

Mangalore University

M. Sc. in Mathematics

Entrance Examination - 2022-23

Marks: 50 Time: 1 Hr

Application Number: _____

Name: _____

Signature: _____

Invigilator's Signature: _____

Date: 15-November-2022

Q. P. Booklet Code: A

Instructions:

- Answer any **25** questions. Only the first **25** answers (attempted questions) are considered for evaluation.
- Choose (Tick [✓]) the most appropriate response from the given four alternatives. (Use Separate Sheets for Rough Work).
- Each question carries 2 marks.

1. An integrating factor of the differential equation $(2x^2 + y)dx + (x^2y - x)dy = 0$ is

- (a) x .
- (b) $\frac{1}{x^2}$.
- (c) x^2 .
- (d) $\frac{1}{x}$.

2. An ideal M of a commutative ring R is a maximal ideal if and only if

- (a) M/R is a field.
- (b) R/M is a field.
- (c) M/R is an integral domain.
- (d) R/M is an integral domain.

3. The unit digit of 2^{2022} is

- (a) 2.
- (b) 4.
- (c) 6.
- (d) 8.

4. Which of the following is an exact differential equation?

- (a) $(y^2 - 4xy - y)dx + (y^2 - 4xy - 2x^2)dy = 0.$
- (b) $(y^2 - 4xy - 2x^2)dx + (x^2 - 4xy - 2y^2)dy = 0.$
- (c) $(x^2 - 4xy - 2y^2)dx + (y^2 - 4xy - 2x^2)dy = 0.$
- (d) $(x^2 - 2x^2y - 2y^2)dx + (y - 4xy - 2x^2)dy = 0.$

5. Let $x_1 = 1$ and $x_{n+1} = 2x_n^2$. Then $\lim_{n \rightarrow \infty} x_n$ equals

- (a) 0
- (b) 2
- (c) 1/2
- (d) ∞

6. Let $A = \begin{bmatrix} 1 & 2 & 0 & 0 \\ 0 & 1 & 2 & 0 \\ 0 & 2 & 1 & 0 \\ 0 & 0 & 2 & 1 \end{bmatrix}$. Then the rank of A^t is

- (a) 2.
- (b) 4.
- (c) 3.
- (d) 1.

7. Number of subspaces of \mathbb{R}^2 over \mathbb{R} is

- (a) 2.
- (b) 4.
- (c) Infinite.
- (d) 1.

8. The value of the product $\left(1 + \frac{2}{1!} + \frac{4}{2!} + \frac{8}{3!} + \dots\right) \left(1 - \frac{1}{1!} + \frac{1}{2!} - \frac{1}{3!} + \dots\right)$ is

- (a) 1.
- (b) e^2 .
- (c) e .
- (d) $\log_e 2$.

9. If φ represents Euler totient function, then the value of $\varphi(2020)=$
- 800.
 - 2020.
 - 1010.
 - 1600.
10. What is the value of the integral $\int_0^{\frac{\pi}{2}}(\sin^2 x + \cos^4 x)dx?$
- $\frac{7\pi}{16}$.
 - $\frac{16\pi}{7}$.
 - 0.
 - $\frac{\pi}{16}$.
11. If y is a solution of $\frac{dy}{dx} + y = x$ with $y(0) = 1$, then $y(1) =$
- 0.
 - $2e$.
 - $\frac{1}{e^2}$.
 - $\frac{2}{e}$.
12. Let $G = (\mathbb{Z}_{10})^*$ be the group of units (i. e., the elements that have a multiplicative inverse) in the ring \mathbb{Z}_{10} . Which of the following is a generator of G ?
- 3.
 - 1.
 - 5.
 - 6.
13. The interpolating polynomial passing through the points $(1, 3)$, $(2, 6)$ and $(4, 18)$ is
- $\frac{3x^2}{2} - \frac{3x}{2} + 3$.
 - $x^2 - x + 3$.
 - $\frac{5x^2}{2} - \frac{9x}{2} + 5$.
 - $x^2 + 2$.

14. The set of all points (x, y) satisfying $x, y \geq 0, y + x \geq 2, y + 4x \geq 4$ is
- Bounded.
 - Open.
 - Empty.
 - Unbounded.
15. If $f(x) = \begin{cases} 1 & \text{if } x \in \mathbb{Q} \\ 0 & \text{if } x \in \mathbb{R} - \mathbb{Q} \end{cases}$ and $g(x) = \begin{cases} x & \text{if } x \in \mathbb{Q} \\ 0 & \text{if } x \in \mathbb{R} - \mathbb{Q} \end{cases}$ for all $x \in \mathbb{R}$, then
- f is continuous and g is discontinuous.
 - f is discontinuous and g is continuous.
 - f is discontinuous and g is continuous at $x = 0$.
 - both f and g are continuous.
16. The dimension of the vector space of all symmetric matrices of order 2×2 with real entries is
- 2.
 - 3.
 - 1.
 - 4.
17. What is the total number of positive integer solutions to the following equation $(x_1 + x_2 + x_3)(y_1 + y_2 + y_3 + y_4) = 15$?
- 1.
 - 2.
 - 3.
 - 4.
18. The solution of the differential equation $dy = (1 + y^2)dx$ is
- $y = \tan x + c$.
 - $y = \tan(x + c)$.
 - $\tan^{-1}(y + c) = x$.
 - $\tan^{-1}(y + c) = 2x$.
19. The number of 4 digit numbers with no two digits common is
- 4536.
 - 3024.
 - 5040.
 - 4823.

20. The dimension of the subspace of \mathbb{R}^6 spanned by the vectors $(1, 1, 0, 1, 0, 0)$, $(0, 0, 0, 0, 1, 0)$, $(1, 1, 0, 0, 0, 1)$, $(1, 1, 0, 1, 1, 0)$, $(1, 1, 0, 0, 1, 1)$ is
- 2.
 - 5.
 - 4.
 - 3.
21. The order and degree of the differential equation $\left(\frac{d^3y}{dx^3}\right)^2 = \sqrt{\frac{dy}{dx} + 1}$ are
- 4, 3 respectively.
 - 3, 2 respectively.
 - 3, 4 respectively.
 - 3, 1 respectively.
22. Which of the following is a degree sequence of a graph?
- 5, 2, 2, 2, 1.
 - 5, 2, 2, 1, 1.
 - 4, 3, 2, 1, 1.
 - 4, 2, 2, 1, 1.
23. $\lim_{x \rightarrow 0} x \sin(1/x)$ equals
- 0.
 - 1.
 - π .
 - ∞ .
24. The minimum value of $3x^4 - 2x^3 - 6x^2 + 6x + 1$ in the interval $[-2, 2]$ is
- 0.
 - 6.
 - 10.
 - 2.
25. Consider $G = \{1, 2, 4, 7, 8, 11, 13, 14\}$, which is a group with respect to multiplication modulo 15. Then which of the following is not a subgroup of G ?
- $\{1, 4, 7, 13\}$.
 - $\{1, 4, 11, 14\}$.
 - $\{1, 4, 7, 14\}$.
 - $\{1, 2, 4, 8\}$.

26. If $L\{f(t)\} = \int_0^\infty e^{-st} f(t) dt$, then $L\{t\} =$
- $\frac{1}{s^2}$.
 - s .
 - $\frac{1}{s-1}$.
 - $\frac{1}{s+1}$.
27. The number of injective maps from a set of 3 elements to a set of 4 elements is
- 36.
 - 24.
 - 64.
 - 81.
28. For the series (i) $\sum \frac{1}{k^2 + k - 1}$ and (ii) $\sum \frac{\cos^2 k}{k^3 + k - 1}$, pick the correct option
- (i) converges and (ii) diverges.
 - (ii) converges and (i) diverges.
 - both (i) and (ii) diverge.
 - both (i) and (ii) converge.
29. Let $f(x) = e^x$ and $g(x) = e^{-x}$ on the interval $[2, 3]$. Then the value of c satisfying the Cauchy's mean value theorem $\left[\text{i. e., } \frac{f'(c)}{g'(c)} = \frac{f(3) - f(2)}{g(3) - g(2)} \right]$ is
- 2.3
 - 2.5
 - 2.4
 - 2.6
30. The 10th derivative of the function $(1 - 2x)^{10}$ at $x = \frac{1}{2}$ is
- $10! 2^{10}$.
 - $-10! 2^{10}$.
 - 2^{10} .
 - 0.

Answer Key for Exam A

Instructions:

- Answer any **25 questions**. Only the **first 25 answers** (attempted questions) are considered for evaluation.
- Choose (Tick []) the most appropriate response from the given four alternatives. (Use Separate Sheets for Rough Work).
- Each question carries 2 marks.

1. (b)
2. (b)
3. (b)
4. (c)
5. (d)
6. (b)
7. (c)
8. (c)
9. (a)
10. (a)
11. (d)
12. (a)
13. (d)
14. (d)
15. (c)
16. (b)
17. (d)
18. (b)
19. (a)

20. (d)

21. (c)

22. (d)

23. (a)

24. (b)

25. (c)

26. (a)

27. (b)

28. (d)

29. (b)

30. (a)

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Q. P. Booklet Code: **B**

Instructions:

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- Each question carries 2 marks.

1. What is the total number of positive integer solutions to the following equation $(x_1 + x_2 + x_3)(y_1 + y_2 + y_3 + y_4) = 15$?
 - (a) 1.
 - (b) 2.
 - (c) 3.
 - (d) 4.
2. Let $f(x) = e^x$ and $g(x) = e^{-x}$ on the interval $[2, 3]$. Then the value of c satisfying the Cauchy's mean value theorem $\left[\text{i. e., } \frac{f'(c)}{g'(c)} = \frac{f(3) - f(2)}{g(3) - g(2)} \right]$ is
 - (a) 2.3
 - (b) 2.5
 - (c) 2.4
 - (d) 2.6
3. Consider $G = \{1, 2, 4, 7, 8, 11, 13, 14\}$, which is a group with respect to multiplication modulo 15. Then which of the following is not a subgroup of G ?
 - (a) $\{1, 4, 7, 13\}$.
 - (b) $\{1, 4, 11, 14\}$.
 - (c) $\{1, 4, 7, 14\}$.
 - (d) $\{1, 2, 4, 8\}$.

4. What is the value of the integral $\int_0^{\frac{\pi}{2}} (\sin^2 x + \cos^4 x) dx$?
- (a) $\frac{7\pi}{16}$.
 (b) $\frac{16\pi}{7}$.
 (c) 0.
 (d) $\frac{\pi}{16}$.
5. The dimension of the vector space of all symmetric matrices of order 2×2 with real entries is
- (a) 2.
 (b) 3.
 (c) 1.
 (d) 4.
6. Let $G = (\mathbb{Z}_{10})^*$ be the group of units (i. e., the elements that have a multiplicative inverse) in the ring \mathbb{Z}_{10} . Which of the following is a generator of G ?
- (a) 3.
 (b) 1.
 (c) 5.
 (d) 6.
7. If $f(x) = \begin{cases} 1 & \text{if } x \in \mathbb{Q} \\ 0 & \text{if } x \in \mathbb{R} - \mathbb{Q} \end{cases}$ and $g(x) = \begin{cases} x & \text{if } x \in \mathbb{Q} \\ 0 & \text{if } x \in \mathbb{R} - \mathbb{Q} \end{cases}$ for all $x \in \mathbb{R}$, then
- (a) f is continuous and g is discontinuous.
 (b) f is discontinuous and g is continuous.
 (c) f is discontinuous and g is continuous at $x = 0$.
 (d) both f and g are continuous.
8. The interpolating polynomial passing through the points $(1, 3)$, $(2, 6)$ and $(4, 18)$ is
- (a) $\frac{3x^2}{2} - \frac{3x}{2} + 3$.
 (b) $x^2 - x + 3$.
 (c) $\frac{5x^2}{2} - \frac{9x}{2} + 5$.
 (d) $x^2 + 2$.

9. If φ represents Euler totient function, then the value of $\varphi(2020)=$
- (a) 800.
 - (b) 2020.
 - (c) 1010.
 - (d) 1600.
10. The number of injective maps from a set of 3 elements to a set of 4 elements is
- (a) 36.
 - (b) 24.
 - (c) 64.
 - (d) 81.
11. The dimension of the subspace of \mathbb{R}^6 spanned by the vectors $(1, 1, 0, 1, 0, 0)$, $(0, 0, 0, 0, 1, 0)$, $(1, 1, 0, 0, 0, 1)$, $(1, 1, 0, 1, 1, 0)$, $(1, 1, 0, 0, 1, 1)$ is
- (a) 2.
 - (b) 5.
 - (c) 4.
 - (d) 3.
12. The 10th derivative of the function $(1 - 2x)^{10}$ at $x = \frac{1}{2}$ is
- (a) $10! 2^{10}$.
 - (b) $-10! 2^{10}$.
 - (c) 2^{10} .
 - (d) 0.
13. The number of 4 digit numbers with no two digits common is
- (a) 4536.
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- 1.
 - $e^2.$
 - $e.$
 - $\log_e 2.$
17. $\lim_{x \rightarrow 0} x \sin(1/x)$ equals
- 0.
 - 1.
 - $\pi.$
 - $\infty.$
18. Which of the following is a degree sequence of a graph?
- 5, 2, 2, 2, 1.
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 - 4, 2, 2, 1, 1.
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- M/R is a field.
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20. The set of all points (x, y) satisfying $x, y \geq 0, y + x \geq 2, y + 4x \geq 4$ is
- Bounded.
 - Open.
 - Empty.
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21. The minimum value of $3x^4 - 2x^3 - 6x^2 + 6x + 1$ in the interval $[-2, 2]$ is
- 0.
 - 6.
 - 10.
 - 2.
22. An integrating factor of the differential equation $(2x^2 + y)dx + (x^2y - x)dy = 0$ is
- x .
 - $\frac{1}{x^2}$.
 - x^2 .
 - $\frac{1}{x}$.
23. If y is a solution of $\frac{dy}{dx} + y = x$ with $y(0) = 1$, then $y(1) =$
- 0.
 - $2e$.
 - $\frac{1}{e^2}$.
 - $\frac{2}{e}$.
24. Which of the following is an exact differential equation?
- $(y^2 - 4xy - y)dx + (y^2 - 4xy - 2x^2)dy = 0$.
 - $(y^2 - 4xy - 2x^2)dx + (x^2 - 4xy - 2y^2)dy = 0$.
 - $(x^2 - 4xy - 2y^2)dx + (y^2 - 4xy - 2x^2)dy = 0$.
 - $(x^2 - 2x^2y - 2y^2)dx + (y - 4xy - 2x^2)dy = 0$.
25. For the series (i) $\sum \frac{1}{k^2 + k - 1}$ and (ii) $\sum \frac{\cos^2 k}{k^3 + k - 1}$, pick the correct option
- (i) converges and (ii) diverges.
 - (ii) converges and (i) diverges.
 - both (i) and (ii) diverge.
 - both (i) and (ii) converge.

26. The order and degree of the differential equation $\left(\frac{d^3y}{dx^3}\right)^2 = \sqrt{\frac{dy}{dx} + 1}$ are

- (a) 4, 3 respectively.
- (b) 3, 2 respectively.
- (c) 3, 4 respectively.
- (d) 3, 1 respectively.

27. Let $x_1 = 1$ and $x_{n+1} = 2x_n^2$. Then $\lim_{n \rightarrow \infty} x_n$ equals

- (a) 0
- (b) 2
- (c) 1/2
- (d) ∞

28. Number of subspaces of \mathbb{R}^2 over \mathbb{R} is

- (a) 2.
- (b) 4.
- (c) Infinite.
- (d) 1.

29. If $L\{f(t)\} = \int_0^\infty e^{-st} f(t) dt$, then $L\{t\} =$

- (a) $\frac{1}{s^2}$.
- (b) s .
- (c) $\frac{1}{s-1}$.
- (d) $\frac{1}{s+1}$.

30. Let $A = \begin{bmatrix} 1 & 2 & 0 & 0 \\ 0 & 1 & 2 & 0 \\ 0 & 2 & 1 & 0 \\ 0 & 0 & 2 & 1 \end{bmatrix}$. Then the rank of A^t is

- (a) 2.
- (b) 4.
- (c) 3.
- (d) 1.

Answer Key for Exam B

Instructions:

- Answer any **25 questions**. Only the **first 25 answers** (attempted questions) are considered for evaluation.
- Choose (Tick [✓]) the most appropriate response from the given four alternatives. (Use Separate Sheets for Rough Work).
- Each question carries 2 marks.

1. (d)
2. (b)
3. (c)
4. (a)
5. (b)
6. (a)
7. (c)
8. (d)
9. (a)
10. (b)
11. (d)
12. (a)
13. (a)
14. (b)
15. (b)
16. (c)
17. (a)
18. (d)
19. (b)

20. (d)

21. (b)

22. (b)

23. (d)

24. (c)

25. (d)

26. (c)

27. (d)

28. (c)

29. (a)

30. (b)

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Date: 15-November-2022

Q. P. Booklet Code: C

Instructions:

- Answer any **25** questions. Only the first **25** answers (attempted questions) are considered for evaluation.
- Choose (Tick [\checkmark]) the most appropriate response from the given four alternatives. (Use Separate Sheets for Rough Work).
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1. An ideal M of a commutative ring R is a maximal ideal if and only if

- (a) M/R is a field.
- (b) R/M is a field.
- (c) M/R is an integral domain.
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2. The set of all points (x, y) satisfying $x, y \geq 0$, $y + x \geq 2$, $y + 4x \geq 4$ is

- (a) Bounded.
- (b) Open.
- (c) Empty.
- (d) Unbounded.

3. The minimum value of $3x^4 - 2x^3 - 6x^2 + 6x + 1$ in the interval $[-2, 2]$ is

- (a) 0.
- (b) -6.
- (c) -10.
- (d) 2.

4. An integrating factor of the differential equation $(2x^2 + y)dx + (x^2y - x)dy = 0$ is
- x .
 - $\frac{1}{x^2}$.
 - x^2 .
 - $\frac{1}{x}$.
5. Consider $G = \{1, 2, 4, 7, 8, 11, 13, 14\}$, which is a group with respect to multiplication modulo 15. Then which of the following is not a subgroup of G ?
- $\{1, 4, 7, 13\}$.
 - $\{1, 4, 11, 14\}$.
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6. If $f(x) = \begin{cases} 1 & \text{if } x \in \mathbb{Q} \\ 0 & \text{if } x \in \mathbb{R} - \mathbb{Q} \end{cases}$ and $g(x) = \begin{cases} x & \text{if } x \in \mathbb{Q} \\ 0 & \text{if } x \in \mathbb{R} - \mathbb{Q} \end{cases}$ for all $x \in \mathbb{R}$, then
- f is continuous and g is discontinuous.
 - f is discontinuous and g is continuous.
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7. What is the total number of positive integer solutions to the following equation $(x_1 + x_2 + x_3)(y_1 + y_2 + y_3 + y_4) = 15$?
- 1.
 - 2.
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8. If φ represents Euler totient function, then the value of $\varphi(2020) =$
- 800.
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9. Let $f(x) = e^x$ and $g(x) = e^{-x}$ on the interval $[2, 3]$. Then the value of c satisfying the Cauchy's mean value theorem $\left[\text{i. e., } \frac{f'(c)}{g'(c)} = \frac{f(3) - f(2)}{g(3) - g(2)} \right]$ is
- (a) 2.3
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10. Let $G = (\mathbb{Z}_{10})^*$ be the group of units (i. e., the elements that have a multiplicative inverse) in the ring \mathbb{Z}_{10} . Which of the following is a generator of G ?
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11. If y is a solution of $\frac{dy}{dx} + y = x$ with $y(0) = 1$, then $y(1) =$
- (a) 0.
 - (b) $2e$.
 - (c) $\frac{1}{e^2}$.
 - (d) $\frac{2}{e}$.
12. The 10th derivative of the function $(1 - 2x)^{10}$ at $x = \frac{1}{2}$ is
- (a) $10! 2^{10}$.
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 - (c) 2^{10} .
 - (d) 0.
13. The number of injective maps from a set of 3 elements to a set of 4 elements is
- (a) 36.
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14. If $L\{f(t)\} = \int_0^\infty e^{-st} f(t) dt$, then $L\{t\} =$
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 - $y = \tan(x + c)$.
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16. For the series (i) $\sum \frac{1}{k^2 + k - 1}$ and (ii) $\sum \frac{\cos^2 k}{k^3 + k - 1}$, pick the correct option
- (i) converges and (ii) diverges.
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 - both (i) and (ii) diverge.
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17. The value of the product $\left(1 + \frac{2}{1!} + \frac{4}{2!} + \frac{8}{3!} + \dots\right) \left(1 - \frac{1}{1!} + \frac{1}{2!} - \frac{1}{3!} + \dots\right)$ is
- 1.
 - e^2 .
 - e .
 - $\log_e 2$.
18. The order and degree of the differential equation $\left(\frac{d^3y}{dx^3}\right)^2 = \sqrt{\frac{dy}{dx} + 1}$ are
- 4, 3 respectively.
 - 3, 2 respectively.
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19. Let $x_1 = 1$ and $x_{n+1} = 2x_n^2$. Then $\lim_{n \rightarrow \infty} x_n$ equals
- 0
 - 2
 - 1/2
 - ∞
20. Which of the following is an exact differential equation?
- $(y^2 - 4xy - y)dx + (y^2 - 4xy - 2x^2)dy = 0$.
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- $\frac{7\pi}{16}$.
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 - 0.
 - $\frac{\pi}{16}$.
22. Which of the following is a degree sequence of a graph?
- 5, 2, 2, 2, 1.
 - 5, 2, 2, 1, 1.
 - 4, 3, 2, 1, 1.
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24. The unit digit of 2^{2022} is
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- (a) 0.
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26. Number of subspaces of \mathbb{R}^2 over \mathbb{R} is
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 - (c) $\frac{5x^2}{2} - \frac{9x}{2} + 5$.
 - (d) $x^2 + 2$.
28. The number of 4 digit numbers with no two digits common is
- (a) 4536.
 - (b) 3024.
 - (c) 5040.
 - (d) 4823.
29. The dimension of the vector space of all symmetric matrices of order 2×2 with real entries is
- (a) 2.
 - (b) 3.
 - (c) 1.
 - (d) 4.

30. The dimension of the subspace of \mathbb{R}^6 spanned by the vectors $(1, 1, 0, 1, 0, 0)$, $(0, 0, 0, 0, 1, 0)$, $(1, 1, 0, 0, 0, 1)$, $(1, 1, 0, 1, 1, 0)$, $(1, 1, 0, 0, 1, 1)$ is
- (a) 2.
 - (b) 5.
 - (c) 4.
 - (d) 3.

Answer Key for Exam C

Instructions:

- Answer any **25 questions**. Only the **first 25 answers** (attempted questions) are considered for evaluation.
- Choose (Tick [✓]) the most appropriate response from the given four alternatives. (Use Separate Sheets for Rough Work).
- Each question carries 2 marks.

1. (b)
2. (d)
3. (b)
4. (b)
5. (c)
6. (c)
7. (d)
8. (a)
9. (b)
10. (a)
11. (d)
12. (a)
13. (b)
14. (a)
15. (b)
16. (d)
17. (c)
18. (c)
19. (d)

20. (c)

21. (a)

22. (d)

23. (b)

24. (b)

25. (a)

26. (c)

27. (d)

28. (a)

29. (b)

30. (d)