King Fahd University of Petroleum and Minerals
Department of Mathematics

Math 208
Major Exam I
Term 252
16 February 2026

EXAM COVER

Number of versions: 4
Number of questions: 15

King Fahd University of Petroleum and Minerals
Department of Mathematics
Math 208
Major Exam I
Term 252
16 February 2026
Net Time Allowed: 90 Minutes

MASTER VERSION

1. The sum of all real values of m that makes the equation

$$(mx^2y + 2xy - y^3)\,dx + (x^2 - 3xy^2 + \frac{1}{3}m^3x^3)\,dy = 0$$

an Exact differential equation is equal to

(a) 0 ——————————————————————————————(correct)
(b) 1
(c) -1
(d) 2
(e) -2

2. The general solution of the exact differential equation

$$(2x + y^2e^{xy})\,dx + (e^{xy} + xye^{xy})\,dy = 0$$

is

(a) $ye^{xy} + x^2 = c$ ——————————————————————————————(correct)
(b) $xe^{xy} + x^2 = c$
(c) $ye^{xy} + y^2 = c$
(d) $xe^{xy} + y^2 = c$
(e) $ye^{xy} + x^3 = c$

3. The general solution of the differential equation $x\dfrac{dy}{dx} = y + 4x\,e^{\frac{-2y}{x}}$ for $x \neq 0$ is given by

(a) $e^{\frac{2y}{x}} - 8\ln|x| = c$ (correct)

(b) $e^{\frac{2y}{x}} - 4\ln|x| = c$

(c) $e^{\frac{2x}{y}} + 4\ln|x| = c$

(d) $e^{\frac{2x}{y}} + 8\ln|x| = c$

(e) $e^{\frac{2y}{x}} - \ln|x| = c$

4. By using a suitable substitution, we can transform the differential equation $y' + \dfrac{2}{x}y = 4x^3y^4$ into the linear differential equation

(a) $\dfrac{dw}{dx} - \dfrac{6}{x}w = -12x^3$ (correct)

(b) $\dfrac{dw}{dx} - \dfrac{3}{x}w = -12x^3$

(c) $\dfrac{dw}{dx} - \dfrac{6}{x}w = 6x^3$

(d) $\dfrac{dw}{dx} - \dfrac{3}{x}w = 6x^3$

(e) $\dfrac{dw}{dx} - \dfrac{2}{x}w = 4x^3$

5. The solution of the initial-value problem $(2-\cos x)\,y' + y\sin x = 2+\cos x,\ y(0) = 0$ is

(a) $y = \dfrac{2x+\sin x}{2-\cos x}$ (correct)

(b) $y = \dfrac{x+\sin x}{2-\cos x}$

(c) $y = \dfrac{2x+\cos x}{2+\cos x}$

(d) $y = \dfrac{x+\cos x}{2+\cos x}$

(e) $y = \dfrac{2x+\sin x}{2x-\cos x}$

6. The order of the differential equation

$$y''' + 2x(y'')^4 + x^2(y')^6 = 0$$

is

(a) 3 (correct)

(b) 4

(c) 6

(d) 10

(e) 1

7. The general solution of the differential equation $\dfrac{dy}{dx} = x\sqrt{\dfrac{1-y^2}{1-x^2}}$ for $|x| < 1$ and $|y| < 1$ is given by

(a) $y = \sin(c - \sqrt{1-x^2})$ _____ (correct)

(b) $y = 2\sin(c - \sqrt{1-x^2})$

(c) $y = \dfrac{1}{2}\sin(c - \sqrt{1-x^2})$

(d) $y = 3\sin(c - \sqrt{1-x^2})$

(e) $y = \dfrac{1}{3}\sin(c - \sqrt{1-x^2})$

8. By using a suitable substitution, we can transform the differential equation $yy'' + (y')^2 = 0$ into the separable differential equation

(a) $\dfrac{dp}{p} + \dfrac{dy}{y} = 0$ _____ (correct)

(b) $\dfrac{dp}{p} + \dfrac{dy}{2y} = 0$

(c) $\dfrac{dp}{p} - \dfrac{dy}{3y} = 0$

(d) $\dfrac{dp}{2p} - \dfrac{dy}{y} = 0$

(e) $\dfrac{dp}{2p} + \dfrac{dy}{y} = 0$

9. All values of m such that $y = e^{mx}$ is a solution of the differential equation $y'' - 6y' - 7y = 0$ are

   (a) $m = 7$ and $m = -1$ _____(correct)

   (b) $m = 7$ and $m = 2$

   (c) $m = -7$ and $m = 2$

   (d) $m = 7$ and $m = 1$

   (e) $m = 7$ and $m = -2$

10. The sum of all real values of k for which the vectors

    $$\mathbf{v}_1 = (2, 3, 0),\ \mathbf{v}_2 = (4, k, 4),\ \mathbf{v}_3 = (-1, 1, k)$$

    do not form a basis for $\mathbb{R}^3$ is

    (a) 6 _____(correct)

    (b) 5

    (c) 4

    (d) -12

    (e) 12

11. A particle is moving in a straight line with acceleration $a(t) = \ln(5t)$ and an initial velocity $v\left(\frac{1}{5}\right) = \frac{4}{5}$. The velocity at any time $t > \frac{1}{5}$ is given by

(a) $v(t) = t\,\ln(5t) - t + 1$ _____(correct)

(b) $v(t) = 2t\,\ln(5t) - t + 1$

(c) $v(t) = 3t\,\ln(5t) - t + 1$

(d) $v(t) = t\,\ln(5t) - 2t + \frac{6}{5}$

(e) $v(t) = t\,\ln(5t) + 2t + \frac{2}{5}$

12. Which one of the following statements is true about the subset V of $\mathbb{R}^3$ defined by

$$V = \{(x_1,\, x_2,\, x_3) : x_3 = x_1 + x_2\}\,?$$

(a) V is a subspace of $\mathbb{R}^3$ _____(correct)

(b) V is not closed under addition

(c) V is not closed under addition but not closed under multiplication by scalars

(d) V is closed under addition but not closed under multiplication by scalars

(e) V is not closed under addition but closed under multiplication by scalar

13. The solution of the system

$$\begin{aligned} x_1 + 3x_2 + 3x_3 + 3x_4 &= 0 \\ 2x_1 + 7x_2 + 5x_3 - x_4 &= 0 \\ 2x_1 + 7x_2 + 4x_3 - 4x_4 &= 0 \end{aligned}$$

is the set of all scalars multiples of a vector $\mathbf{u}$ where $\mathbf{u} = (a, b, c, d)$, then $\dfrac{a}{c} =$

(a) 2 _____ (correct)

(b) 4

(c) -2

(d) -4

(e) 0

14. The general solution of the differential equation

$$\frac{dy}{dx} = \frac{x + y + 2}{2x + 2y - 1}$$

is given by

(a) $2y - x - \dfrac{5}{3}\ln|3x + 3y + 1| = c$ _____ (correct)

(b) $2y + x - \dfrac{5}{3}\ln|3x + 3y + 1| = c$

(c) $2x + y + \dfrac{5}{3}\ln|3x + 3y - 1| = c$

(d) $x + y + \dfrac{5}{3}\ln|3x + 3y - 1| = c$

(e) $2x + 2y - \dfrac{5}{3}\ln|2x + 2y - 1| = c$

15. A certain radioactive substance decomposes at a rate directly proportional to the quantity of the substance present. If 50% of a certain quantity has decomposed in 20 years, how many years will it take for 80% of the original quantity to decompose?

(a) $\dfrac{20 \ln 5}{\ln 2}$ (correct)

(b) $\dfrac{30 \ln 5}{\ln 2}$

(c) $\dfrac{15 \ln 5}{\ln 2}$

(d) $\dfrac{40 \ln 5}{\ln 2}$

(e) $\dfrac{24 \ln 5}{\ln 2}$

King Fahd University of Petroleum and Minerals
Department of Mathematics

CODE 1 **CODE 1**

Math 208
Major Exam I
Term 252
16 February 2026
Net Time Allowed: 90 Minutes

Name			
ID		**Sec**	

Check that this exam has 15 questions.

Important Instructions:

1. All types of calculators, smart watches or mobile phones are NOT allowed during the examination.
2. Use HB 2.5 pencils only.
3. Use a good eraser. DO NOT use the erasers attached to the pencil.
4. Write your name, ID number and Section number on the examination paper and in the upper left corner of the answer sheet.
5. When bubbling your ID number and Section number, be sure that the bubbles match with the numbers that you write.
6. The Test Code Number is already bubbled in your answer sheet. Make sure that it is the same as that printed on your question paper.
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1. The sum of all real values of m that makes the equation

$$(mx^2y + 2xy - y^3)\,dx + (x^2 - 3xy^2 + \frac{1}{3}m^3x^3)\,dy = 0$$

an Exact differential equation is equal to

(a) 0
(b) 1
(c) -2
(d) -1
(e) 2

2. By using a suitable substitution, we can transform the differential equation $y' + \frac{2}{x}y = 4x^3y^4$ into the linear differential equation

(a) $\frac{dw}{dx} - \frac{3}{x}w = -12x^3$
(b) $\frac{dw}{dx} - \frac{6}{x}w = 6x^3$
(c) $\frac{dw}{dx} - \frac{2}{x}w = 4x^3$
(d) $\frac{dw}{dx} - \frac{3}{x}w = 6x^3$
(e) $\frac{dw}{dx} - \frac{6}{x}w = -12x^3$

3. The solution of the initial-value problem $(2-\cos x)\,y' + y\sin x = 2+\cos x,\ y(0)=0$ is

(a) $y = \dfrac{x+\sin x}{2-\cos x}$

(b) $y = \dfrac{2x+\cos x}{2+\cos x}$

(c) $y = \dfrac{2x+\sin x}{2x-\cos x}$

(d) $y = \dfrac{x+\cos x}{2+\cos x}$

(e) $y = \dfrac{2x+\sin x}{2-\cos x}$

4. The general solution of the exact differential equation

$$(2x + y^2e^{xy})\,dx + (e^{xy} + xye^{xy})\,dy = 0$$

is

(a) $xe^{xy} + y^2 = c$

(b) $ye^{xy} + x^3 = c$

(c) $xe^{xy} + x^2 = c$

(d) $ye^{xy} + x^2 = c$

(e) $ye^{xy} + y^2 = c$

5. The general solution of the differential equation $x\dfrac{dy}{dx} = y + 4x\,e^{\frac{-2y}{x}}$ for $x \neq 0$ is given by

(a) $e^{\frac{2y}{x}} - 8\ln|x| = c$
(b) $e^{\frac{2x}{y}} + 4\ln|x| = c$
(c) $e^{\frac{2y}{x}} - \ln|x| = c$
(d) $e^{\frac{2y}{x}} - 4\ln|x| = c$
(e) $e^{\frac{2x}{y}} + 8\ln|x| = c$

6. The sum of all real values of k for which the vectors

$$\mathbf{v}_1 = (2, 3, 0),\ \mathbf{v}_2 = (4, k, 4),\ \mathbf{v}_3 = (-1, 1, k)$$

do not form a basis for $\mathbb{R}^3$ is

(a) 6
(b) -12
(c) 12
(d) 4
(e) 5

7. All values of m such that $y = e^{mx}$ is a solution of the differential equation $y'' - 6y' - 7y = 0$ are

   (a) $m = 7$ and $m = 1$
   (b) $m = -7$ and $m = 2$
   (c) $m = 7$ and $m = -2$
   (d) $m = 7$ and $m = 2$
   (e) $m = 7$ and $m = -1$

8. The general solution of the differential equation $\dfrac{dy}{dx} = x\sqrt{\dfrac{1-y^2}{1-x^2}}$ for $|x| < 1$ and $|y| < 1$ is given by

   (a) $y = \dfrac{1}{3}\sin(c - \sqrt{1-x^2})$
   (b) $y = 2\sin(c - \sqrt{1-x^2})$
   (c) $y = 3\sin(c - \sqrt{1-x^2})$
   (d) $y = \sin(c - \sqrt{1-x^2})$
   (e) $y = \dfrac{1}{2}\sin(c - \sqrt{1-x^2})$

9. The order of the differential equation

$$y''' + 2x(y'')^4 + x^2(y')^6 = 0$$

is

(a) 1
(b) 4
(c) 10
(d) 3
(e) 6

10. By using a suitable substitution, we can transform the differential equation $yy'' + (y')^2 = 0$ into the separable differential equation

(a) $\dfrac{dp}{2p} + \dfrac{dy}{y} = 0$
(b) $\dfrac{dp}{p} - \dfrac{dy}{3y} = 0$
(c) $\dfrac{dp}{p} + \dfrac{dy}{2y} = 0$
(d) $\dfrac{dp}{p} + \dfrac{dy}{y} = 0$
(e) $\dfrac{dp}{2p} - \dfrac{dy}{y} = 0$

11. A certain radioactive substance decomposes at a rate directly proportional to the quantity of the substance present. If 50% of a certain quantity has decomposed in 20 years, how many years will it take for 80% of the original quantity to decompose?

(a) $\dfrac{40 \ln 5}{\ln 2}$

(b) $\dfrac{20 \ln 5}{\ln 2}$

(c) $\dfrac{24 \ln 5}{\ln 2}$

(d) $\dfrac{15 \ln 5}{\ln 2}$

(e) $\dfrac{30 \ln 5}{\ln 2}$

12. The general solution of the differential equation

$$\frac{dy}{dx} = \frac{x + y + 2}{2x + 2y - 1}$$

is given by

(a) $2y + x - \dfrac{5}{3} \ln |3x + 3y + 1| = c$

(b) $2y - x - \dfrac{5}{3} \ln |3x + 3y + 1| = c$

(c) $x + y + \dfrac{5}{3} \ln |3x + 3y - 1| = c$

(d) $2x + 2y - \dfrac{5}{3} \ln |2x + 2y - 1| = c$

(e) $2x + y + \dfrac{5}{3} \ln |3x + 3y - 1| = c$

13. The solution of the system

$$\begin{aligned} x_1 + 3x_2 + 3x_3 + 3x_4 &= 0 \\ 2x_1 + 7x_2 + 5x_3 - x_4 &= 0 \\ 2x_1 + 7x_2 + 4x_3 - 4x_4 &= 0 \end{aligned}$$

is the set of all scalars multiples of a vector $\mathbf{u}$ where $\mathbf{u} = (a, b, c, d)$, then $\dfrac{a}{c} =$

(a) 4
(b) 2
(c) -2
(d) 0
(e) -4

14. A particle is moving in a straight line with acceleration $a(t) = \ln(5t)$ and an initial velocity $v\left(\dfrac{1}{5}\right) = \dfrac{4}{5}$. The velocity at any time $t > \dfrac{1}{5}$ is given by

(a) $v(t) = t\,\ln(5t) - 2t + \dfrac{6}{5}$
(b) $v(t) = t\,\ln(5t) + 2t + \dfrac{2}{5}$
(c) $v(t) = 3t\,\ln(5t) - t + 1$
(d) $v(t) = 2t\,\ln(5t) - t + 1$
(e) $v(t) = t\,\ln(5t) - t + 1$

15. Which one of the following statements is true about the subset V of $\mathbb{R}^3$ defined by

$$V = \{(x_1, x_2, x_3) : x_3 = x_1 + x_2\}\,?$$

(a) V is closed under addition but not closed under multiplication by scalars

(b) V is a subspace of $\mathbb{R}^3$

(c) V is not closed under addition

(d) V is not closed under addition but not closed under multiplication by scalars

(e) V is not closed under addition but closed under multiplication by scalar

King Fahd University of Petroleum and Minerals
Department of Mathematics

CODE 2 **CODE 2**

Math 208
Major Exam I
Term 252
16 February 2026
Net Time Allowed: 90 Minutes

Name			
ID		**Sec**	

Check that this exam has 15 questions.

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1. The sum of all real values of m that makes the equation

$$(mx^2y + 2xy - y^3)\,dx + (x^2 - 3xy^2 + \frac{1}{3}m^3x^3)\,dy = 0$$

an Exact differential equation is equal to

(a) -2
(b) 2
(c) 0
(d) 1
(e) -1

2. The solution of the initial-value problem $(2-\cos x)\,y' + y\sin x = 2+\cos x,\ y(0) = 0$ is

(a) $y = \dfrac{2x + \sin x}{2 - \cos x}$
(b) $y = \dfrac{2x + \sin x}{2x - \cos x}$
(c) $y = \dfrac{x + \sin x}{2 - \cos x}$
(d) $y = \dfrac{x + \cos x}{2 + \cos x}$
(e) $y = \dfrac{2x + \cos x}{2 + \cos x}$

3. By using a suitable substitution, we can transform the differential equation $y' + \frac{2}{x}y = 4x^3y^4$ into the linear differential equation

(a) $\frac{dw}{dx} - \frac{2}{x}w = 4x^3$
(b) $\frac{dw}{dx} - \frac{6}{x}w = 6x^3$
(c) $\frac{dw}{dx} - \frac{3}{x}w = -12x^3$
(d) $\frac{dw}{dx} - \frac{3}{x}w = 6x^3$
(e) $\frac{dw}{dx} - \frac{6}{x}w = -12x^3$

4. The general solution of the exact differential equation

$$(2x + y^2e^{xy})\,dx + (e^{xy} + xye^{xy})\,dy = 0$$

is

(a) $ye^{xy} + x^3 = c$
(b) $xe^{xy} + x^2 = c$
(c) $ye^{xy} + y^2 = c$
(d) $ye^{xy} + x^2 = c$
(e) $xe^{xy} + y^2 = c$

5. The general solution of the differential equation $x\dfrac{dy}{dx} = y + 4x\,e^{\frac{-2y}{x}}$ for $x \neq 0$ is given by

   (a) $e^{\frac{2x}{y}} + 4\ln|x| = c$
   (b) $e^{\frac{2y}{x}} - \ln|x| = c$
   (c) $e^{\frac{2y}{x}} - 8\ln|x| = c$
   (d) $e^{\frac{2x}{y}} + 8\ln|x| = c$
   (e) $e^{\frac{2y}{x}} - 4\ln|x| = c$

6. All values of m such that $y = e^{mx}$ is a solution of the differential equation $y'' - 6y' - 7y = 0$ are

   (a) $m = -7$ and $m = 2$
   (b) $m = 7$ and $m = 1$
   (c) $m = 7$ and $m = -2$
   (d) $m = 7$ and $m = 2$
   (e) $m = 7$ and $m = -1$

7. The general solution of the differential equation $\dfrac{dy}{dx} = x\sqrt{\dfrac{1-y^2}{1-x^2}}$ for $|x| < 1$ and $|y| < 1$ is given by

   (a) $y = 3\sin(c - \sqrt{1-x^2})$
   (b) $y = \dfrac{1}{2}\sin(c - \sqrt{1-x^2})$
   (c) $y = 2\sin(c - \sqrt{1-x^2})$
   (d) $y = \sin(c - \sqrt{1-x^2})$
   (e) $y = \dfrac{1}{3}\sin(c - \sqrt{1-x^2})$

8. The order of the differential equation

$$y''' + 2x(y'')^4 + x^2(y')^6 = 0$$

   is

   (a) 4
   (b) 1
   (c) 3
   (d) 10
   (e) 6

9. The sum of all real values of k for which the vectors

$$\mathbf{v}_1 = (2, 3, 0),\ \mathbf{v}_2 = (4, k, 4),\ \mathbf{v}_3 = (-1, 1, k)$$

do not form a basis for $\mathbb{R}^3$ is

(a) 5
(b) -12
(c) 4
(d) 12
(e) 6

10. By using a suitable substitution, we can transform the differential equation $yy'' + (y')^2 = 0$ into the separable differential equation

(a) $\dfrac{dp}{2p} + \dfrac{dy}{y} = 0$
(b) $\dfrac{dp}{2p} - \dfrac{dy}{y} = 0$
(c) $\dfrac{dp}{p} - \dfrac{dy}{3y} = 0$
(d) $\dfrac{dp}{p} + \dfrac{dy}{y} = 0$
(e) $\dfrac{dp}{p} + \dfrac{dy}{2y} = 0$

11. Which one of the following statements is true about the subset V of $\mathbb{R}^3$ defined by

$$V = \{(x_1, x_2, x_3) : x_3 = x_1 + x_2\}\,?$$

(a) V is not closed under addition but closed under multiplication by scalar
(b) V is closed under addition but not closed under multiplication by scalars
(c) V is a subspace of $\mathbb{R}^3$
(d) V is not closed under addition
(e) V is not closed under addition but not closed under multiplication by scalars

12. A particle is moving in a straight line with acceleration $a(t) = \ln(5t)$ and an initial velocity $v\left(\frac{1}{5}\right) = \frac{4}{5}$. The velocity at any time $t > \frac{1}{5}$ is given by

(a) $v(t) = 3t\,\ln(5t) - t + 1$
(b) $v(t) = t\,\ln(5t) + 2t + \frac{2}{5}$
(c) $v(t) = t\,\ln(5t) - 2t + \frac{6}{5}$
(d) $v(t) = t\,\ln(5t) - t + 1$
(e) $v(t) = 2t\,\ln(5t) - t + 1$

13. The general solution of the differential equation

$$\frac{dy}{dx} = \frac{x+y+2}{2x+2y-1}$$

is given by

(a) $2y - x - \frac{5}{3}\ln|3x+3y+1| = c$

(b) $x + y + \frac{5}{3}\ln|3x+3y-1| = c$

(c) $2x + y + \frac{5}{3}\ln|3x+3y-1| = c$

(d) $2x + 2y - \frac{5}{3}\ln|2x+2y-1| = c$

(e) $2y + x - \frac{5}{3}\ln|3x+3y+1| = c$

14. A certain radioactive substance decomposes at a rate directly proportional to the quantity of the substance present. If 50% of a certain quantity has decomposed in 20 years, how many years will it take for 80% of the original quantity to decompose?

(a) $\frac{40\ln 5}{\ln 2}$

(b) $\frac{24\ln 5}{\ln 2}$

(c) $\frac{30\ln 5}{\ln 2}$

(d) $\frac{20\ln 5}{\ln 2}$

(e) $\frac{15\ln 5}{\ln 2}$

15. The solution of the system

$$\begin{aligned} x_1 + 3x_2 + 3x_3 + 3x_4 &= 0 \\ 2x_1 + 7x_2 + 5x_3 - x_4 &= 0 \\ 2x_1 + 7x_2 + 4x_3 - 4x_4 &= 0 \end{aligned}$$

is the set of all scalars multiples of a vector $\mathbf{u}$ where $\mathbf{u} = (a, b, c, d)$, then $\dfrac{a}{c} =$

(a) -2

(b) 0

(c) 2

(d) 4

(e) -4

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Department of Mathematics

CODE 3 **CODE 3**

Math 208
Major Exam I
Term 252
16 February 2026
Net Time Allowed: 90 Minutes

Name			
ID		**Sec**	

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1. The general solution of the exact differential equation

$$(2x + y^2e^{xy})\,dx + (e^{xy} + xye^{xy})\,dy = 0$$

is

(a) $xe^{xy} + y^2 = c$
(b) $xe^{xy} + x^2 = c$
(c) $ye^{xy} + y^2 = c$
(d) $ye^{xy} + x^3 = c$
(e) $ye^{xy} + x^2 = c$

2. By using a suitable substitution, we can transform the differential equation $y' + \frac{2}{x}y = 4x^3y^4$ into the linear differential equation

(a) $\frac{dw}{dx} - \frac{3}{x}w = -12x^3$
(b) $\frac{dw}{dx} - \frac{6}{x}w = 6x^3$
(c) $\frac{dw}{dx} - \frac{2}{x}w = 4x^3$
(d) $\frac{dw}{dx} - \frac{3}{x}w = 6x^3$
(e) $\frac{dw}{dx} - \frac{6}{x}w = -12x^3$

3. The sum of all real values of m that makes the equation

$$(mx^2y + 2xy - y^3)\,dx + (x^2 - 3xy^2 + \frac{1}{3}m^3x^3)\,dy = 0$$

an Exact differential equation is equal to

(a) 1
(b) -2
(c) -1
(d) 2
(e) 0

4. The solution of the initial-value problem $(2-\cos x)\,y' + y\sin x = 2+\cos x,\ y(0) = 0$ is

(a) $y = \dfrac{x+\cos x}{2+\cos x}$
(b) $y = \dfrac{x+\sin x}{2-\cos x}$
(c) $y = \dfrac{2x+\cos x}{2+\cos x}$
(d) $y = \dfrac{2x+\sin x}{2-\cos x}$
(e) $y = \dfrac{2x+\sin x}{2x-\cos x}$

5. The general solution of the differential equation $x\dfrac{dy}{dx} = y + 4x\,e^{\frac{-2y}{x}}$ for $x \neq 0$ is given by

(a) $e^{\frac{2y}{x}} - \ln|x| = c$
(b) $e^{\frac{2x}{y}} + 8\ln|x| = c$
(c) $e^{\frac{2x}{y}} + 4\ln|x| = c$
(d) $e^{\frac{2y}{x}} - 4\ln|x| = c$
(e) $e^{\frac{2y}{x}} - 8\ln|x| = c$

6. The sum of all real values of k for which the vectors

$$\mathbf{v}_1 = (2, 3, 0),\ \mathbf{v}_2 = (4, k, 4),\ \mathbf{v}_3 = (-1, 1, k)$$

do not form a basis for $\mathbb{R}^3$ is

(a) 5
(b) 6
(c) 4
(d) -12
(e) 12

7. The general solution of the differential equation $\dfrac{dy}{dx} = x\sqrt{\dfrac{1-y^2}{1-x^2}}$ for $|x| < 1$ and $|y| < 1$ is given by

(a) $y = \sin(c - \sqrt{1-x^2})$
(b) $y = 2\sin(c - \sqrt{1-x^2})$
(c) $y = 3\sin(c - \sqrt{1-x^2})$
(d) $y = \dfrac{1}{2}\sin(c - \sqrt{1-x^2})$
(e) $y = \dfrac{1}{3}\sin(c - \sqrt{1-x^2})$

8. By using a suitable substitution, we can transform the differential equation $yy'' + (y')^2 = 0$ into the separable differential equation

(a) $\dfrac{dp}{2p} + \dfrac{dy}{y} = 0$
(b) $\dfrac{dp}{2p} - \dfrac{dy}{y} = 0$
(c) $\dfrac{dp}{p} + \dfrac{dy}{y} = 0$
(d) $\dfrac{dp}{p} - \dfrac{dy}{3y} = 0$
(e) $\dfrac{dp}{p} + \dfrac{dy}{2y} = 0$

9. The order of the differential equation

$$y''' + 2x(y'')^4 + x^2(y')^6 = 0$$

is

(a) 6
(b) 4
(c) 10
(d) 3
(e) 1

10. All values of m such that $y = e^{mx}$ is a solution of the differential equation $y'' - 6y' - 7y = 0$ are

(a) $m = -7$ and $m = 2$
(b) $m = 7$ and $m = 1$
(c) $m = 7$ and $m = 2$
(d) $m = 7$ and $m = -1$
(e) $m = 7$ and $m = -2$

11. Which one of the following statements is true about the subset V of $\mathbb{R}^3$ defined by

$$V = \{(x_1, x_2, x_3) : x_3 = x_1 + x_2\}\,?$$

(a) V is not closed under addition
(b) V is not closed under addition but closed under multiplication by scalar
(c) V is closed under addition but not closed under multiplication by scalars
(d) V is a subspace of $\mathbb{R}^3$
(e) V is not closed under addition but not closed under multiplication by scalars

12. The solution of the system

$$\begin{aligned} x_1 + 3x_2 + 3x_3 + 3x_4 &= 0 \\ 2x_1 + 7x_2 + 5x_3 - x_4 &= 0 \\ 2x_1 + 7x_2 + 4x_3 - 4x_4 &= 0 \end{aligned}$$

is the set of all scalars multiples of a vector $\mathbf{u}$ where $\mathbf{u} = (a, b, c, d)$, then $\dfrac{a}{c} =$

(a) 2
(b) -4
(c) 0
(d) -2
(e) 4

13. A particle is moving in a straight line with acceleration $a(t) = \ln(5t)$ and an initial velocity $v\left(\frac{1}{5}\right) = \frac{4}{5}$. The velocity at any time $t > \frac{1}{5}$ is given by

(a) $v(t) = t\,\ln(5t) - t + 1$

(b) $v(t) = 2t\,\ln(5t) - t + 1$

(c) $v(t) = 3t\,\ln(5t) - t + 1$

(d) $v(t) = t\,\ln(5t) - 2t + \frac{6}{5}$

(e) $v(t) = t\,\ln(5t) + 2t + \frac{2}{5}$

14. The general solution of the differential equation

$$\frac{dy}{dx} = \frac{x + y + 2}{2x + 2y - 1}$$

is given by

(a) $2y - x - \frac{5}{3}\ln|3x + 3y + 1| = c$

(b) $2x + 2y - \frac{5}{3}\ln|2x + 2y - 1| = c$

(c) $2y + x - \frac{5}{3}\ln|3x + 3y + 1| = c$

(d) $2x + y + \frac{5}{3}\ln|3x + 3y - 1| = c$

(e) $x + y + \frac{5}{3}\ln|3x + 3y - 1| = c$

15. A certain radioactive substance decomposes at a rate directly proportional to the quantity of the substance present. If 50% of a certain quantity has decomposed in 20 years, how many years will it take for 80% of the original quantity to decompose?

(a) $\dfrac{24 \ln 5}{\ln 2}$

(b) $\dfrac{20 \ln 5}{\ln 2}$

(c) $\dfrac{15 \ln 5}{\ln 2}$

(d) $\dfrac{40 \ln 5}{\ln 2}$

(e) $\dfrac{30 \ln 5}{\ln 2}$

King Fahd University of Petroleum and Minerals
Department of Mathematics

CODE 4 **CODE 4**

Math 208
Major Exam I
Term 252
16 February 2026
Net Time Allowed: 90 Minutes

Name			
ID		**Sec**	

Check that this exam has 15 questions.

Important Instructions:

1. All types of calculators, smart watches or mobile phones are NOT allowed during the examination.
2. Use HB 2.5 pencils only.
3. Use a good eraser. DO NOT use the erasers attached to the pencil.
4. Write your name, ID number and Section number on the examination paper and in the upper left corner of the answer sheet.
5. When bubbling your ID number and Section number, be sure that the bubbles match with the numbers that you write.
6. The Test Code Number is already bubbled in your answer sheet. Make sure that it is the same as that printed on your question paper.
7. When bubbling, make sure that the bubbled space is fully covered.
8. When erasing a bubble, make sure that you do not leave any trace of penciling.

1. The general solution of the exact differential equation

$$(2x + y^2e^{xy})\,dx + (e^{xy} + xye^{xy})\,dy = 0$$

is

(a) $ye^{xy} + y^2 = c$
(b) $xe^{xy} + x^2 = c$
(c) $ye^{xy} + x^2 = c$
(d) $ye^{xy} + x^3 = c$
(e) $xe^{xy} + y^2 = c$

2. The sum of all real values of m that makes the equation

$$(mx^2y + 2xy - y^3)\,dx + (x^2 - 3xy^2 + \frac{1}{3}m^3x^3)\,dy = 0$$

an Exact differential equation is equal to

(a) -2
(b) 0
(c) 1
(d) 2
(e) -1

3. By using a suitable substitution, we can transform the differential equation $y' + \frac{2}{x}y = 4x^3y^4$ into the linear differential equation

(a) $\frac{dw}{dx} - \frac{2}{x}w = 4x^3$

(b) $\frac{dw}{dx} - \frac{3}{x}w = -12x^3$

(c) $\frac{dw}{dx} - \frac{6}{x}w = 6x^3$

(d) $\frac{dw}{dx} - \frac{3}{x}w = 6x^3$

(e) $\frac{dw}{dx} - \frac{6}{x}w = -12x^3$

4. The solution of the initial-value problem $(2-\cos x)\,y' + y\sin x = 2+\cos x,\ y(0) = 0$ is

(a) $y = \frac{x+\sin x}{2-\cos x}$

(b) $y = \frac{2x+\cos x}{2+\cos x}$

(c) $y = \frac{x+\cos x}{2+\cos x}$

(d) $y = \frac{2x+\sin x}{2x-\cos x}$

(e) $y = \frac{2x+\sin x}{2-\cos x}$

5. The general solution of the differential equation $x\dfrac{dy}{dx} = y + 4x\,e^{\frac{-2y}{x}}$ for $x \neq 0$ is given by

(a) $e^{\frac{2y}{x}} - 8\ln|x| = c$
(b) $e^{\frac{2x}{y}} + 4\ln|x| = c$
(c) $e^{\frac{2y}{x}} - 4\ln|x| = c$
(d) $e^{\frac{2y}{x}} - \ln|x| = c$
(e) $e^{\frac{2x}{y}} + 8\ln|x| = c$

6. The sum of all real values of k for which the vectors

$$\mathbf{v}_1 = (2, 3, 0),\ \mathbf{v}_2 = (4, k, 4),\ \mathbf{v}_3 = (-1, 1, k)$$

do not form a basis for $\mathbb{R}^3$ is

(a) 12
(b) 6
(c) 5
(d) 4
(e) -12

7. The order of the differential equation

$$y''' + 2x(y'')^4 + x^2(y')^6 = 0$$

is

(a) 10
(b) 6
(c) 4
(d) 3
(e) 1

8. The general solution of the differential equation $\dfrac{dy}{dx} = x\sqrt{\dfrac{1-y^2}{1-x^2}}$ for $|x| < 1$ and $|y| < 1$ is given by

(a) $y = 2\sin(c - \sqrt{1-x^2})$
(b) $y = \dfrac{1}{3}\sin(c - \sqrt{1-x^2})$
(c) $y = 3\sin(c - \sqrt{1-x^2})$
(d) $y = \dfrac{1}{2}\sin(c - \sqrt{1-x^2})$
(e) $y = \sin(c - \sqrt{1-x^2})$

9. By using a suitable substitution, we can transform the differential equation $yy'' + (y')^2 = 0$ into the separable differential equation

(a) $\dfrac{dp}{p} + \dfrac{dy}{2y} = 0$

(b) $\dfrac{dp}{p} + \dfrac{dy}{y} = 0$

(c) $\dfrac{dp}{p} - \dfrac{dy}{3y} = 0$

(d) $\dfrac{dp}{2p} + \dfrac{dy}{y} = 0$

(e) $\dfrac{dp}{2p} - \dfrac{dy}{y} = 0$

10. All values of m such that $y = e^{mx}$ is a solution of the differential equation $y'' - 6y' - 7y = 0$ are

(a) $m = 7$ and $m = 1$

(b) $m = 7$ and $m = 2$

(c) $m = 7$ and $m = -2$

(d) $m = 7$ and $m = -1$

(e) $m = -7$ and $m = 2$

11. The general solution of the differential equation

$$\frac{dy}{dx} = \frac{x+y+2}{2x+2y-1}$$

is given by

(a) $2y - x - \frac{5}{3}\ln|3x+3y+1| = c$

(b) $2y + x - \frac{5}{3}\ln|3x+3y+1| = c$

(c) $2x + 2y - \frac{5}{3}\ln|2x+2y-1| = c$

(d) $x + y + \frac{5}{3}\ln|3x+3y-1| = c$

(e) $2x + y + \frac{5}{3}\ln|3x+3y-1| = c$

12. The solution of the system

$$\begin{aligned} x_1 + 3x_2 + 3x_3 + 3x_4 &= 0 \\ 2x_1 + 7x_2 + 5x_3 - x_4 &= 0 \\ 2x_1 + 7x_2 + 4x_3 - 4x_4 &= 0 \end{aligned}$$

is the set of all scalars multiples of a vector $\mathbf{u}$ where $\mathbf{u} = (a, b, c, d)$, then $\frac{a}{c} =$

(a) -4

(b) 2

(c) -2

(d) 0

(e) 4

13. A certain radioactive substance decomposes at a rate directly proportional to the quantity of the substance present. If 50% of a certain quantity has decomposed in 20 years, how many years will it take for 80% of the original quantity to decompose?

(a) $\dfrac{20 \ln 5}{\ln 2}$

(b) $\dfrac{30 \ln 5}{\ln 2}$

(c) $\dfrac{24 \ln 5}{\ln 2}$

(d) $\dfrac{15 \ln 5}{\ln 2}$

(e) $\dfrac{40 \ln 5}{\ln 2}$

14. Which one of the following statements is true about the subset V of $\mathbb{R}^3$ defined by

$$V = \{(x_1, x_2, x_3) : x_3 = x_1 + x_2\}\,?$$

(a) V is closed under addition but not closed under multiplication by scalars

(b) V is not closed under addition but not closed under multiplication by scalars

(c) V is not closed under addition but closed under multiplication by scalar

(d) V is not closed under addition

(e) V is a subspace of $\mathbb{R}^3$

15. A particle is moving in a straight line with acceleration $a(t) = \ln(5t)$ and an initial velocity $v\left(\frac{1}{5}\right) = \frac{4}{5}$. The velocity at any time $t > \frac{1}{5}$ is given by

(a) $v(t) = t\,\ln(5t) + 2t + \frac{2}{5}$

(b) $v(t) = t\,\ln(5t) - 2t + \frac{6}{5}$

(c) $v(t) = 2t\,\ln(5t) - t + 1$

(d) $v(t) = 3t\,\ln(5t) - t + 1$

(e) $v(t) = t\,\ln(5t) - t + 1$

Math 208, Term 252, Major Exam I **Answer KEY**

Q	MASTER	1	2	3	4
1	A	A $_{1}$	C $_{1}$	E $_{2}$	C $_{2}$
2	A	E $_{4}$	A $_{5}$	E $_{4}$	B $_{1}$
3	A	E $_{5}$	E $_{4}$	E $_{1}$	E $_{4}$
4	A	D $_{2}$	D $_{2}$	D $_{5}$	E $_{5}$
5	A	A $_{3}$	C $_{3}$	E $_{3}$	A $_{3}$
6	A	A $_{10}$	E $_{9}$	B $_{10}$	B $_{10}$
7	A	E $_{9}$	D $_{7}$	A $_{7}$	D $_{6}$
8	A	D $_{7}$	C $_{6}$	C $_{8}$	E $_{7}$
9	A	D $_{6}$	E $_{10}$	D $_{6}$	B $_{8}$
10	A	D $_{8}$	D $_{8}$	D $_{9}$	D $_{9}$
11	A	B $_{15}$	C $_{12}$	D $_{12}$	A $_{14}$
12	A	B $_{14}$	D $_{11}$	A $_{13}$	B $_{13}$
13	A	B $_{13}$	A $_{14}$	A $_{11}$	A $_{15}$
14	A	E $_{11}$	D $_{15}$	A $_{14}$	E $_{12}$
15	A	B $_{12}$	C $_{13}$	B $_{15}$	E $_{11}$

Answer Counts

V	A	B	C	D	E
1	3	4	0	4	4
2	2	0	5	5	3
3	4	2	1	4	4
4	3	4	1	2	5

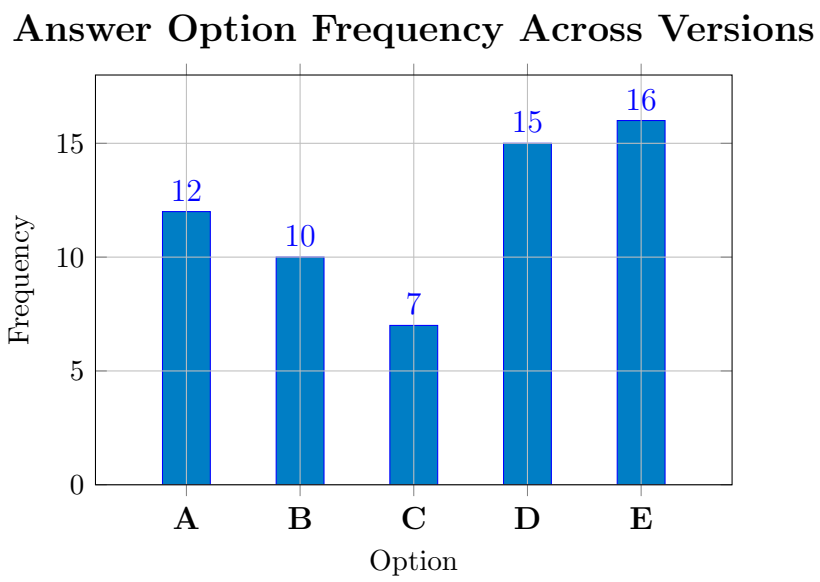

Figure 1: Frequency of Each Answer Option (Excluding MASTER)