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Your JEE Guide

CBSE Class XII · Mathematics (041)

Sample Question Paper 1 · Session 2026-27

Time allowed: 3 hours **Maximum marks: 80**

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General instructions:

1. This question paper contains 38 questions. All questions are compulsory.
2. This question paper is divided into five Sections: A, B, C, D and E.
3. In Section A, Questions 1 to 18 are multiple choice questions (MCQs) and Questions 19 and 20 are Assertion–Reason based questions of 1 mark each.
4. In Section B, Questions 21 to 25 are very short answer (VSA) type questions carrying 2 marks each.
5. In Section C, Questions 26 to 31 are short answer (SA) type questions carrying 3 marks each.
6. In Section D, Questions 32 to 35 are long answer (LA) type questions carrying 5 marks each.
7. In Section E, Questions 36 to 38 are case study based questions carrying 4 marks each.
8. There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 3 questions in Section C, 2 questions in Section D and one sub-part each in 2 questions of Section E.
9. Draw neat and clean figures wherever required. Take π = 22/7 wherever required, if not stated.
10. Use of calculators is not allowed.

Section A

1.	The relation R = {(1, 1), (2, 2), (3, 3), (1, 2), (2, 3)} on the set {1, 2, 3} is: (A) reflexive but neither symmetric nor transitive (B) an equivalence relation (C) transitive but not reflexive (D) symmetric and transitive	1
2.	The function f: R → R defined by f(x) = 3x + 2 is: (A) onto but not one-one (B) one-one and onto (C) one-one but not onto (D) neither one-one nor onto	1
3.	The principal value of $\sin^{-1}\left(-\frac{1}{2}\right)$ is: (A) $\frac{7\pi}{6}$ (B) $-\frac{\pi}{3}$ (C) $\frac{5\pi}{6}$ (D) $-\frac{\pi}{6}$	1
4.	The value of $\tan^{-1}\sqrt{3} - \sec^{-1}(-2)$ is: (A) π (B) $\frac{2\pi}{3}$ (C) $-\frac{\pi}{3}$ (D) $\frac{\pi}{3}$	1

5.	If A is a square matrix of order 3 with |A| = 4, then |2A| is: (A) 64 (B) 32 (C) 16 (D) 8	1
6.	If $A = \begin{bmatrix} 2 & 3 \\ 1 & 2 \end{bmatrix}$, then A^{-1} is: (A) $\begin{bmatrix} 2 & 3 \\ 1 & 2 \end{bmatrix}$ (B) $\begin{bmatrix} -2 & 3 \\ 1 & -2 \end{bmatrix}$ (C) $\begin{bmatrix} 2 & -1 \\ -3 & 2 \end{bmatrix}$ (D) $\begin{bmatrix} 2 & -3 \\ -1 & 2 \end{bmatrix}$	1
7.	If A is a square matrix with $A^2 = A$, then $(I + A)^2 - 3A$ equals: (A) I (B) 3A (C) A (D) O	1
8.	The value of k for which $f(x) = \begin{cases} kx^2, & x \le 2 \\ 3, & x > 2 \end{cases}$ is continuous at x = 2 is: (A) 3 (B) 12 (C) $\frac{3}{4}$ (D) $\frac{4}{3}$	1
9.	$\frac{d}{dx}\sin(x^2)$ is: (A) $\cos(x^2)$ (B) $2x\sin(x^2)$ (C) $2x\cos(x^2)$ (D) $\cos(2x)$	1
10.	The function $f(x) = x^3 - 3x^2 + 3x - 100$ is: (A) increasing only for x > 1 (B) increasing on R (C) neither increasing nor decreasing on R (D) decreasing on R	1
11.	$\int e^x(\sin x + \cos x)\,dx$ equals: (A) $e^x(\sin x - \cos x) + C$ (B) $-e^x\cos x + C$ (C) $e^x\cos x + C$ (D) $e^x\sin x + C$	1
12.	$\int_0^{\pi/2} \frac{\sin x}{\sin x + \cos x}\,dx$ equals: (A) $\frac{\pi}{4}$ (B) $\frac{\pi}{2}$ (C) 0 (D) 1	1
13.	The order and degree of $\left(\frac{d^2y}{dx^2}\right)^3 + \left(\frac{dy}{dx}\right)^2 + \sin\left(\frac{dy}{dx}\right) + 1 = 0$ are: (A) 3 and 2 (B) 2 and 3 (C) 1 and 2 (D) 2 and not defined	1

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14.	The integrating factor of $\frac{dy}{dx} + \frac{y}{x} = x^2$ is: (A) e^x (B) $\frac{1}{x}$ (C) x (D) $\log x$	1
15.	The projection of $\vec{a} = 2\hat{i} + 3\hat{j} + 2\hat{k}$ on $\vec{b} = \hat{i} + 2\hat{j} + \hat{k}$ is: (A) $\frac{\sqrt{6}}{10}$ (B) $\frac{10}{\sqrt{6}}$ (C) 10 (D) $\frac{5}{\sqrt{6}}$	1
16.	The direction cosines of the y-axis are: (A) 0, 1, 0 (B) 0, 0, 1 (C) 1, 0, 0 (D) 1, 1, 0	1
17.	If P(A) = 0.8, P(B) = 0.5 and P(B|A) = 0.4, then P(A ∩ B) is: (A) 0.4 (B) 0.2 (C) 0.25 (D) 0.32	1
18.	The corner points of the feasible region of an LPP are (0, 0), (5, 0), (3, 4) and (0, 5). The maximum value of Z = 3x + 2y is: (A) 17 (B) 16 (C) 15 (D) 10	1
19.	**Assertion (A):** f(x) = |x| is continuous at x = 0. **Reason (R):** f(x) = |x| is differentiable at x = 0. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A. (B) Both A and R are true but R is not the correct explanation of A. (C) A is true but R is false. (D) A is false but R is true.	1
20.	**Assertion (A):** If A and B are independent with P(A) = 0.3 and P(B) = 0.4, then P(A ∪ B) = 0.58. **Reason (R):** For independent events, P(A ∩ B) = P(A)P(B). (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A. (B) Both A and R are true but R is not the correct explanation of A. (C) A is true but R is false. (D) A is false but R is true.	1

Section B

21.	Find the value of $\sin^{-1}\left(\sin\frac{3\pi}{5}\right)$. **OR** Show that $\tan^{-1}\frac{1}{2} + \tan^{-1}\frac{2}{11} = \tan^{-1}\frac{3}{4}$.	2
22.	Find $\frac{dy}{dx}$ if $x^2 + xy + y^2 = 100$.	2

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23.	Find the intervals in which $f(x) = 2x^3 - 9x^2 + 12x + 15$ is increasing or decreasing. **OR** Find the local maximum and local minimum values of $f(x) = x^3 - 6x^2 + 9x + 15$.	2
24.	Find a unit vector perpendicular to both $\vec{a} = \hat{i} + \hat{j} + \hat{k}$ and $\vec{b} = \hat{i} + 2\hat{j} + 3\hat{k}$.	2
25.	A die is thrown. E is the event "the number is a multiple of 3" and F is the event "the number is even". Are E and F independent?	2

Section C

26.	Find $\int \frac{x}{(x+1)(x+2)}\,dx$. **OR** Find $\int x^2 \log x\,dx$.	3
27.	Evaluate $\int_0^{\pi} \frac{x \sin x}{1 + \cos^2 x}\,dx$.	3
28.	Solve the differential equation $\frac{dy}{dx} + 2y = \sin x$. **OR** Find the particular solution of $\frac{dy}{dx} = \frac{1+y^2}{1+x^2}$, given y = 1 when x = 0.	3
29.	Find the shortest distance between the lines $\vec{r} = (\hat{i} + 2\hat{j} + \hat{k}) + \lambda(\hat{i} - \hat{j} + \hat{k})$ and $\vec{r} = (2\hat{i} - \hat{j} - \hat{k}) + \mu(2\hat{i} + \hat{j} + 2\hat{k})$. **OR** Find the angle between the lines $\vec{r} = 3\hat{i} + 2\hat{j} - 4\hat{k} + \lambda(\hat{i} + 2\hat{j} + 2\hat{k})$ and $\vec{r} = 5\hat{i} - 2\hat{j} + \mu(3\hat{i} + 2\hat{j} + 6\hat{k})$.	3
30.	Solve graphically: maximise Z = 3x + 2y subject to x + 2y ≤ 10, 3x + y ≤ 15, x ≥ 0, y ≥ 0.	3
31.	Bag I contains 4 red and 4 black balls; bag II contains 2 red and 6 black balls. A bag is chosen at random and a ball drawn from it is red. Find the probability that it was drawn from bag I.	3

Section D

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32.	Show that the relation R on A = {1, 2, 3, 4, 5}, R = {(a, b): |a – b| is even}, is an equivalence relation. Show that all elements of {1, 3, 5} are related to each other, all elements of {2, 4} are related to each other, and no element of {1, 3, 5} is related to any element of {2, 4}. **OR** Let $f : R - \{-\frac{4}{3}\} \to R$ be given by $f(x) = \frac{4x}{3x+4}$. Show that f is one-one. Is f onto? Justify your answer.	5
33.	Solve the system using matrices: 2x – 3y + 5z = 11, 3x + 2y – 4z = –5, x + y – 2z = –3.	5
34.	Using integration, find the area of the region bounded by the parabola $y = x^2$ and the line y = x + 2. **OR** Using integration, find the area enclosed by the ellipse $\frac{x^2}{16} + \frac{y^2}{9} = 1$.	5
35.	Find $\int \frac{x^2+1}{(x-1)^2(x+3)}\,dx$.	5

Section E

36.	**Case study 1.** A farmer has 400 m of fencing to enclose a rectangular field along a straight river. No fencing is needed along the river. Let x m be the length of each of the two sides perpendicular to the river. (i) Express the area A of the field in terms of x. *[1]* (ii) Find $\frac{dA}{dx}$. *[1]* (iii) Find the dimensions that give the largest area, and the largest area. *[2]* **OR** (iii) If only 300 m of fencing were available, what would the largest area be? *[2]*	4
37.	**Case study 2.** In a school, 60% of the senior students take Science and 40% take Commerce. 30% of the Science students and 20% of the Commerce students belong to the coding club. A senior student is chosen at random. (i) Find the probability that the student is in the coding club. *[1]* (ii) Find the probability that the student takes Science and is in the coding club. *[1]* (iii) Given that the student is in the coding club, find the probability that the student takes Science. *[2]* **OR** (iii) Given that the student is in the coding club, find the probability that the student takes Commerce. *[2]*	4

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38.	**Case study 3.** A drone flies in a straight line from point A(1, 2, 3) towards point B(4, 6, 3), coordinates in metres. (i) Find the vector $\overrightarrow{AB}$ and the distance AB. *[2]* (ii) Write the equation of the line AB in vector and cartesian forms. *[2]*	4

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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

1. **(A)** reflexive but neither symmetric nor transitive. *Working:* (1, 2) ∈ R but (2, 1) ∉ R, so not symmetric; (1, 2), (2, 3) ∈ R but (1, 3) ∉ R, so not transitive.

2. **(B)** one-one and onto. *Working:* $f(x_1) = f(x_2) \Rightarrow x_1 = x_2$, and every real y has the pre-image $(y - 2)/3$.

3. **(D)** $-\frac{\pi}{6}$. *Working:* The principal value lies in $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$ and $\sin\left(-\frac{\pi}{6}\right) = -\frac{1}{2}$.

4. **(C)** $-\frac{\pi}{3}$. *Working:* $\frac{\pi}{3} - \frac{2\pi}{3} = -\frac{\pi}{3}$.

5. **(B)** 32. *Working:* $|kA| = k^3|A| = 8 \times 4 = 32$.

6. **(D)** $\begin{bmatrix} 2 & -3 \\ -1 & 2 \end{bmatrix}$. *Working:* $|A| = 4 - 3 = 1$, so $A^{-1} = \operatorname{adj} A$.

7. **(A)** I. *Working:* $I + 2A + A^2 - 3A = I + 3A - 3A = I$.

8. **(C)** $\frac{3}{4}$. *Working:* $4k = 3$.

9. **(C)** $2x\cos\left(x^2\right)$. *Working:* Chain rule.

10. **(B)** increasing on R. *Working:* $f'(x) = 3(x-1)^2 \geq 0$, zero only at $x = 1$.

11. **(D)** $e^x \sin x + C$. *Working:* $\int e^x (f + f')\,dx = e^x f + C$ with $f = \sin x$.

12. **(A)** $\frac{\pi}{4}$. *Working:* With $x \to \frac{\pi}{2} - x$, the integral equals the same with cos in the numerator; adding gives $2I = \frac{\pi}{2}$.

13. **(D)** 2 and not defined. *Working:* The highest derivative is the second; the equation is not a polynomial in the derivatives, so the degree is not defined.

14. **(C)** x. *Working:* $e^{\int \frac{1}{x} dx} = x$.

15. **(B)** $\frac{10}{\sqrt{6}}$. *Working:* $\frac{\vec{a}\cdot\vec{b}}{|\vec{b}|} = \frac{2+6+2}{\sqrt{6}}$.

16. **(A)** 0, 1, 0. *Working:* It makes angles 90°, 0°, 90° with the axes.

17. **(D)** 0.32. *Working:* $P(A \cap B) = P(A)P(B|A) = 0.8 \times 0.4$.

18. **(A)** 17. *Working:* Z = 0, 15, 17, 10 at the corners.

19. **(C)** A is true but R is false. *Working:* A is true. R is false: the left and right derivatives at 0 are −1 and 1.

20. **(A)** Both Assertion (A) and Reason (R) are true and R is the correct explanation of A. *Working:* $P(A \cup B) = 0.3 + 0.4 - 0.12 = 0.58$, using R.

Section B

21. $\frac{3\pi}{5}$ is not in $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$ (½). $\sin\frac{3\pi}{5} = \sin\left(\pi - \frac{3\pi}{5}\right) = \sin\frac{2\pi}{5}$ (1), so the value is $\frac{2\pi}{5}$ (½).

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OR LHS $= \tan^{-1}\frac{\frac{1}{2}+\frac{2}{11}}{1-\frac{1}{2}\cdot\frac{2}{11}}$ (1) $= \tan^{-1}\frac{15/22}{10/11} = \tan^{-1}\frac{3}{4}$ (1).

22. $2x + y + x\frac{dy}{dx} + 2y\frac{dy}{dx} = 0$ (1), so $\frac{dy}{dx} = -\frac{2x+y}{x+2y}$ (1).

23. $f'(x) = 6(x-1)(x-2)$ (½). f′(x) > 0 on $(-\infty, 1) \cup (2, \infty)$: increasing there (1); f′(x) < 0 on (1, 2): decreasing (½).

OR $f'(x) = 3(x-1)(x-3)$; f′′(1) = –6 < 0 and f′′(3) = 6 > 0 (1). Local maximum f(1) = 19; local minimum f(3) = 15 (1).

24. $\vec{a} \times \vec{b} = \hat{i} - 2\hat{j} + \hat{k}$ (1). Unit vector $\pm\frac{1}{\sqrt{6}}(\hat{i} - 2\hat{j} + \hat{k})$ (1).

25. P(E) = 2/6 = 1/3, P(F) = 1/2, P(E ∩ F) = P({6}) = 1/6 (1). P(E)P(F) = 1/6 = P(E ∩ F), so they are independent (1).

Section C

26. $\frac{x}{(x+1)(x+2)} = \frac{-1}{x+1} + \frac{2}{x+2}$ (1½). Integral $= -\log|x+1| + 2\log|x+2| + C$ (1½).

OR By parts with u = log x, dv = x² dx (1): $\frac{x^3}{3}\log x - \int \frac{x^3}{3}\cdot\frac{1}{x}\,dx$ (1) $= \frac{x^3}{3}\log x - \frac{x^3}{9} + C$ (1).

27. Using $\int_0^a f(x)dx = \int_0^a f(a-x)dx$: $I = \int_0^\pi \frac{(\pi - x)\sin x}{1+\cos^2 x}dx$, so $2I = \pi\int_0^\pi \frac{\sin x}{1+\cos^2 x}dx$ (1). Put cos x = t: $2I = \pi\int_{-1}^{1}\frac{dt}{1+t^2} = \pi\cdot\frac{\pi}{2}$ (1½). $I = \frac{\pi^2}{4}$ (½).

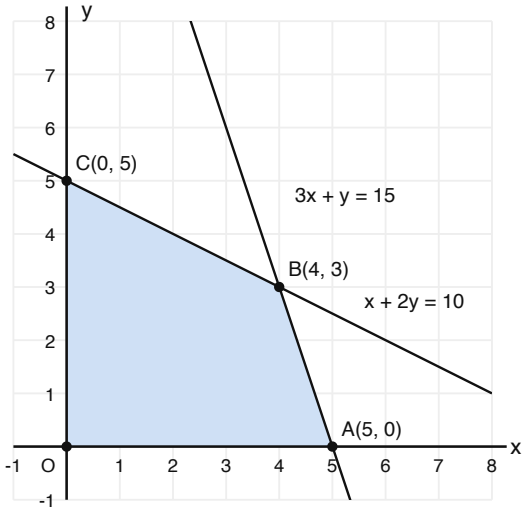
28. IF $= e^{2x}$ (½). $ye^{2x} = \int e^{2x}\sin x\,dx = \frac{e^{2x}(2\sin x - \cos x)}{5} + C$ (2). $y = \frac{2\sin x - \cos x}{5} + Ce^{-2x}$ (½).

OR $\int\frac{dy}{1+y^2} = \int\frac{dx}{1+x^2}$: $\tan^{-1} y = \tan^{-1} x + C$ (1½). x = 0, y = 1 gives $C = \frac{\pi}{4}$ (½). So $y = \tan\left(\tan^{-1} x + \frac{\pi}{4}\right) = \frac{1+x}{1-x}$ (1).

29. $\vec{b}_1 \times \vec{b}_2 = -3\hat{i} + 3\hat{k}$, magnitude $3\sqrt{2}$ (1). $\vec{a}_2 - \vec{a}_1 = \hat{i} - 3\hat{j} - 2\hat{k}$; dot product = –3 – 6 = –9 (1). SD $= \frac{9}{3\sqrt{2}} = \frac{3}{\sqrt{2}}$ units (1).

OR $\cos\theta = \frac{|1\cdot 3 + 2\cdot 2 + 2\cdot 6|}{3\cdot 7}$ (2) $= \frac{19}{21}$, so $\theta = \cos^{-1}\frac{19}{21}$ (1).

30. Feasible region OABC with corners O(0, 0), A(5, 0), B(4, 3), C(0, 5) (1½):



Z = 0, 15, 18, 10 (1). Maximum Z = 18 at (4, 3) (½).

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31. $P(E_1) = P(E_2) = ½$; $P(R|E_1) = ½$, $P(R|E_2) = ¼$ (1). By Bayes' theorem, $P(E_1|R) = \frac{\frac{1}{2}\cdot\frac{1}{2}}{\frac{1}{2}\cdot\frac{1}{2}+\frac{1}{2}\cdot\frac{1}{4}}$ (1) $= \frac{2}{3}$ (1).

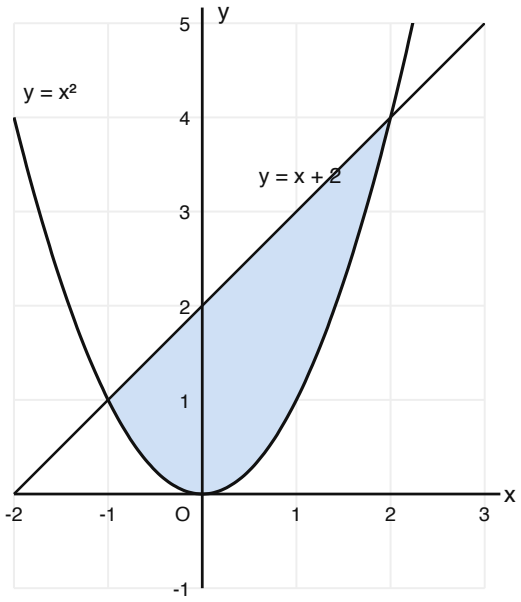
Section D

32. Reflexive: $|a - a| = 0$ is even (1). Symmetric: $|a - b| = |b - a|$ (1). Transitive: if $a - b$ and $b - c$ are even, so is $a - c = (a - b) + (b - c)$ (1). Elements of {1, 3, 5} differ by even numbers, as do 2 and 4 (1). An odd and an even number differ by an odd number, so no element of {1, 3, 5} is related to one of {2, 4} (1).

OR $f(x_1) = f(x_2) \Rightarrow 4x_1(3x_2 + 4) = 4x_2(3x_1 + 4) \Rightarrow 16x_1 = 16x_2$, so f is one-one (2). If $\frac{4x}{3x+4} = \frac{4}{3}$, then 12x = 12x + 16, which is impossible (2). So $\frac{4}{3}$ has no pre-image and f is not onto R (1).

33. AX = B with $A = \begin{bmatrix} 2 & -3 & 5 \\ 3 & 2 & -4 \\ 1 & 1 & -2 \end{bmatrix}$, $|A| = -1 \neq 0$ (1). $\operatorname{adj} A = \begin{bmatrix} 0 & -1 & 2 \\ 2 & -9 & 23 \\ 1 & -5 & 13 \end{bmatrix}$ (2). $X = A^{-1}B = -\operatorname{adj} A \cdot \begin{bmatrix} 11 \\ -5 \\ -3 \end{bmatrix} = \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$ (1½). x = 1, y = 2, z = 3 (½).

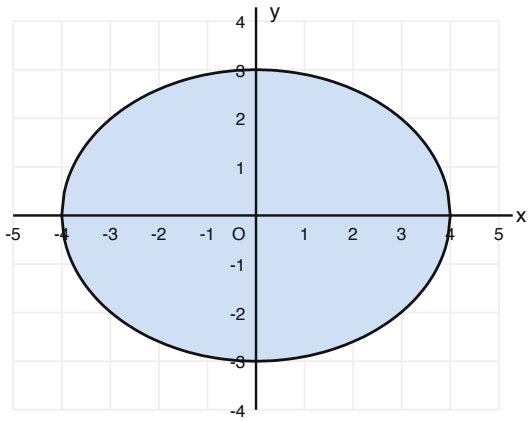
34. The curves meet where $x^2 = x + 2$: x = –1, 2 (1). Figure (1):



Area $= \int_{-1}^{2}(x + 2 - x^2)\,dx$ (1) $= \left[\frac{x^2}{2} + 2x - \frac{x^3}{3}\right]_{-1}^{2} = \frac{10}{3} + \frac{7}{6} = \frac{9}{2}$ sq. units (2).

OR Figure (1):

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Area = 4 × area in the first quadrant $= 4\int_0^4 \frac{3}{4}\sqrt{16-x^2}\,dx$ (1) $= 3\left[\frac{x}{2}\sqrt{16-x^2} + 8\sin^{-1}\frac{x}{4}\right]_0^4$ (2) $= 3\cdot 8\cdot\frac{\pi}{2} = 12\pi$ sq. units (1).

35. $\frac{x^2+1}{(x-1)^2(x+3)} = \frac{A}{x-1} + \frac{B}{(x-1)^2} + \frac{C}{x+3}$ (1). x = 1: B = ½; x = –3: C = 5/8; comparing x² terms, A = 3/8 (2). Integral $= \frac{3}{8}\log|x-1| - \frac{1}{2(x-1)} + \frac{5}{8}\log|x+3| + C$ (2).

Section E

36. (i) $A = x(400-2x) = 400x - 2x^2$.

(ii) 400 – 4x.

(iii) 400 – 4x = 0 gives x = 100; $\frac{d^2A}{dx^2} = -4 < 0$, so maximum. The field is 100 m × 200 m with area 20 000 m². **OR** A = x(300 – 2x), maximum at x = 75: area = 75 × 150 = 11 250 m².

37. (i) 0.6 × 0.3 + 0.4 × 0.2 = 0.26.

(ii) 0.6 × 0.3 = 0.18.

(iii) $\frac{0.18}{0.26} = \frac{9}{13}$ (Bayes' theorem). **OR** $\frac{0.08}{0.26} = \frac{4}{13}$.

38. (i) $\overrightarrow{AB} = 3\hat{i} + 4\hat{j}$ (1); AB = 5 m (1).

(ii) $\vec{r} = (\hat{i} + 2\hat{j} + 3\hat{k}) + \lambda(3\hat{i} + 4\hat{j})$ (1); $\frac{x-1}{3} = \frac{y-2}{4}$, z = 3 (1).

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