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Your JEE Guide

ISC Class XII · Mathematics

Sample Question Paper 6 · Session 2026-27

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

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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 = {(x, y): x + 2y = 8} is defined on $\mathbb{N}$. The range of R is: (a) {1, 2, 3} (b) {0, 2, 4, 6} (c) {1, 2, 3, 4} (d) {2, 4, 6}	1
	(ii) The number of one-one functions from {1, 2, 3} to {a, b, c} is: (a) 3 (b) 27 (c) 9 (d) 6	1
	(iii) The value of $\cot\left(\tan^{-1} x + \cot^{-1} x\right)$ is: (a) 1 (b) 0 (c) x (d) not defined	1
	(iv) For $-1 \le x \le 1$, $\cos^{-1}(-x)$ equals: (a) $\cos^{-1} x$ (b) $-\cos^{-1} x$ (c) $\pi - \cos^{-1} x$ (d) $\pi + \cos^{-1} x$	1

	(v) If $A = \begin{bmatrix} \cos\alpha & -\sin\alpha \\ \sin\alpha & \cos\alpha \end{bmatrix}$, $0 < \alpha < \frac{\pi}{2}$, and $A + A' = I$, then α is: (a) $\frac{\pi}{4}$ (b) $\frac{\pi}{6}$ (c) $\frac{\pi}{3}$ (d) $\frac{\pi}{12}$	1
	(vi) A is an invertible matrix of order 3 with |A| = 2. Then $\left\|A^{-1}\right\|$ is: (a) $\frac{1}{8}$ (b) $\frac{1}{2}$ (c) 8 (d) 2	1
	(vii) Statement I: sin|x| is continuous at every real number. **Statement II:** |sin x| is differentiable at x = 0. (a) Statement I is false and Statement II is true. (b) Both the statements are true. (c) Both the statements are false. (d) Statement I is true and Statement II is false.	1
	(viii) If y = log x, x > 0, then $x\frac{d^2y}{dx^2} + \frac{dy}{dx}$ equals: (a) 0 (b) $-\frac{1}{x}$ (c) 1 (d) $\frac{1}{x}$	1
	(ix) The rate of change of the area of a square with respect to its side, when the side is 4 cm, is: (a) 4 cm²/cm (b) 2 cm²/cm (c) 16 cm²/cm (d) 8 cm²/cm	1
	(x) For $0 < x < \frac{\pi}{4}$, $\int \sqrt{1 + \sin 2x}\, dx$ equals: (a) $\sin x - \cos x + C$ (b) $-\frac{1}{2}\cos 2x + C$ (c) $\sin x + \cos x + C$ (d) $\cos x - \sin x + C$	1
	(xi) $\int_{-\pi/2}^{\pi/2} \left(x^3 + x\cos x + \tan^5 x + 1\right) dx$ equals: (a) 2 (b) $\frac{\pi}{2}$ (c) π (d) 0	1
	(xii) The differential equation of the family y = A cos x + B sin x is: (a) $\frac{dy}{dx} + y = 0$ (b) $\frac{d^2y}{dx^2} + y = 0$ (c) $\frac{d^2y}{dx^2} - y = 0$ (d) $\frac{d^2y}{dx^2} = 0$	1
	(xiii) If $\vec{a} \times \vec{b} = \vec{0}$ and $\vec{a} \cdot \vec{b} = 0$, then: (a) $\vec{a} = \vec{0}$ or $\vec{b} = \vec{0}$ (b) $\vec{a} \parallel \vec{b}$ (c) $\vec{a} \perp \vec{b}$ (d) $\lvert\vec{a}\rvert = \lvert\vec{b}\rvert$	1

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	(xiv) The distance of the plane 2x – 3y + 6z = 7 from the origin is: (a) 7 units (b) 1 unit (c) $\frac{1}{7}$ unit (d) $\frac{7}{11}$ unit	1
	(xv) A bag has 5 red and 3 blue balls. Two balls are drawn at random without replacement. The probability that both are blue is: (a) $\frac{3}{8}$ (b) $\frac{9}{64}$ (c) $\frac{3}{28}$ (d) $\frac{15}{28}$	1
	(xvi) Assertion: $f(x) = x^2 - 2x + 3$ has a local minimum at x = 1. **Reason:** f′(1) = 0 and f′′(1) > 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: Two mutually exclusive events A and B with non-zero probabilities are independent. **Reason:** For mutually exclusive events, P(A ∩ B) = 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
	(xviii) A square matrix A of order 3 has determinant 3. Find |adj(adj A)|.	1
	(xix) Find the derivative of $e^{\sin^{-1} x}$.	1
	(xx) If P(E) = 0.6, P(F) = 0.3 and P(E ∩ F) = 0.2, find P(E | F).	1

Section B (14 marks)

2.	On A = {1, 2, 3, 4, 5, 6}, R = {(a, b): b = a + 1}. Is R reflexive, symmetric or transitive? **OR** If f(x) = |x| and g(x) = |5x – 2|, find f ∘ g and g ∘ f.	2
3.	Write $\tan^{-1} \frac{\sqrt{1+x^2}-1}{x}$, x ≠ 0, in its simplest form.	2
4.	If $e^y(x+1) = 1$, show that $\frac{d^2y}{dx^2} = \left(\frac{dy}{dx}\right)^2$. **OR** Find $\frac{dy}{dx}$ if $y = \sec^{-1}\left(\frac{1}{2x^2-1}\right), 0 < x < \frac{1}{\sqrt{2}}$.	2

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5.	The length x of a rectangle is decreasing at 5 cm/min and the width y is increasing at 4 cm/min. Find the rates of change of the perimeter and the area when x = 8 cm and y = 6 cm.	2
6.	Find $\int \frac{dx}{\sin^2 x \cos^2 x}$. **OR** Find $\int x\sqrt{x+2}\,dx$.	2
7.	If $\vec{a} = \hat{i} - \hat{j} + 7\hat{k}$ and $\vec{b} = 5\hat{i} - \hat{j} + \lambda\hat{k}$, find λ so that $\vec{a} + \vec{b}$ and $\vec{a} - \vec{b}$ are perpendicular.	2
8.	P(A) = 0.4, P(B) = p and P(A ∪ B) = 0.6. Find p if (a) A and B are mutually exclusive, (b) A and B are independent.	2

Section C (21 marks)

9.	For $A = \begin{bmatrix} 3 & -2 \\ 4 & -2 \end{bmatrix}$, find k such that $A^2 = kA - 2I$. **OR** Using determinants, find the values of k for which the area of the triangle with vertices (k, 0), (4, 0) and (0, 2) is 4 square units.	3
10.	Find k so that $f(x) = \begin{cases} \frac{x^3+x^2-16x+20}{(x-2)^2}, & x \neq 2 \\ k, & x = 2 \end{cases}$ is continuous at x = 2.	3
11.	If $y = Ae^{mx} + Be^{nx}$, show that $\frac{d^2y}{dx^2} - (m+n)\frac{dy}{dx} + mny = 0$.	3
12.	Find the intervals in which $f(x) = (x+1)^3(x-3)^3$ is strictly increasing or strictly decreasing. **OR** Find the equation of the normal to the curve $x^2 = 4y$ that passes through the point (1, 2).	3
13.	Find $\int \frac{xe^x}{(1+x)^2}\,dx$.	3
14.	Evaluate $\int_0^{\pi/4} \frac{\sin x + \cos x}{9 + 16\sin 2x}\,dx$. **OR** Evaluate $\int_0^2 x\sqrt{2-x}\,dx$.	3
15.	Solve the differential equation $(x-y)\,dy - (x+y)\,dx = 0$.	3

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Section D (25 marks)

16.	Use the matrix method to solve: 3x + y + 2z = 4, x + 2y − z = 8, 2x − y + z = −2.	5
17.	A rectangular page has an area of 600 cm². It has margins of 3 cm at the top and bottom and 2 cm on each side. Find the dimensions of the page that give the largest printed area, and that area. **OR** Find $\int \sqrt{\tan x}\, dx$.	5
18.	Using integration, find the area of the region {(x, y): 0 ≤ y ≤ x² + 1, 0 ≤ y ≤ x + 1, 0 ≤ x ≤ 2}. **OR** Using integration, find the area of the region enclosed by the parabola $x^2 = 4y$ and the line x = 4y − 2.	5
19.	(a) Solve the differential equation $\frac{dy}{dx} - 2y = e^{3x}$, given that y = 2 when x = 0. *[4]* (b) Find the slope of the solution curve at x = 0. *[1]*	5
20.	(a) Find the equation of the plane through (2, 1, −1) perpendicular to each of the planes x − y + z = 1 and 2x + y − z = 3. *[3]* (b) Find the distance of the point (1, 2, 3) from this plane. *[1]* (c) Show that the line $\vec{r} = (\hat{i} + 2\hat{j}) + \lambda(\hat{j} - \hat{k})$ is parallel to the plane but does not lie in it. *[1]* **OR** In a school, 60% of students come by school bus, 30% walk and 10% are dropped by their parents. The probabilities of arriving late are 0.05, 0.1 and 0.2 respectively. (a) Find the probability that a student chosen at random is late. *[2]* (b) A student is late. Find the probability that the student came by bus. *[2]* (c) Given that a student is late, which way of coming to school is least likely? *[1]*	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) **(a)** {1, 2, 3}. *Working:* x = 8 − 2y must be a natural number, so y = 1, 2, 3 (giving x = 6, 4, 2).

(ii) **(d)** 6. *Working:* 3 × 2 × 1 = 6.

(iii) **(b)** 0. *Working:* The angle is $\frac{\pi}{2}$ and $\cot\frac{\pi}{2} = 0$.

(iv) **(c)** $\pi - \cos^{-1} x$. *Working:* If $\cos^{-1} x = \theta$ in [0, π], then $\cos(\pi - \theta) = -x$ with π − θ in [0, π].

(v) **(c)** $\frac{\pi}{3}$. *Working:* $A + A'$ has diagonal entries 2 cos α, so 2 cos α = 1.

(vi) **(b)** $\frac{1}{2}$. *Working:* $|A^{-1}| = \frac{1}{|A|}$.

(vii) **(d)** Statement I is true and Statement II is false. *Working:* sin|x| is a composition of continuous functions. Near 0, |sin x| behaves like |x|, with one-sided derivatives −1 and 1.

(viii) **(a)** 0. *Working:* $y' = \frac{1}{x}$ and $y'' = -\frac{1}{x^2}$, so $-\frac{1}{x} + \frac{1}{x} = 0$.

(ix) **(d)** 8 cm²/cm. *Working:* $\frac{d}{dx}x^2 = 2x = 8$.

(x) **(a)** $\sin x - \cos x + C$. *Working:* $1 + \sin 2x = (\sin x + \cos x)^2$, and sin x + cos x > 0 here.

(xi) **(c)** π. *Working:* The first three terms are odd functions and integrate to 0; $\int_{-\pi/2}^{\pi/2} 1\,dx = \pi$.

(xii) **(b)** $\frac{d^2y}{dx^2} + y = 0$. *Working:* $y'' = -A\cos x - B\sin x = -y$.

(xiii) **(a)** $\vec{a} = \vec{0}$ or $\vec{b} = \vec{0}$. *Working:* $|\vec{a}|^2|\vec{b}|^2 = |\vec{a} \times \vec{b}|^2 + (\vec{a} \cdot \vec{b})^2 = 0$.

(xiv) **(b)** 1 unit. *Working:* $\frac{7}{\sqrt{4+9+36}} = 1$.

(xv) **(c)** $\frac{3}{28}$. *Working:* $\frac{3}{8} \times \frac{2}{7} = \frac{3}{28}$.

(xvi) **(a)** Both Assertion and Reason are true, and Reason is the correct explanation of Assertion. *Working:* The second-derivative test, stated in the Reason, gives the Assertion.

(xvii) **(d)** Assertion is false and Reason is true. *Working:* P(A ∩ B) = 0 while P(A) P(B) > 0, so they cannot be independent: the Assertion is false and the Reason is true.

(xviii) $|\operatorname{adj} A| = |A|^2 = 9$ (½); $|\operatorname{adj}(\operatorname{adj} A)| = 9^2 = 81$ (½).

(xix) Chain rule (½): $\frac{e^{\sin^{-1} x}}{\sqrt{1-x^2}}$ (½).

(xx) P(E | F) = P(E ∩ F)/P(F) (½) = 0.2/0.3 = 2/3 (½).

Section B (14 marks)

2. (1, 1) ∉ R: not reflexive (½). (1, 2) ∈ R but (2, 1) ∉ R: not symmetric (½). (1, 2), (2, 3) ∈ R but (1, 3) ∉ R: not transitive (1).

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OR (f ∘ g)(x) = ||5x – 2|| = |5x – 2| (1). (g ∘ f)(x) = |5|x| – 2| (1).

3. Put x = tan θ: $\frac{\sec\theta - 1}{\tan\theta} = \frac{1-\cos\theta}{\sin\theta} = \tan\frac{\theta}{2}$ (1). So the expression is $\frac{\theta}{2} = \frac{1}{2}\tan^{-1}x$ (1).

4. y = –log(x + 1), so $\frac{dy}{dx} = -\frac{1}{x+1}$ (1) and $\frac{d^2y}{dx^2} = \frac{1}{(x+1)^2} = \left(\frac{dy}{dx}\right)^2$ (1).

OR $y = \cos^{-1}(2x^2 - 1)$; with x = cos θ this is $2\theta = 2\cos^{-1}x$ (1). $\frac{dy}{dx} = -\frac{2}{\sqrt{1-x^2}}$ (1).

5. P = 2(x + y): $\frac{dP}{dt} = 2(-5 + 4) = -2$ cm/min (1). A = xy: $\frac{dA}{dt} = 8(4) + 6(-5) = 2$ cm²/min (1).

6. $\frac{1}{\sin^2 x\cos^2 x} = \frac{\sin^2 x + \cos^2 x}{\sin^2 x\cos^2 x} = \sec^2 x + \csc^2 x$ (1). Integral $= \tan x - \cot x + C$ (1).

OR Put t = x + 2: $\int (t-2)\sqrt{t}\,dt$ (1) $= \frac{2}{5}(x+2)^{5/2} - \frac{4}{3}(x+2)^{3/2} + C$ (1).

7. $(\vec{a} + \vec{b})\cdot(\vec{a} - \vec{b}) = |\vec{a}|^2 - |\vec{b}|^2 = 0$ (1). 51 = 26 + λ², so λ = ±5 (1).

8. (a) 0.6 = 0.4 + p, so p = 0.2 (1). (b) 0.6 = 0.4 + p – 0.4p, so 0.6p = 0.2 and $p = \frac{1}{3}$ (1).

Section C (21 marks)

9. $A^2 = \begin{bmatrix} 1 & -2 \\ 4 & -4 \end{bmatrix}$ (1). $kA - 2I = \begin{bmatrix} 3k-2 & -2k \\ 4k & -2k-2 \end{bmatrix}$ (1). Comparing entries, k = 1 (1).

OR $\frac{1}{2}\begin{Vmatrix} k & 0 & 1 \\ 4 & 0 & 1 \\ 0 & 2 & 1 \end{Vmatrix} = 4$ (1). $\frac{1}{2}|-2k + 8| = 4$ (1), so k = 0 or k = 8 (1).

10. $x^3 + x^2 - 16x + 20 = (x-2)^2(x+5)$ (1½). For x ≠ 2, f(x) = x + 5 → 7 (1). So k = 7 (½).

11. $y' = mAe^{mx} + nBe^{nx}$, $y'' = m^2Ae^{mx} + n^2Be^{nx}$ (1). Substituting, the coefficient of Ae^{mx} is $m^2 - (m+n)m + mn = 0$ (1) and that of Be^{nx} is $n^2 - (m+n)n + mn = 0$ (1).

12. $f'(x) = 3(x+1)^2(x-3)^3 + 3(x+1)^3(x-3)^2 = 6(x+1)^2(x-3)^2(x-1)$ (1½). f′ < 0 for x < 1 (apart from x = –1): strictly decreasing on (–∞, 1) (½). f′ > 0 for x > 1 (apart from x = 3): strictly increasing on (1, ∞) (1).

OR At $(2t, t^2)$ the tangent has slope t, so the normal is $y - t^2 = -\frac{1}{t}(x - 2t)$ (1). Through (1, 2): $t^3 = 1$, t = 1, the point (2, 1) (1). Normal: x + y = 3 (1).

13. $\frac{x}{(1+x)^2} = \frac{1}{1+x} - \frac{1}{(1+x)^2}$ (1), of the form f + f′ with $f = \frac{1}{1+x}$ (1). Integral $= \frac{e^x}{1+x} + C$ (1).

14. Put t = sin x – cos x: dt = (cos x + sin x) dx, sin 2x = 1 – t², t from –1 to 0 (1). $\int_{-1}^{0}\frac{dt}{25-16t^2} = \frac{1}{40}\left[\log\frac{5+4t}{5-4t}\right]_{-1}^{0}$ (1) $= \frac{1}{40}\log 9 = \frac{1}{20}\log 3$ (1).

OR Using $x \to 2 - x$: $\int_0^2 (2-x)\sqrt{x}\,dx$ (1) $= \left[\frac{4}{3}x^{3/2} - \frac{2}{5}x^{5/2}\right]_0^2$ (1) $= \frac{8\sqrt{2}}{3} - \frac{8\sqrt{2}}{5} = \frac{16\sqrt{2}}{15}$ (1).

15. $\frac{dy}{dx} = \frac{x+y}{x-y}$; put y = vx (1). $x\frac{dv}{dx} = \frac{1+v^2}{1-v}$, so $\frac{(1-v)\,dv}{1+v^2} = \frac{dx}{x}$ (1). $\tan^{-1}v - \frac{1}{2}\log(1+v^2) = \log|x| + C$, i.e. $\tan^{-1}\frac{y}{x} = \frac{1}{2}\log(x^2+y^2) + C$ (1).

Section D (25 marks)

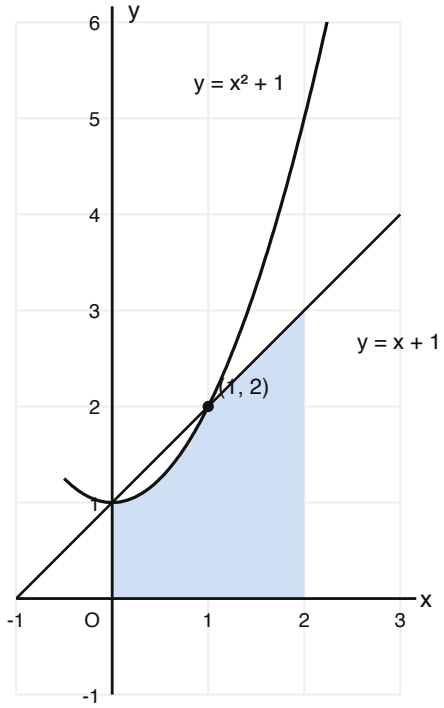
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16. $A = \begin{bmatrix} 3 & 1 & 2 \\ 1 & 2 & -1 \\ 2 & -1 & 1 \end{bmatrix}$, |A| = 3(1) − 1(3) + 2(−5) = −10 (1). $\operatorname{adj} A = \begin{bmatrix} 1 & -3 & -5 \\ -3 & -1 & 5 \\ -5 & 5 & 5 \end{bmatrix}$ (2).
$X = -\frac{1}{10}\begin{bmatrix} 1 & -3 & -5 \\ -3 & -1 & 5 \\ -5 & 5 & 5 \end{bmatrix}\begin{bmatrix} 4 \\ 8 \\ -2 \end{bmatrix} = -\frac{1}{10}\begin{bmatrix} -10 \\ -30 \\ 10 \end{bmatrix}$ (1), so x = 1, y = 3, z = −1 (1).

17. Width x, height $\frac{600}{x}$. Printed area $A = (x-4)\left(\frac{600}{x} - 6\right) = 624 - 6x - \frac{2400}{x}$ (2). $A' = -6 + \frac{2400}{x^2} = 0$ gives x = 20 (1). $A'' = -\frac{4800}{x^3} < 0$: a maximum (1). The page is 20 cm × 30 cm and the printed area is 16 × 24 = 384 cm² (1).

OR Put $\tan x = t^2$: $\int \frac{2t^2}{1+t^4}dt = \int \frac{1+\frac{1}{t^2}}{t^2+\frac{1}{t^2}}dt + \int \frac{1-\frac{1}{t^2}}{t^2+\frac{1}{t^2}}dt$ (2). With $u = t - \frac{1}{t}$ and $w = t + \frac{1}{t}$: $\frac{1}{\sqrt{2}}\tan^{-1}\frac{t^2-1}{\sqrt{2}\,t} + \frac{1}{2\sqrt{2}}\log\left|\frac{t^2-\sqrt{2}\,t+1}{t^2+\sqrt{2}\,t+1}\right|$ (2), with $t = \sqrt{\tan x}$, plus C (1).

18. The curves meet at x = 0 and x = 1; on [0, 1], $x^2 + 1 \le x + 1$, and on [1, 2] the line is lower (1). Sketch (1):



Area $= \int_0^1 (x^2+1)dx + \int_1^2 (x+1)dx$ (1) $= \frac{4}{3} + \frac{5}{2} = \frac{23}{6}$ square units (2).

OR $x^2 = x + 2$ gives x = −1 and x = 2 (1). Area $= \int_{-1}^{2}\left(\frac{x+2}{4} - \frac{x^2}{4}\right)dx$ (2) $= \frac{1}{4}\left[\frac{x^2}{2} + 2x - \frac{x^3}{3}\right]_{-1}^{2} = \frac{1}{4}\cdot\frac{27}{6} = \frac{9}{8}$ square units (2).

19. (a) IF $= e^{-2x}$ (1). $ye^{-2x} = \int e^x dx = e^x + C$ (1½). y(0) = 2 gives C = 1, so $y = e^{3x} + e^{2x}$ (1½). (b) $\frac{dy}{dx} = 2y + e^{3x} = 4 + 1 = 5$ at x = 0 (1).

20. (a) Normal $= (1,-1,1) \times (2,1,-1) = (0,3,3)$, i.e. (0, 1, 1) (2). Plane: (y − 1) + (z + 1) = 0, i.e. y + z = 0 (1). (b) $\frac{|2+3|}{\sqrt{2}} = \frac{5}{\sqrt{2}}$ units (1). (c) (0, 1, −1)·(0, 1, 1) = 0, so the line is parallel; its point (1, 2, 0) gives y + z = 2 ≠ 0, so it is not in the plane (1).

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OR (a) P(L) = 0.6 × 0.05 + 0.3 × 0.1 + 0.1 × 0.2 = 0.03 + 0.03 + 0.02 = 0.08 (2). (b) P(bus | L) $= \frac{0.03}{0.08} = \frac{3}{8}$ (2). (c) P(walk | L) = 3/8 and P(parents | L) = 2/8, so being dropped by parents is least likely (1).

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