3, 2) ∈ R as 3 ≤ 4 and (2, 1.5) ∈ R as 2 ≤ 2.25, but (3, 1.5) ∉ R as 3 > 2.25: not transitive (1).

3. $\tan^{-1}\frac{1}{5} + \tan^{-1}\frac{2}{3} = \tan^{-1}\frac{\frac{1}{5}+\frac{2}{3}}{1-\frac{2}{15}}$, valid as the product is less than 1 (1) $= \tan^{-1}\frac{13/15}{13/15} = \tan^{-1} 1 = \frac{\pi}{4}$ (1).

OR $\frac{5x}{1-6x^2} = 1$, so $6x^2 + 5x - 1 = 0$, x = 1/6 or x = –1 (1). x = –1 makes the left side negative, so x = 1/6 (1).

4. $\frac{dx}{d\theta} = a(1-\cos\theta)$, $\frac{dy}{d\theta} = a\sin\theta$ (1). $\frac{dy}{dx} = \frac{\sin\theta}{1-\cos\theta} = \cot\frac{\theta}{2}$ (1).

5. $\sin^3 x = (1-\cos^2 x)\sin x$; put t = cos x (1): $-\cos x + \frac{\cos^3 x}{3} + C$ (1).

OR $\frac{1}{2}\int \frac{dx}{\sqrt{\frac{9}{4}-x^2}}$ (1) $= \frac{1}{2}\sin^{-1}\frac{2x}{3} + C$ (1).

6. $\vec{c} = -(\vec{a}+\vec{b})$, so $49 = 25 + 9 + 2\vec{a}\cdot\vec{b}$, giving $\vec{a}\cdot\vec{b} = \frac{15}{2}$ (1). $\cos\theta = \frac{15/2}{15} = \frac{1}{2}$, θ = 60° (1).

7. The foot is t(2, 3, 4) for some t (1). Then 4t + 9t + 16t = 29, t = 1, so the foot is (2, 3, 4) (1).

OR $\cos\theta = \frac{|2-1+2|}{\sqrt{6}\sqrt{6}} = \frac{1}{2}$ (1), so θ = 60° (1).

8. (a) $1 - \frac{2}{3}\cdot\frac{3}{4} = \frac{1}{2}$ (1). (b) $\frac{1}{3}\cdot\frac{3}{4} + \frac{2}{3}\cdot\frac{1}{4} = \frac{5}{12}$ (1).

Section C (21 marks)

9. $P = \frac{1}{2}(A + A') = \begin{bmatrix} 3 & 3 \\ 3 & -1 \end{bmatrix}$, symmetric (1). $Q = \frac{1}{2}(A - A') = \begin{bmatrix} 0 & 2 \\ -2 & 0 \end{bmatrix}$, skew-symmetric (1). P + Q = A (1).

OR Area $= \frac{1}{2}\left\|\begin{vmatrix} 2 & 1 & 1 \\ 7 & 1 & 1 \\ 5 & 4 & 1 \end{vmatrix}\right\| = \frac{1}{2}|2(1-4) + 7(4-1) + 5(1-1)| = \frac{15}{2}$ square units (1½).

Line PR: $\begin{vmatrix} x & y & 1 \\ 2 & 1 & 1 \\ 5 & 4 & 1 \end{vmatrix} = 0$ gives –3x + 3y + 3 = 0, i.e. y = x – 1 (1½).

10. Continuity at x = 2: 2a + b = 5 (1). At x = 10: 10a + b = 21 (1). Solving, a = 2, b = 1 (1).

11. $x\frac{dy}{dx} = -3\sin(\log x) + 4\cos(\log x)$ (1). Differentiating again: $x\frac{d^2y}{dx^2} + \frac{dy}{dx} = \frac{-3\cos(\log x) - 4\sin(\log x)}{x} = -\frac{y}{x}$ (1½). Multiplying by x gives the result (½).

12. $f'(x) = 6(x-1)(x-6)$ (1). f′′(x) = 12x – 42: f′′(1) = –30 < 0 and f′′(6) = 30 > 0 (1). Local maximum f(1) = –3; local minimum f(6) = –128 (1).

13. 2x + 3 = (2x + 4) – 1 (1). $\int \frac{2x+4}{\sqrt{x^2+4x+5}}dx = 2\sqrt{x^2+4x+5}$ and $\int \frac{dx}{\sqrt{(x+2)^2+1}} = \log\left|x+2+\sqrt{x^2+4x+5}\right|$ (1½). Integral $= 2\sqrt{x^2+4x+5} - \log\left|x+2+\sqrt{x^2+4x+5}\right| + C$ (½).

OR Put $t = \sin^2 x$, dt = 2 sin x cos x dx; t goes from 0 to 1 (1). $\frac{1}{2}\int_0^1 \frac{dt}{1+t^2} = \frac{1}{2}[\tan^{-1} t]_0^1$ (1) $= \frac{\pi}{8}$ (1).

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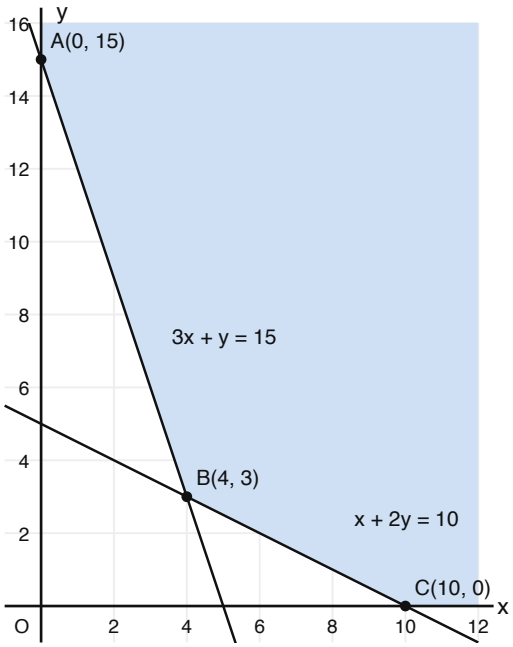
14. IF $= e^x$ (½). $ye^x = \int e^x \cos x\, dx = \frac{e^x(\sin x + \cos x)}{2} + C$ (2). $y = \frac{\sin x + \cos x}{2} + Ce^{-x}$ (½).

15. (a) 11 outcomes have at least one 3; of these (3, 5) and (5, 3) have sum 8, so the probability is $\frac{2}{11}$ (1½). (b) Sum 8: (2, 6), (3, 5), (4, 4), (5, 3), (6, 2); two of these contain a 3, so $\frac{2}{5}$ (1½).

OR 10k = 1, k = 1/10 (1). Mean $= \frac{0+2+6+12}{10} = 2$ (1). P(X ≥ 2) = $\frac{3+4}{10} = \frac{7}{10}$ (1).

Section D (25 marks)

16. Let x kg of P and y kg of Q be used. Minimise Z = 40x + 60y subject to x + 2y ≥ 10, 3x + y ≥ 15, x, y ≥ 0 (1½). Feasible region (unbounded) (1½):

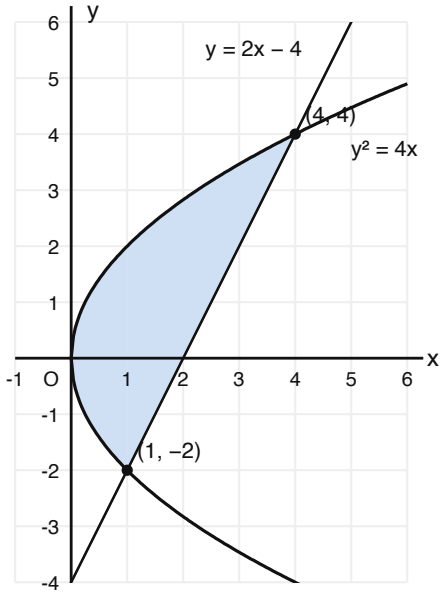


Corners A(0, 15), B(4, 3), C(10, 0): Z = 900, 340, 400 (1). The half-plane 40x + 60y < 340 has no point in common with the region, so the minimum cost is ₹340 with 4 kg of P and 3 kg of Q (1).

17. $A = \begin{bmatrix} 1 & 2 & -1 \\ 2 & -1 & 3 \\ 1 & 1 & 1 \end{bmatrix}$, |A| = 1(–4) – 2(–1) – 1(3) = –5 ≠ 0 (1). $\operatorname{adj} A = \begin{bmatrix} -4 & -3 & 5 \\ 1 & 2 & -5 \\ 3 & 1 & -5 \end{bmatrix}$ (2). $X = A^{-1}B = -\frac{1}{5}\begin{bmatrix} -4 & -3 & 5 \\ 1 & 2 & -5 \\ 3 & 1 & -5 \end{bmatrix}\begin{bmatrix} -2 \\ 11 \\ 2 \end{bmatrix} = -\frac{1}{5}\begin{bmatrix} -15 \\ 10 \\ -5 \end{bmatrix}$ (1), so x = 3, y = –2, z = 1 (1).

18. Intersections: $y^2 = 2(y + 4)$, y = 4 or –2, i.e. (4, 4) and (1, –2) (1). Sketch (1):

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Area $= \int_{-2}^{4} \left(\frac{y+4}{2} - \frac{y^2}{4} \right) dy$ (1) $= \left[\frac{y^2}{4} + 2y - \frac{y^3}{12} \right]_{-2}^{4} = \frac{20}{3} + \frac{7}{3} = 9$ square units (2).

OR AB: y = 2x + 1; BC: y = 7 – x; AC: $y = \frac{x}{2} + 1$ (1½). Area $= \int_0^2 \left(2x + 1 - \frac{x}{2} - 1\right) dx + \int_2^4 \left(7 - x - \frac{x}{2} - 1\right) dx$ (1½) $= 3 + 3 = 6$ square units (2).

19. Let the rectangle be 2x by y with $x^2 + y^2 = 25$; A = 2xy (1). Maximise $A^2 = 4x^2(25 - x^2)$: $\frac{d}{dx} = 200x - 16x^3 = 0$ gives $x^2 = \frac{25}{2}$ (2). The second derivative $200 - 48x^2 = -400 < 0$: a maximum (1). $x = y = \frac{5}{\sqrt{2}}$: the rectangle is $5\sqrt{2}$ cm by $\frac{5}{\sqrt{2}}$ cm, area 25 cm² (1).

OR $\pi r^2 h = 128\pi$, so $h = \frac{128}{r^2}$ (1). $S = 2\pi r^2 + \frac{256\pi}{r}$ (1). $S' = 4\pi r - \frac{256\pi}{r^2} = 0$ gives r = 4 cm, h = 8 cm (1½). $S'' = 4\pi + \frac{512\pi}{r^3} > 0$: a minimum (½). Least area $= 32\pi + 64\pi = 96\pi$ cm² (1).

20. (a) P(+) = 0.01 × 0.95 + 0.99 × 0.02 = 0.0095 + 0.0198 = 0.0293 (2). (b) P(D | +) = 0.0095/0.0293 = $\frac{95}{293} \approx 0.32$ (2). (c) Most positive results come from the large healthy group, so a positive test alone is weak evidence; a second test is needed (1).

OR A point of the line is (λ, 1 + 2λ, 2 + 3λ) (1). PQ is (λ – 4, 2λ – 6, 3λ – 4); perpendicular to (1, 2, 3): 14λ – 28 = 0, λ = 2 (1½). Foot Q(2, 5, 8) (½). Image = 2Q – P = (0, 3, 10) (1). Distance PQ $= \sqrt{4 + 4 + 4} = 2\sqrt{3}$ units (1).

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