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Your JEE Guide

ISC Class XII · Mathematics

Sample Question Paper 4 · 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)** On the set {1, 2, 3}, the relation R = {(1, 1), (2, 2), (3, 3), (1, 3)} is: (a) reflexive and symmetric but not transitive (b) an equivalence relation (c) symmetric but not transitive (d) reflexive and transitive but not symmetric	1
	(ii) If f(x) = 2x + 3 and $g(x) = x^2$, then (g ∘ f)(1) equals: (a) 5 (b) 11 (c) 25 (d) 9	1
	(iii) The value of $\cos\left(\sin^{-1}\frac{3}{5} + \cos^{-1}\frac{3}{5}\right)$ is: (a) 0 (b) $\frac{3}{5}$ (c) 1 (d) $\frac{4}{5}$	1
	(iv) The domain of $\sin^{-1}(2x - 1)$ is: (a) [–1, 1] (b) [0, 1] (c) [0, 2] (d) [–1, 0]	1

	(v) If $A = \begin{bmatrix} 2 & 0 \\ 0 & 3 \end{bmatrix}$, then A^{-1} is: (a) $\begin{bmatrix} \frac{1}{3} & 0 \\ 0 & \frac{1}{2} \end{bmatrix}$ (b) $\begin{bmatrix} 3 & 0 \\ 0 & 2 \end{bmatrix}$ (c) $\begin{bmatrix} \frac{1}{2} & 0 \\ 0 & \frac{1}{3} \end{bmatrix}$ (d) $\begin{bmatrix} -2 & 0 \\ 0 & -3 \end{bmatrix}$	1
	(vi) If a square matrix A satisfies $A^2 = A$, then $(I - A)^2$ equals: (a) I – A (b) I (c) O (d) A	1
	(vii) Statement I: Every polynomial function is continuous on $\mathbb{R}$. **Statement II:** f(x) = |x| + |x – 1| is continuous on $\mathbb{R}$. (a) Statement I is true and Statement II is false. (b) Both the statements are true. (c) Both the statements are false. (d) Statement I is false and Statement II is true.	1
	(viii) If y = log(sec x + tan x), then $\frac{dy}{dx}$ equals: (a) $\sec^2 x$ (b) tan x (c) sec x tan x (d) sec x	1
	(ix) The function $f(x) = x^2 - 4x$ has: (a) a local maximum at x = 2 (b) a local minimum at x = 4 (c) a local minimum at x = 2 (d) a local minimum at x = –2	1
	(x) $\int e^x \left(\frac{1}{x} - \frac{1}{x^2} \right) dx$ equals: (a) $\frac{e^x}{x^2} + C$ (b) $e^x \log x + C$ (c) $-\frac{e^x}{x} + C$ (d) $\frac{e^x}{x} + C$	1
	(xi) $\int_0^1 \frac{dx}{\sqrt{1 - x^2}}$ equals: (a) $\frac{\pi}{2}$ (b) $\frac{\pi}{4}$ (c) π (d) 1	1
	(xii) The number of arbitrary constants in the particular solution of a differential equation of order 3 is: (a) 3 (b) 0 (c) 1 (d) 2	1
	(xiii) If $\vec{a}$ and $\vec{b}$ are unit vectors with $\lvert\vec{a} - \vec{b}\rvert = \sqrt{2}$, the angle between them is: (a) $\frac{\pi}{2}$ (b) $\frac{\pi}{3}$ (c) π (d) $\frac{\pi}{4}$	1

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	(xiv) The distance of the point (2, 3, 4) from the plane 3x – 6y + 2z + 11 = 0 is: (a) 2 units (b) $\frac{11}{7}$ units (c) 1 unit (d) 7 units	1
	(xv) A and B are independent with P(A) = 0.3 and P(B) = 0.6. Then P(A and not B) is: (a) 0.18 (b) 0.12 (c) 0.42 (d) 0.28	1
	(xvi) Assertion: The relation R = {(a, b): a ≤ b} on $\mathbb{R}$ is not symmetric. **Reason:** (1, 2) ∈ R but (2, 1) ∉ R. (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: $\int_0^{2\pi} \sin x\, dx = 0.$ **Reason:** The area enclosed by y = sin x and the x-axis from x = 0 to x = 2π is zero. (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 value of $\tan^{-1}\left(\tan\frac{3\pi}{4}\right)$.	1
	(xix) Show that $f(x) = x^3 + 3x$ is strictly increasing on $\mathbb{R}$.	1
	(xx) Find the angle between the line $\frac{x+1}{2} = \frac{y}{3} = \frac{z-3}{6}$ and the plane 10x + 2y – 11z = 3.	1

Section B (14 marks)

2.	Show that f: $\mathbb{R} \to \mathbb{R}$, $f(x) = \frac{x}{x^2+1}$ is neither one-one nor onto.	2
3.	Evaluate $\tan^{-1}\left[2\cos\left(2\sin^{-1}\frac{1}{2}\right)\right]$.	2
4.	Find the value of k for which $f(x) = \begin{cases} \frac{\sqrt{1+x}-1}{x}, & x \neq 0 \\ k, & x = 0 \end{cases}$ is continuous at x = 0. **OR** Find $\frac{dy}{dx}$ if $y = \sin^{-1}\left(\frac{1-x^2}{1+x^2}\right)$, 0 < x < 1.	2

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5.	The total cost of producing x units of an item is $C(x) = 0.005x^3 - 0.02x^2 + 30x + 5000$ rupees. Find the marginal cost when 3 units are produced.	2
6.	Find $\int \frac{\sin x}{(1+\cos x)^2}\,dx$. **OR** Find $\int \tan^{-1} x\,dx$.	2
7.	Show that the points with position vectors $-2\hat{i}+3\hat{j}+5\hat{k}$, $\hat{i}+2\hat{j}+3\hat{k}$ and $7\hat{i}-\hat{k}$ are collinear. **OR** Using vectors, find the area of the triangle with vertices A(2, 0, 1), B(3, 1, 3) and C(1, 2, 4).	2
8.	A family has two children. Find the probability that both are boys given that (a) at least one is a boy, (b) the elder child is a boy.	2

Section C (21 marks)

9.	For $A = \begin{bmatrix}1 & 2 & 2\\ 2 & 1 & 2\\ 2 & 2 & 1\end{bmatrix}$, show that $A^2 - 4A - 5I = O$. Hence find A^{-1}. **OR** If x, y and z are different and $\begin{vmatrix}x & x^2 & 1+x^3\\ y & y^2 & 1+y^3\\ z & z^2 & 1+z^3\end{vmatrix} = 0$, show that xyz = –1.	3
10.	If $y = (\tan^{-1} x)^2$, show that $(x^2+1)^2\frac{d^2y}{dx^2} + 2x(x^2+1)\frac{dy}{dx} = 2$.	3
11.	Sand pours from a pipe at 12 cm³/s and forms a conical pile whose height is always one-sixth of its radius. How fast is the height increasing when the height is 4 cm?	3
12.	Find $\int x^2 \tan^{-1} x\,dx$. **OR** Find $\int \frac{\cos 2x}{(\sin x + \cos x)^2}\,dx$.	3
13.	Evaluate $\int_{\pi/6}^{\pi/3} \frac{dx}{1+\sqrt{\tan x}}$.	3
14.	Find the particular solution of $(1+e^{2x})\,dy + (1+y^2)e^x\,dx = 0$, given that y = 1 when x = 0.	3

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15.	A random variable X has the distribution P(X = 0) = 0.1, P(X = 1) = k, P(X = 2) = 2k, P(X = 3) = 2k, P(X = 4) = k. Find k, the mean of X and P(X < 3). **OR** A box of 10 bulbs has 3 defective ones. Two bulbs are drawn at random without replacement. Find the probability distribution and the mean of the number X of defective bulbs drawn.	3

Section D (25 marks)

16.	A small firm makes chairs and tables. A chair needs 2 hours of carpentry and 1 hour of polishing; a table needs 3 hours of carpentry and 3 hours of polishing. Each day 24 hours of carpentry and 15 hours of polishing are available. The profit is ₹300 on a chair and ₹500 on a table. Formulate a linear programming problem to maximise the daily profit and solve it graphically.	5
17.	Find $\int (x+3)\sqrt{3-4x-x^2}\,dx$. **OR** Evaluate $\int_1^4 (\lvert x-1\rvert + \lvert x-2\rvert + \lvert x-3\rvert)\,dx$.	5
18.	At every point (x, y) of a curve the slope is x + y, and the curve passes through (0, 1). (a) Find the equation of the curve. *[3]* (b) Find the lowest point of the curve. *[2]*	5
19.	The line $\vec{r} = (\hat{i} + 2\hat{j} - \hat{k}) + \lambda(2\hat{i} - \hat{j} + 2\hat{k})$ meets the plane x + y + z = 8 at Q. (a) Find Q. *[2]* (b) Find the distance of Q from P(1, 3, 3). *[1]* (c) Find the angle between the line and the plane. *[2]* **OR** Find the vector and Cartesian equations of the line through (2, –1, 3) that is perpendicular to both the lines $\frac{x-3}{1} = \frac{y+2}{2} = \frac{z-1}{3}$ and $\frac{x-1}{2} = \frac{y+1}{-1} = \frac{z}{1}$.	5

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20.	In a college, 40% of students are in Science, 35% in Commerce and 25% in Arts. Of these, 60%, 40% and 20% respectively own a laptop. (a) Find the probability that a student chosen at random owns a laptop. *[2]* (b) A student chosen at random owns a laptop. Find the probability that the student is in Science. *[2]* (c) For the same student, find the probability that the student is in Arts. *[1]* **OR** A die is loaded so that the probability of the face i is proportional to i (i = 1, 2, …, 6). (a) Write the probability distribution of the number X shown. *[1]* (b) Find the mean of X and P(X is even). *[2]* (c) Find the variance of X. *[2]*	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)** reflexive and transitive but not symmetric. *Working:* All (a, a) are present; (1, 3) ∈ R but (3, 1) ∉ R; every chain such as (1, 1), (1, 3) gives a pair already in R.

(ii) **(c)** 25. *Working:* f(1) = 5 and g(5) = 25.

(iii) **(a)** 0. *Working:* $\sin^{-1} x + \cos^{-1} x = \frac{\pi}{2}$ and $\cos \frac{\pi}{2} = 0$.

(iv) **(b)** [0, 1]. *Working:* –1 ≤ 2x – 1 ≤ 1 gives 0 ≤ x ≤ 1.

(v) **(c)** $\begin{bmatrix} \frac{1}{2} & 0 \\ 0 & \frac{1}{3} \end{bmatrix}$. *Working:* The inverse of a diagonal matrix with non-zero entries takes the reciprocal of each diagonal entry.

(vi) **(a)** I – A. *Working:* $I - 2A + A^2 = I - 2A + A = I - A$.

(vii) **(b)** Both the statements are true. *Working:* Polynomials are continuous everywhere; |x| and |x – 1| are continuous, and so is their sum.

(viii) **(d)** sec x. *Working:* $\frac{\sec x \tan x + \sec^2 x}{\sec x + \tan x} = \sec x$.

(ix) **(c)** a local minimum at x = 2. *Working:* f′(x) = 2x – 4 = 0 at x = 2 and f′′ = 2 > 0.

(x) **(d)** $\frac{e^x}{x} + C$. *Working:* It has the form $\int e^x (f + f') dx$ with $f = \frac{1}{x}$.

(xi) **(a)** $\frac{\pi}{2}$. *Working:* $\left[\sin^{-1} x\right]_0^1 = \frac{\pi}{2}$.

(xii) **(b)** 0. *Working:* A particular solution has no arbitrary constants.

(xiii) **(a)** $\frac{\pi}{2}$. *Working:* $|\vec{a} - \vec{b}|^2 = 2 - 2\cos\theta = 2$, so cos θ = 0.

(xiv) **(c)** 1 unit. *Working:* $\frac{|6 - 18 + 8 + 11|}{\sqrt{9 + 36 + 4}} = \frac{7}{7}$.

(xv) **(b)** 0.12. *Working:* 0.3 × (1 – 0.6) = 0.12.

(xvi) **(a)** Both Assertion and Reason are true, and Reason is the correct explanation of Assertion. *Working:* The Reason gives a pair whose reverse is missing, which is exactly what makes R not symmetric.

(xvii) **(c)** Assertion is true and Reason is false. *Working:* $\left[-\cos x\right]_0^{2\pi} = 0$, so the Assertion is true. The area is $2\int_0^{\pi} \sin x \, dx = 4$ square units, so the Reason is false: the integral is zero because the parts above and below the axis cancel.

(xviii) $\tan \frac{3\pi}{4} = \tan\left(-\frac{\pi}{4}\right)$ (½), so the value is $-\frac{\pi}{4}$ (½).

(xix) $f'(x) = 3x^2 + 3$ (½), which is positive for every real x (½).

(xx) $\sin\phi = \frac{|20 + 6 - 66|}{7 \times 15} = \frac{8}{21}$ (½), so $\phi = \sin^{-1} \frac{8}{21}$ (½).

Section B (14 marks)

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2. $f(2) = f\left(\frac{1}{2}\right) = \frac{2}{5}$, so f is not one-one (1). $x^2 + 1 \geq 2|x|$ gives $|f(x)| \leq \frac{1}{2}$, so 1 has no pre-image and f is not onto (1).

3. $2\sin^{-1}\frac{1}{2} = \frac{\pi}{3}$ and $2\cos\frac{\pi}{3} = 1$ (1). $\tan^{-1} 1 = \frac{\pi}{4}$ (1).

4. $\frac{\sqrt{1+x}-1}{x} = \frac{(1+x)-1}{x(\sqrt{1+x}+1)} = \frac{1}{\sqrt{1+x}+1} \to \frac{1}{2}$ (1½). So $k = \frac{1}{2}$ (½).

OR With x = tan θ, $y = \sin^{-1}(\cos 2\theta) = \frac{\pi}{2} - 2\tan^{-1} x$ (1). $\frac{dy}{dx} = -\frac{2}{1+x^2}$ (1).

5. $C'(x) = 0.015x^2 - 0.04x + 30$ (1). C′(3) = 0.135 − 0.12 + 30 = ₹30.015 (1).

6. Put t = 1 + cos x, dt = −sin x dx (1): $-\int \frac{dt}{t^2} = \frac{1}{1+\cos x} + C$ (1).

OR By parts: $x\tan^{-1} x - \int \frac{x}{1+x^2}dx$ (1) $= x\tan^{-1} x - \frac{1}{2}\log(1+x^2) + C$ (1).

7. $\overrightarrow{AB} = 3\hat{i} - \hat{j} - 2\hat{k}$ and $\overrightarrow{BC} = 6\hat{i} - 2\hat{j} - 4\hat{k}$ (1). $\overrightarrow{BC} = 2\overrightarrow{AB}$ with B common, so A, B, C are collinear (1).

OR $\overrightarrow{AB} \times \overrightarrow{AC} = (1,1,2) \times (-1,2,3) = (-1,-5,3)$ (1). Area $= \frac{1}{2}\sqrt{1+25+9} = \frac{\sqrt{35}}{2}$ square units (1).

8. Sample space BB, BG, GB, GG. (a) $\frac{1}{3}$ (1). (b) $\frac{1}{2}$ (1).

Section C (21 marks)

9. $A^2 = \begin{bmatrix} 9 & 8 & 8 \\ 8 & 9 & 8 \\ 8 & 8 & 9 \end{bmatrix}$, and $A^2 - 4A = 5I$ (1½). Multiplying by A^{-1}: $A - 4I = 5A^{-1}$, so $A^{-1} = \frac{1}{5}\begin{bmatrix} -3 & 2 & 2 \\ 2 & -3 & 2 \\ 2 & 2 & -3 \end{bmatrix}$ (1½).

OR Splitting the third column: $\begin{vmatrix} x & x^2 & 1 \\ y & y^2 & 1 \\ z & z^2 & 1 \end{vmatrix} + xyz \begin{vmatrix} 1 & x & x^2 \\ 1 & y & y^2 \\ 1 & z & z^2 \end{vmatrix}$ (1). Both determinants equal $\Delta = (x-y)(y-z)(z-x) \neq 0$ after rearranging columns (1). So $(1+xyz)\Delta = 0$, giving xyz = −1 (1).

10. $(1+x^2)\frac{dy}{dx} = 2\tan^{-1} x$ (1). Differentiating: $(1+x^2)\frac{d^2y}{dx^2} + 2x\frac{dy}{dx} = \frac{2}{1+x^2}$ (1½). Multiplying by $1+x^2$ gives the result (½).

11. r = 6h, so $V = \frac{1}{3}\pi(6h)^2 h = 12\pi h^3$ (1). $\frac{dV}{dt} = 36\pi h^2 \frac{dh}{dt}$ (1). $12 = 36\pi(16)\frac{dh}{dt}$, so $\frac{dh}{dt} = \frac{1}{48\pi}$ cm/s (1).

12. By parts: $\frac{x^3}{3}\tan^{-1} x - \frac{1}{3}\int \frac{x^3}{1+x^2}dx$ (1). $\frac{x^3}{1+x^2} = x - \frac{x}{1+x^2}$ (1). Integral $= \frac{x^3}{3}\tan^{-1} x - \frac{x^2}{6} + \frac{1}{6}\log(1+x^2) + C$ (1).

OR $\cos 2x = (\cos x - \sin x)(\cos x + \sin x)$ (1), so the integrand is $\frac{\cos x - \sin x}{\cos x + \sin x}$ (1). Integral $= \log|\sin x + \cos x| + C$ (1).

13. Write it as $I = \int \frac{\sqrt{\cos x}}{\sqrt{\cos x}+\sqrt{\sin x}}dx$. Using $x \to \frac{\pi}{6} + \frac{\pi}{3} - x$ swaps sin and cos (1). Adding, $2I = \int_{\pi/6}^{\pi/3} dx = \frac{\pi}{6}$ (1), so $I = \frac{\pi}{12}$ (1).

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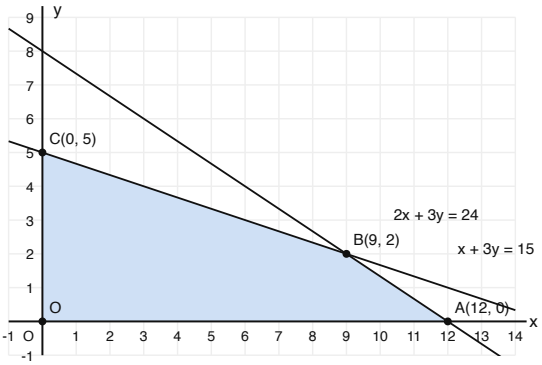
14. $\frac{dy}{1+y^2} = -\frac{e^x\,dx}{1+e^{2x}}$ (1). $\tan^{-1} y = -\tan^{-1} e^x + C$ (1). At (0, 1): $\frac{\pi}{4} = -\frac{\pi}{4} + C$, so $\tan^{-1} y + \tan^{-1} e^x = \frac{\pi}{2}$ (1).

15. 0.1 + 6k = 1, k = 0.15 (1). Mean = 0.15 + 0.6 + 0.9 + 0.6 = 2.25 (1). P(X < 3) = 0.1 + 0.15 + 0.3 = 0.55 (1).

OR P(X = 0) = $\frac{7}{10}\cdot\frac{6}{9} = \frac{7}{15}$, P(X = 1) = $2\cdot\frac{3}{10}\cdot\frac{7}{9} = \frac{7}{15}$, P(X = 2) = $\frac{3}{10}\cdot\frac{2}{9} = \frac{1}{15}$ (2). Mean $= \frac{7}{15} + \frac{2}{15} = \frac{3}{5}$ (1).

Section D (25 marks)

16. Let x chairs and y tables be made. Maximise Z = 300x + 500y subject to 2x + 3y ≤ 24, x + 3y ≤ 15, x, y ≥ 0 (1½). Feasible region OABC (1½):



Z(O) = 0, Z(A) = 3600, Z(B) = 3700, Z(C) = 2500 (1). Maximum profit ₹3700 with 9 chairs and 2 tables (1).

17. $x + 3 = -\frac{1}{2}(-4 - 2x) + 1$ (1). $-\frac{1}{2}\int(-4-2x)\sqrt{3-4x-x^2}\,dx = -\frac{1}{3}(3-4x-x^2)^{3/2}$ (1½). $\int\sqrt{7-(x+2)^2}\,dx = \frac{x+2}{2}\sqrt{3-4x-x^2} + \frac{7}{2}\sin^{-1}\frac{x+2}{\sqrt{7}}$ (2). Add the two parts and C (½).

OR On [1, 2] the integrand is 4 – x; on [2, 3] it is x; on [3, 4] it is 3x – 6 (2). Integrals: $\frac{5}{2} + \frac{5}{2} + \frac{9}{2}$ (2) $= \frac{19}{2}$ (1).

18. (a) $\frac{dy}{dx} - y = x$; IF $= e^{-x}$ (1). $ye^{-x} = \int xe^{-x}dx = -(x+1)e^{-x} + C$ (1). y(0) = 1 gives C = 2: $y = 2e^x - x - 1$ (1). (b) $y' = 2e^x - 1 = 0$ at x = –log 2, and $y'' = 2e^x > 0$ (1). Lowest point (–log 2, log 2) (1).

19. (a) (1 + 2λ) + (2 – λ) + (–1 + 2λ) = 8 gives λ = 2 (1), so Q = (5, 0, 3) (1). (b) PQ $= \sqrt{16+9+0} = 5$ units (1). (c) $\sin\phi = \frac{|2-1+2|}{3\sqrt{3}} = \frac{1}{\sqrt{3}}$ (1½), $\phi = \sin^{-1}\frac{1}{\sqrt{3}}$ (½).

OR Direction $= (1,2,3)\times(2,-1,1) = (5,5,-5)$, i.e. (1, 1, –1) (3). $\vec{r} = (2\hat{i} - \hat{j} + 3\hat{k}) + \lambda(\hat{i} + \hat{j} - \hat{k})$; $\frac{x-2}{1} = \frac{y+1}{1} = \frac{z-3}{-1}$ (2).

20. (a) P(L) = 0.4 × 0.6 + 0.35 × 0.4 + 0.25 × 0.2 = 0.24 + 0.14 + 0.05 = 0.43 (2). (b) P(S | L) $= \frac{0.24}{0.43} = \frac{24}{43}$ (2). (c) P(A | L) $= \frac{0.05}{0.43} = \frac{5}{43}$ (1).

OR (a) P(X = i) $= \frac{i}{21}$ (1). (b) Mean $= \frac{1+4+9+16+25+36}{21} = \frac{13}{3}$ (1); P(even) $= \frac{12}{21} = \frac{4}{7}$ (1). (c) $E(X^2) = \frac{\sum i^3}{21} = \frac{441}{21} = 21$ (1); variance $= 21 - \frac{169}{9} = \frac{20}{9}$ (1).

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