King Fahd University of Petroleum and Minerals
Department of Mathematics

MATH 208
Major Exam I
Term 251
30 September 2025

EXAM COVER

Number of versions: 8
Number of questions: 15

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Department of Mathematics

MATH 208

Major Exam I

Term 251

30 September 2025

Net Time Allowed: 90 Minutes

MASTER VERSION

1. If the function $k(x)$ with $k(0) = 0$ makes

$$\frac{dy}{dx} = \frac{y\cos x + 2xe^y + 3}{k(x) - x^2e^y + 2x}$$

an exact differential equation, then $k(x) =$

(a) $-\sin x - 2x$ ______________________________ (correct)

(b) $\sin x - 2x$

(c) $-\sin x + 3x$

(d) $-\sin x + 4x$

(e) $\sin x + 2x$

2. A general solution of the exact differential equation

$$(y^2 + 3x^2 - 2xy^3)\,dx - (1 - 2xy + 3x^2y^2)\,dy = 0$$

is

(a) $y - xy^2 + x^2y^3 - x^3 = c$ ______________________________ (correct)

(b) $y + xy^2 + x^2y^3 - x^3 = c$

(c) $y - xy^2 - x^2y^3 - x^3 = c$

(d) $y - xy^2 + x^2y^3 + x^3 = c$

(e) $y - 2xy^2 + x^2y^3 + x^3 = c$

3. The solution of the initial-value problem

$$(1 + x\cos^2 y + x + \cos^2 y)\,dx - x\sin y\,dy = 0,\ y(1) = 0$$

is

(a) $\ln|x| + x + \tan^{-1}(\cos y) = 1 + \frac{\pi}{4}$ ________________________________(correct)

(b) $\ln|x| + 2x + \tan^{-1}(\cos y) = 1 + \frac{\pi}{4}$

(c) $\ln|x| + 3x + \tan^{-1}(\cos y) = 1 + \frac{\pi}{3}$

(d) $\ln|x| + 4x + \tan^{-1}(\cos y) = 1 + \frac{\pi}{4}$

(e) $\ln|x| + 5x + \tan^{-1}(\cos y) = 1 + \frac{\pi}{2}$

4. At 4:00 pm, a thermometer reading $20°C$ is put into a freezer where the temperature is $-10°C$. If the reading is $5°C$ at 4:02 pm, then the reading at 4:06 pm is

(a) $-6.25°C$ ________________________________(correct)

(b) $-4.25°C$

(c) $0°C$

(d) $-8.25°C$

(e) $-7.25°C$

5. The general solution of the linear differential equation

$$(x^2+1)\frac{dy}{dx} + 3x^3 y = 6x\, e^{-\frac{3}{2}x^2}$$

is

(a) $y(x) = [-2 + c(x^2+1)^{\frac{3}{2}}]\, e^{-\frac{3}{2}x^2}$ ____________________(correct)

(b) $y(x) = [-3 + c(x^2+1)^{\frac{3}{2}}]\, e^{-\frac{3}{2}x^2}$

(c) $y(x) = [-4 + c(x^2+1)^{\frac{3}{2}}]\, e^{-\frac{3}{2}x^2}$

(d) $y(x) = [-6 + c(x^2+1)^{\frac{3}{2}}]\, e^{-\frac{3}{2}x^2}$

(e) $y(x) = [1 + c(x^2+1)^{\frac{3}{2}}]\, e^{-\frac{3}{2}x^2}$

6. By using a suitable substitution, we can transform the differential equation

$$(2y\cos^2 x - 2\sqrt{y})\, dx + x\cos^2 x\, dy = 0$$

into the linear differential equation

(a) $v' + \frac{1}{x}v = \frac{1}{x}\sec^2 x$ ____________________(correct)

(b) $v' - \frac{1}{x}v = \frac{1}{x}\sec^2 x$

(c) $v' + \frac{2}{x}v = \frac{1}{x}\sec^2 x$

(d) $v' - \frac{2}{x}v = \frac{1}{x}\sec^2 x$

(e) $v' + \frac{2}{x}v = \frac{1}{x}\cos^2 x$

7. The general solution of the differential equation

$$(2xy + 3y^2)\,dx - (2xy + x^2)\,dy = 0$$

is given by

(a) $y^2 + xy = cx^3$ ________________ (correct)
(b) $y^3 + xy = cx^2$
(c) $y^2 + 2xy = cx^3$
(d) $y^2 - xy = cx^2$
(e) $y^2 + xy = cx^4$

8. The general solution of the differential equation $x^2y'' + 3xy' = 2$ is given by (Note: A and B are constants, and $x > 0$)

(a) $y(x) = \ln x + \dfrac{A}{x^2} + B$ ________________ (correct)
(b) $y(x) = 2\ln x + \dfrac{A}{x^2} + B$
(c) $y(x) = \ln x + \dfrac{A}{x^3} + B$
(d) $y(x) = 2\ln x + \dfrac{A}{x^3} + B$
(e) $y(x) = \ln x + \dfrac{A}{x^2} + Bx$

9. By making a suitable substitution, the differential equation $\dfrac{dy}{dx} = 1 + e^{y-x+5}$ can be transformed into a separable differential equation

   (a) $e^{-v}\,dv = dx$ ______________________________ (correct)

   (b) $e^{v}\,dv = dx$

   (c) $e^{-v}\,dv = 2\,dx$

   (d) $e^{v}\,dv = 2\,dx$

   (e) $e^{-v}\,dv = x\,dx$

10. Let $y = x^m$ be a solution of the differential equation $xy^{(4)} + 6y''' = 0$, then the sum of all values of m is equal to

    (a) 0 ______________________________ (correct)

    (b) 1

    (c) 2

    (d) -1

    (e) 3

11. A particle is moving in a straight line with acceleration $a(t) = t^2 \ln t$ and an initial velocity $v(1) = 0$. The velocity at any time $t > 1$ is given by

(a) $\dfrac{t^3}{3} \ln t - \dfrac{t^3}{9} + \dfrac{1}{9}$ ________________ (correct)
(b) $\dfrac{t^3}{3} \ln t - \dfrac{t^3}{8} + \dfrac{1}{8}$
(c) $\dfrac{t^4}{4} \ln t - \dfrac{t^4}{8} + \dfrac{1}{8}$
(d) $\dfrac{t^4}{4} \ln t - \dfrac{t^4}{9} + \dfrac{1}{9}$
(e) $\dfrac{t^2}{2} \ln t - \dfrac{t^2}{8} + \dfrac{1}{8}$

12. Which one of the following subsets is not a subspace of $\mathbb{R}^3$

(a) The set of all vectors (x_1, x_2, x_3) such that $x_3 = 1$ ________________ (correct)
(b) The set of all vectors (x_1, x_2, x_3) such that $x_3 = 0$
(c) The set of all vectors (x_1, x_2, x_3) such that $x_1 + x_2 = 0$
(d) The set of all vectors (x_1, x_2, x_3) such that $x_3 = x_1 + x_2$
(e) The set of all vectors (x_1, x_2, x_3) such that $x_1 + x_2 + x_3 = 0$

13. Let $\mathbf{v}_1 = (5, 3, 4)$, $\mathbf{v}_2 = (3, 2, 5)$ and $\mathbf{w} = (1, 0, -7)$ be three vectors in $\mathbb{R}^3$.
If $\mathbf{w} = a\mathbf{v}_1 + b\mathbf{v}_2$, then $ab =$

(a) -6 ______ (correct)
(b) 6
(c) 0
(d) -8
(e) 10

14. If the solution space of the system

$$\begin{aligned} x_1 - 4x_2 - 3x_3 - 7x_4 &= 0 \\ 2x_1 - x_2 + x_3 + 7x_4 &= 0 \\ x_1 + 2x_2 + 3x_3 + 11x_4 &= 0 \end{aligned}$$

is the set of all linear combinations of the form $s\mathbf{u} + t\mathbf{v}$ where s, t are real numbers, then

(a) $\mathbf{u} = (-5, -3, 0, 1)$ and $\mathbf{v} = (-1, -1, 1, 0)$ ______ (correct)
(b) $\mathbf{u} = (5, -3, 0, 1)$ and $\mathbf{v} = (-1, -1, 1, 0)$
(c) $\mathbf{u} = (-5, -3, 0, -1)$ and $\mathbf{v} = (-1, -1, 1, 0)$
(d) $\mathbf{u} = (-5, -3, 0, 1)$ and $\mathbf{v} = (1, -1, 1, 0)$
(e) $\mathbf{u} = (-5, -3, 0, -1)$ and $\mathbf{v} = (1, 1, -1, 0)$

15. If the vectors $\mathbf{u} = (5, -4, 3)$, $\mathbf{v} = (-2, 0, 3)$ and $\mathbf{w} = (a, -8, 1)$ are linearly dependent, then $3a =$

(a) 40 ____ (correct)

(b) -40

(c) 42

(d) 36

(e) -42

King Fahd University of Petroleum and Minerals
Department of Mathematics

CODE 1 **CODE 1**

MATH 208
Major Exam I
Term 251
30 September 2025
Net Time Allowed: 90 Minutes

Name			
ID		**Sec**	

Check that this exam has 15 questions.

Important Instructions:

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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.
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1. If the solution space of the system

$$\begin{aligned} x_1 - 4x_2 - 3x_3 - 7x_4 &= 0 \\ 2x_1 - x_2 + x_3 + 7x_4 &= 0 \\ x_1 + 2x_2 + 3x_3 + 11x_4 &= 0 \end{aligned}$$

is the set of all linear combinations of the form $s\mathbf{u} + t\mathbf{v}$ where s, t are real numbers, then

(a) $\mathbf{u} = (5, -3, 0, 1)$ and $\mathbf{v} = (-1, -1, 1, 0)$
(b) $\mathbf{u} = (-5, -3, 0, 1)$ and $\mathbf{v} = (-1, -1, 1, 0)$
(c) $\mathbf{u} = (-5, -3, 0, 1)$ and $\mathbf{v} = (1, -1, 1, 0)$
(d) $\mathbf{u} = (-5, -3, 0, -1)$ and $\mathbf{v} = (1, 1, -1, 0)$
(e) $\mathbf{u} = (-5, -3, 0, -1)$ and $\mathbf{v} = (-1, -1, 1, 0)$

2. The solution of the initial-value problem

$$(1 + x\cos^2 y + x + \cos^2 y)\,dx - x\sin y\,dy = 0,\ y(1) = 0$$

is

(a) $\ln|x| + x + \tan^{-1}(\cos y) = 1 + \dfrac{\pi}{4}$
(b) $\ln|x| + 4x + \tan^{-1}(\cos y) = 1 + \dfrac{\pi}{4}$
(c) $\ln|x| + 5x + \tan^{-1}(\cos y) = 1 + \dfrac{\pi}{2}$
(d) $\ln|x| + 3x + \tan^{-1}(\cos y) = 1 + \dfrac{\pi}{3}$
(e) $\ln|x| + 2x + \tan^{-1}(\cos y) = 1 + \dfrac{\pi}{4}$

3. At 4:00 pm, a thermometer reading $20°C$ is put into a freezer where the temperature is $-10°C$. If the reading is $5°C$ at 4:02 pm, then the reading at 4:06 pm is

(a) $0°C$
(b) $-6.25°C$
(c) $-4.25°C$
(d) $-7.25°C$
(e) $-8.25°C$

4. If the function $k(x)$ with $k(0) = 0$ makes

$$\frac{dy}{dx} = \frac{y\cos x + 2xe^y + 3}{k(x) - x^2 e^y + 2x}$$

an exact differential equation, then $k(x) =$

(a) $-\sin x - 2x$
(b) $\sin x - 2x$
(c) $\sin x + 2x$
(d) $-\sin x + 4x$
(e) $-\sin x + 3x$

5. A particle is moving in a straight line with acceleration $a(t) = t^2 \ln t$ and an initial velocity $v(1) = 0$. The velocity at any time $t > 1$ is given by

(a) $\dfrac{t^2}{2}\ln t - \dfrac{t^2}{8} + \dfrac{1}{8}$

(b) $\dfrac{t^4}{4}\ln t - \dfrac{t^4}{8} + \dfrac{1}{8}$

(c) $\dfrac{t^3}{3}\ln t - \dfrac{t^3}{8} + \dfrac{1}{8}$

(d) $\dfrac{t^3}{3}\ln t - \dfrac{t^3}{9} + \dfrac{1}{9}$

(e) $\dfrac{t^4}{4}\ln t - \dfrac{t^4}{9} + \dfrac{1}{9}$

6. By using a suitable substitution, we can transform the differential equation

$$(2y\cos^2 x - 2\sqrt{y})\,dx + x\cos^2 x\,dy = 0$$

into the linear differential equation

(a) $v' + \dfrac{2}{x}v = \dfrac{1}{x}\sec^2 x$

(b) $v' - \dfrac{1}{x}v = \dfrac{1}{x}\sec^2 x$

(c) $v' + \dfrac{1}{x}v = \dfrac{1}{x}\sec^2 x$

(d) $v' + \dfrac{2}{x}v = \dfrac{1}{x}\cos^2 x$

(e) $v' - \dfrac{2}{x}v = \dfrac{1}{x}\sec^2 x$

7. Let $y = x^m$ be a solution of the differential equation $xy^{(4)} + 6y''' = 0$, then the sum of all values of m is equal to

(a) 3
(b) -1
(c) 1
(d) 0
(e) 2

8. Which one of the following subsets is not a subspace of $\mathbb{R}^3$

(a) The set of all vectors (x_1, x_2, x_3) such that $x_3 = 1$
(b) The set of all vectors (x_1, x_2, x_3) such that $x_1 + x_2 + x_3 = 0$
(c) The set of all vectors (x_1, x_2, x_3) such that $x_3 = 0$
(d) The set of all vectors (x_1, x_2, x_3) such that $x_3 = x_1 + x_2$
(e) The set of all vectors (x_1, x_2, x_3) such that $x_1 + x_2 = 0$

9. By making a suitable substitution, the differential equation $\dfrac{dy}{dx} = 1 + e^{y-x+5}$ can be transformed into a separable differential equation

(a) $e^{v}\,dv = dx$

(b) $e^{v}\,dv = 2\,dx$

(c) $e^{-v}\,dv = 2\,dx$

(d) $e^{-v}\,dv = x\,dx$

(e) $e^{-v}\,dv = dx$

10. The general solution of the differential equation $x^2y'' + 3xy' = 2$ is given by (Note: A and B are constants, and $x > 0$)

(a) $y(x) = \ln x + \dfrac{A}{x^2} + B$

(b) $y(x) = \ln x + \dfrac{A}{x^3} + B$

(c) $y(x) = 2\ln x + \dfrac{A}{x^3} + B$

(d) $y(x) = \ln x + \dfrac{A}{x^2} + Bx$

(e) $y(x) = 2\ln x + \dfrac{A}{x^2} + B$

11. If the vectors $\mathbf{u} = (5, -4, 3)$, $\mathbf{v} = (-2, 0, 3)$ and $\mathbf{w} = (a, -8, 1)$ are linearly dependent, then $3a =$

(a) 40
(b) 42
(c) 36
(d) -42
(e) -40

12. A general solution of the exact differential equation

$$(y^2 + 3x^2 - 2xy^3)\,dx - (1 - 2xy + 3x^2y^2)\,dy = 0$$

is

(a) $y - xy^2 + x^2y^3 + x^3 = c$
(b) $y - 2xy^2 + x^2y^3 + x^3 = c$
(c) $y - xy^2 - x^2y^3 - x^3 = c$
(d) $y - xy^2 + x^2y^3 - x^3 = c$
(e) $y + xy^2 + x^2y^3 - x^3 = c$

13. Let $\mathbf{v}_1 = (5, 3, 4)$, $\mathbf{v}_2 = (3, 2, 5)$ and $\mathbf{w} = (1, 0, -7)$ be three vectors in $\mathbb{R}^3$.
If $\mathbf{w} = a\mathbf{v}_1 + b\mathbf{v}_2$, then $ab =$

(a) -6
(b) 6
(c) 0
(d) -8
(e) 10

14. The general solution of the linear differential equation

$$(x^2 + 1)\frac{dy}{dx} + 3x^3 y = 6x\, e^{-\frac{3}{2}x^2}$$

is

(a) $y(x) = [1 + c(x^2 + 1)^{\frac{3}{2}}]\, e^{-\frac{3}{2}x^2}$
(b) $y(x) = [-3 + c(x^2 + 1)^{\frac{3}{2}}]\, e^{-\frac{3}{2}x^2}$
(c) $y(x) = [-2 + c(x^2 + 1)^{\frac{3}{2}}]\, e^{-\frac{3}{2}x^2}$
(d) $y(x) = [-6 + c(x^2 + 1)^{\frac{3}{2}}]\, e^{-\frac{3}{2}x^2}$
(e) $y(x) = [-4 + c(x^2 + 1)^{\frac{3}{2}}]\, e^{-\frac{3}{2}x^2}$

15. The general solution of the differential equation

$$(2xy + 3y^2)\, dx - (2xy + x^2)\, dy = 0$$

is given by

(a) $y^3 + xy = cx^2$
(b) $y^2 + 2xy = cx^3$
(c) $y^2 - xy = cx^2$
(d) $y^2 + xy = cx^3$
(e) $y^2 + xy = cx^4$

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Department of Mathematics

CODE 2 **CODE 2**

MATH 208
Major Exam I
Term 251
30 September 2025
Net Time Allowed: 90 Minutes

Name	
ID		**Sec**	

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1. If the solution space of the system

$$\begin{aligned} x_1 - 4x_2 - 3x_3 - 7x_4 = 0 \\ 2x_1 - x_2 + x_3 + 7x_4 = 0 \\ x_1 + 2x_2 + 3x_3 + 11x_4 = 0 \end{aligned}$$

is the set of all linear combinations of the form $s\mathbf{u} + t\mathbf{v}$ where s, t are real numbers, then

(a) $\mathbf{u} = (-5, -3, 0, -1)$ and $\mathbf{v} = (1, 1, -1, 0)$
(b) $\mathbf{u} = (-5, -3, 0, 1)$ and $\mathbf{v} = (-1, -1, 1, 0)$
(c) $\mathbf{u} = (-5, -3, 0, 1)$ and $\mathbf{v} = (1, -1, 1, 0)$
(d) $\mathbf{u} = (5, -3, 0, 1)$ and $\mathbf{v} = (-1, -1, 1, 0)$
(e) $\mathbf{u} = (-5, -3, 0, -1)$ and $\mathbf{v} = (-1, -1, 1, 0)$

2. The general solution of the linear differential equation

$$(x^2 + 1)\frac{dy}{dx} + 3x^3 y = 6x\, e^{-\frac{3}{2}x^2}$$

is

(a) $y(x) = [-4 + c(x^2 + 1)^{\frac{3}{2}}]\, e^{-\frac{3}{2}x^2}$
(b) $y(x) = [-2 + c(x^2 + 1)^{\frac{3}{2}}]\, e^{-\frac{3}{2}x^2}$
(c) $y(x) = [-6 + c(x^2 + 1)^{\frac{3}{2}}]\, e^{-\frac{3}{2}x^2}$
(d) $y(x) = [1 + c(x^2 + 1)^{\frac{3}{2}}]\, e^{-\frac{3}{2}x^2}$
(e) $y(x) = [-3 + c(x^2 + 1)^{\frac{3}{2}}]\, e^{-\frac{3}{2}x^2}$

3. By making a suitable substitution, the differential equation $\dfrac{dy}{dx} = 1 + e^{y-x+5}$ can be transformed into a separable differential equation

   (a) $e^{-v}\,dv = 2\,dx$
   (b) $e^{v}\,dv = 2\,dx$
   (c) $e^{-v}\,dv = x\,dx$
   (d) $e^{-v}\,dv = dx$
   (e) $e^{v}\,dv = dx$

4. The general solution of the differential equation $x^2y'' + 3xy' = 2$ is given by (Note: A and B are constants, and $x > 0$)

   (a) $y(x) = 2\ln x + \dfrac{A}{x^3} + B$
   (b) $y(x) = 2\ln x + \dfrac{A}{x^2} + B$
   (c) $y(x) = \ln x + \dfrac{A}{x^3} + B$
   (d) $y(x) = \ln x + \dfrac{A}{x^2} + Bx$
   (e) $y(x) = \ln x + \dfrac{A}{x^2} + B$

5. Let $y = x^m$ be a solution of the differential equation $xy^{(4)} + 6y''' = 0$, then the sum of all values of m is equal to

(a) 2
(b) -1
(c) 3
(d) 1
(e) 0

6. If the vectors $\mathbf{u} = (5, -4, 3)$, $\mathbf{v} = (-2, 0, 3)$ and $\mathbf{w} = (a, -8, 1)$ are linearly dependent, then $3a =$

(a) 42
(b) 36
(c) -42
(d) -40
(e) 40

7. The solution of the initial-value problem

$$(1 + x\cos^2 y + x + \cos^2 y)\,dx - x\sin y\,dy = 0,\ y(1) = 0$$

is

(a) $\ln|x| + 3x + \tan^{-1}(\cos y) = 1 + \frac{\pi}{3}$

(b) $\ln|x| + 5x + \tan^{-1}(\cos y) = 1 + \frac{\pi}{2}$

(c) $\ln|x| + 2x + \tan^{-1}(\cos y) = 1 + \frac{\pi}{4}$

(d) $\ln|x| + x + \tan^{-1}(\cos y) = 1 + \frac{\pi}{4}$

(e) $\ln|x| + 4x + \tan^{-1}(\cos y) = 1 + \frac{\pi}{4}$

8. A particle is moving in a straight line with acceleration $a(t) = t^2 \ln t$ and an initial velocity $v(1) = 0$. The velocity at any time $t > 1$ is given by

(a) $\frac{t^2}{2}\ln t - \frac{t^2}{8} + \frac{1}{8}$

(b) $\frac{t^3}{3}\ln t - \frac{t^3}{9} + \frac{1}{9}$

(c) $\frac{t^4}{4}\ln t - \frac{t^4}{8} + \frac{1}{8}$

(d) $\frac{t^3}{3}\ln t - \frac{t^3}{8} + \frac{1}{8}$

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9. A general solution of the exact differential equation

$$(y^2 + 3x^2 - 2xy^3)\,dx - (1 - 2xy + 3x^2y^2)\,dy = 0$$

is

(a) $y + xy^2 + x^2y^3 - x^3 = c$
(b) $y - xy^2 + x^2y^3 + x^3 = c$
(c) $y - 2xy^2 + x^2y^3 + x^3 = c$
(d) $y - xy^2 - x^2y^3 - x^3 = c$
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10. If the function $k(x)$ with $k(0) = 0$ makes

$$\frac{dy}{dx} = \frac{y\cos x + 2xe^y + 3}{k(x) - x^2e^y + 2x}$$

an exact differential equation, then $k(x) =$

(a) $-\sin x + 4x$
(b) $-\sin x + 3x$
(c) $\sin x - 2x$
(d) $-\sin x - 2x$
(e) $\sin x + 2x$

11. Which one of the following subsets is not a subspace of $\mathbb{R}^3$

(a) The set of all vectors (x_1, x_2, x_3) such that $x_3 = x_1 + x_2$

(b) The set of all vectors (x_1, x_2, x_3) such that $x_3 = 0$

(c) The set of all vectors (x_1, x_2, x_3) such that $x_3 = 1$

(d) The set of all vectors (x_1, x_2, x_3) such that $x_1 + x_2 + x_3 = 0$

(e) The set of all vectors (x_1, x_2, x_3) such that $x_1 + x_2 = 0$

12. By using a suitable substitution, we can transform the differential equation

$$(2y\cos^2 x - 2\sqrt{y})\,dx + x\cos^2 x\,dy = 0$$

into the linear differential equation

(a) $v' - \frac{1}{x}v = \frac{1}{x}\sec^2 x$

(b) $v' + \frac{2}{x}v = \frac{1}{x}\sec^2 x$

(c) $v' + \frac{1}{x}v = \frac{1}{x}\sec^2 x$

(d) $v' + \frac{2}{x}v = \frac{1}{x}\cos^2 x$

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If $\mathbf{w} = a\mathbf{v}_1 + b\mathbf{v}_2$, then $ab =$

(a) -6
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(c) 0
(d) -8
(e) 10

14. At 4:00 pm, a thermometer reading $20°C$ is put into a freezer where the temperature is $-10°C$. If the reading is $5°C$ at 4:02 pm, then the reading at 4:06 pm is

(a) $-4.25°C$
(b) $-6.25°C$
(c) $0°C$
(d) $-8.25°C$
(e) $-7.25°C$

15. The general solution of the differential equation

$$(2xy + 3y^2)\,dx - (2xy + x^2)\,dy = 0$$

is given by

(a) $y^2 - xy = cx^2$

(b) $y^2 + 2xy = cx^3$

(c) $y^2 + xy = cx^4$

(d) $y^3 + xy = cx^2$

(e) $y^2 + xy = cx^3$

King Fahd University of Petroleum and Minerals
Department of Mathematics

CODE 3 **CODE 3**

MATH 208
Major Exam I
Term 251
30 September 2025
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.
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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. A general solution of the exact differential equation

$$(y^2 + 3x^2 - 2xy^3)\,dx - (1 - 2xy + 3x^2y^2)\,dy = 0$$

is

(a) $y - 2xy^2 + x^2y^3 + x^3 = c$
(b) $y + xy^2 + x^2y^3 - x^3 = c$
(c) $y - xy^2 + x^2y^3 + x^3 = c$
(d) $y - xy^2 + x^2y^3 - x^3 = c$
(e) $y - xy^2 - x^2y^3 - x^3 = c$

2. If the vectors $\mathbf{u} = (5, -4, 3)$, $\mathbf{v} = (-2, 0, 3)$ and $\mathbf{w} = (a, -8, 1)$ are linearly dependent, then $3a =$

(a) 42
(b) 36
(c) -42
(d) 40
(e) -40

3. The general solution of the differential equation $x^2y'' + 3xy' = 2$ is given by (Note: A and B are constants, and $x > 0$)

(a) $y(x) = 2\ln x + \dfrac{A}{x^2} + B$

(b) $y(x) = \ln x + \dfrac{A}{x^2} + Bx$

(c) $y(x) = \ln x + \dfrac{A}{x^2} + B$

(d) $y(x) = \ln x + \dfrac{A}{x^3} + B$

(e) $y(x) = 2\ln x + \dfrac{A}{x^3} + B$

4. The general solution of the linear differential equation

$$(x^2+1)\frac{dy}{dx} + 3x^3y = 6x\,e^{-\frac{3}{2}x^2}$$

is

(a) $y(x) = [1 + c(x^2+1)^{\frac{3}{2}}]\,e^{-\frac{3}{2}x^2}$

(b) $y(x) = [-3 + c(x^2+1)^{\frac{3}{2}}]\,e^{-\frac{3}{2}x^2}$

(c) $y(x) = [-2 + c(x^2+1)^{\frac{3}{2}}]\,e^{-\frac{3}{2}x^2}$

(d) $y(x) = [-4 + c(x^2+1)^{\frac{3}{2}}]\,e^{-\frac{3}{2}x^2}$

(e) $y(x) = [-6 + c(x^2+1)^{\frac{3}{2}}]\,e^{-\frac{3}{2}x^2}$

5. If the function $k(x)$ with $k(0) = 0$ makes

$$\frac{dy}{dx} = \frac{y\cos x + 2xe^y + 3}{k(x) - x^2e^y + 2x}$$

an exact differential equation, then $k(x) =$

(a) $\sin x + 2x$

(b) $\sin x - 2x$

(c) $-\sin x - 2x$

(d) $-\sin x + 4x$

(e) $-\sin x + 3x$

6. A particle is moving in a straight line with acceleration $a(t) = t^2 \ln t$ and an initial velocity $v(1) = 0$. The velocity at any time $t > 1$ is given by

(a) $\dfrac{t^2}{2}\ln t - \dfrac{t^2}{8} + \dfrac{1}{8}$

(b) $\dfrac{t^3}{3}\ln t - \dfrac{t^3}{8} + \dfrac{1}{8}$

(c) $\dfrac{t^4}{4}\ln t - \dfrac{t^4}{9} + \dfrac{1}{9}$

(d) $\dfrac{t^3}{3}\ln t - \dfrac{t^3}{9} + \dfrac{1}{9}$

(e) $\dfrac{t^4}{4}\ln t - \dfrac{t^4}{8} + \dfrac{1}{8}$

7. By making a suitable substitution, the differential equation $\dfrac{dy}{dx} = 1 + e^{y-x+5}$ can be transformed into a separable differential equation

(a) $e^{-v}\,dv = 2\,dx$

(b) $e^{v}\,dv = dx$

(c) $e^{v}\,dv = 2\,dx$

(d) $e^{-v}\,dv = dx$

(e) $e^{-v}\,dv = x\,dx$

8. If the solution space of the system

$$\begin{aligned} x_1 - 4x_2 - 3x_3 - 7x_4 &= 0 \\ 2x_1 - x_2 + x_3 + 7x_4 &= 0 \\ x_1 + 2x_2 + 3x_3 + 11x_4 &= 0 \end{aligned}$$

is the set of all linear combinations of the form $s\mathbf{u} + t\mathbf{v}$ where s, t are real numbers, then

(a) $\mathbf{u} = (-5, -3, 0, 1)$ and $\mathbf{v} = (-1, -1, 1, 0)$

(b) $\mathbf{u} = (-5, -3, 0, -1)$ and $\mathbf{v} = (-1, -1, 1, 0)$

(c) $\mathbf{u} = (5, -3, 0, 1)$ and $\mathbf{v} = (-1, -1, 1, 0)$

(d) $\mathbf{u} = (-5, -3, 0, 1)$ and $\mathbf{v} = (1, -1, 1, 0)$

(e) $\mathbf{u} = (-5, -3, 0, -1)$ and $\mathbf{v} = (1, 1, -1, 0)$

9. Which one of the following subsets is not a subspace of $\mathbb{R}^3$

(a) The set of all vectors (x_1, x_2, x_3) such that $x_1 + x_2 = 0$

(b) The set of all vectors (x_1, x_2, x_3) such that $x_3 = 0$

(c) The set of all vectors (x_1, x_2, x_3) such that $x_3 = x_1 + x_2$

(d) The set of all vectors (x_1, x_2, x_3) such that $x_1 + x_2 + x_3 = 0$

(e) The set of all vectors (x_1, x_2, x_3) such that $x_3 = 1$

10. At 4:00 pm, a thermometer reading $20°C$ is put into a freezer where the temperature is $-10°C$. If the reading is $5°C$ at 4:02 pm, then the reading at 4:06 pm is

(a) $-6.25°C$

(b) $-4.25°C$

(c) $0°C$

(d) $-7.25°C$

(e) $-8.25°C$

11. By using a suitable substitution, we can transform the differential equation

$$(2y\cos^2 x - 2\sqrt{y})\,dx + x\cos^2 x\,dy = 0$$

into the linear differential equation

(a) $v' - \dfrac{1}{x}v = \dfrac{1}{x}\sec^2 x$
(b) $v' + \dfrac{1}{x}v = \dfrac{1}{x}\sec^2 x$
(c) $v' + \dfrac{2}{x}v = \dfrac{1}{x}\sec^2 x$
(d) $v' + \dfrac{2}{x}v = \dfrac{1}{x}\cos^2 x$
(e) $v' - \dfrac{2}{x}v = \dfrac{1}{x}\sec^2 x$

12. Let $y = x^m$ be a solution of the differential equation $xy^{(4)} + 6y''' = 0$, then the sum of all values of m is equal to

(a) 3
(b) -1
(c) 1
(d) 2
(e) 0

13. Let $\mathbf{v}_1 = (5, 3, 4)$, $\mathbf{v}_2 = (3, 2, 5)$ and $\mathbf{w} = (1, 0, -7)$ be three vectors in $\mathbb{R}^3$.
If $\mathbf{w} = a\mathbf{v}_1 + b\mathbf{v}_2$, then $ab =$

(a) -6

(b) 6

(c) 0

(d) -8

(e) 10

14. The solution of the initial-value problem

$$(1 + x\cos^2 y + x + \cos^2 y)\, dx - x \sin y\, dy = 0, \; y(1) = 0$$

is

(a) $\ln|x| + 5x + \tan^{-1}(\cos y) = 1 + \dfrac{\pi}{2}$

(b) $\ln|x| + x + \tan^{-1}(\cos y) = 1 + \dfrac{\pi}{4}$

(c) $\ln|x| + 3x + \tan^{-1}(\cos y) = 1 + \dfrac{\pi}{3}$

(d) $\ln|x| + 4x + \tan^{-1}(\cos y) = 1 + \dfrac{\pi}{4}$

(e) $\ln|x| + 2x + \tan^{-1}(\cos y) = 1 + \dfrac{\pi}{4}$

15. The general solution of the differential equation

$$(2xy + 3y^2)\,dx - (2xy + x^2)\,dy = 0$$

is given by

(a) $y^2 + xy = cx^3$
(b) $y^3 + xy = cx^2$
(c) $y^2 - xy = cx^2$
(d) $y^2 + xy = cx^4$
(e) $y^2 + 2xy = cx^3$

King Fahd University of Petroleum and Minerals
Department of Mathematics

CODE 4 **CODE 4**

MATH 208
Major Exam I
Term 251
30 September 2025
Net Time Allowed: 90 Minutes

Name	
ID	
Sec	

Check that this exam has 15 questions.

Important Instructions:

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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. If the solution space of the system

$$\begin{aligned} x_1 - 4x_2 - 3x_3 - 7x_4 &= 0 \\ 2x_1 - x_2 + x_3 + 7x_4 &= 0 \\ x_1 + 2x_2 + 3x_3 + 11x_4 &= 0 \end{aligned}$$

is the set of all linear combinations of the form $s\mathbf{u} + t\mathbf{v}$ where s, t are real numbers, then

(a) $\mathbf{u} = (-5, -3, 0, 1)$ and $\mathbf{v} = (-1, -1, 1, 0)$

(b) $\mathbf{u} = (-5, -3, 0, -1)$ and $\mathbf{v} = (1, 1, -1, 0)$

(c) $\mathbf{u} = (5, -3, 0, 1)$ and $\mathbf{v} = (-1, -1, 1, 0)$

(d) $\mathbf{u} = (-5, -3, 0, 1)$ and $\mathbf{v} = (1, -1, 1, 0)$

(e) $\mathbf{u} = (-5, -3, 0, -1)$ and $\mathbf{v} = (-1, -1, 1, 0)$

2. Let $y = x^m$ be a solution of the differential equation $xy^{(4)} + 6y''' = 0$, then the sum of all values of m is equal to

(a) 0

(b) 3

(c) 2

(d) -1

(e) 1

3. A particle is moving in a straight line with acceleration $a(t) = t^2 \ln t$ and an initial velocity $v(1) = 0$. The velocity at any time $t > 1$ is given by

(a) $\dfrac{t^3}{3}\ln t - \dfrac{t^3}{8} + \dfrac{1}{8}$

(b) $\dfrac{t^4}{4}\ln t - \dfrac{t^4}{8} + \dfrac{1}{8}$

(c) $\dfrac{t^2}{2}\ln t - \dfrac{t^2}{8} + \dfrac{1}{8}$

(d) $\dfrac{t^4}{4}\ln t - \dfrac{t^4}{9} + \dfrac{1}{9}$

(e) $\dfrac{t^3}{3}\ln t - \dfrac{t^3}{9} + \dfrac{1}{9}$

4. By using a suitable substitution, we can transform the differential equation

$$(2y\cos^2 x - 2\sqrt{y})\,dx + x\cos^2 x\,dy = 0$$

into the linear differential equation

(a) $v' + \dfrac{2}{x}v = \dfrac{1}{x}\sec^2 x$

(b) $v' + \dfrac{2}{x}v = \dfrac{1}{x}\cos^2 x$

(c) $v' - \dfrac{1}{x}v = \dfrac{1}{x}\sec^2 x$

(d) $v' - \dfrac{2}{x}v = \dfrac{1}{x}\sec^2 x$

(e) $v' + \dfrac{1}{x}v = \dfrac{1}{x}\sec^2 x$

5. Which one of the following subsets is not a subspace of $\mathbb{R}^3$

(a) The set of all vectors (x_1, x_2, x_3) such that $x_3 = x_1 + x_2$
(b) The set of all vectors (x_1, x_2, x_3) such that $x_3 = 0$
(c) The set of all vectors (x_1, x_2, x_3) such that $x_1 + x_2 = 0$
(d) The set of all vectors (x_1, x_2, x_3) such that $x_3 = 1$
(e) The set of all vectors (x_1, x_2, x_3) such that $x_1 + x_2 + x_3 = 0$

6. The solution of the initial-value problem

$$(1 + x\cos^2 y + x + \cos^2 y)\, dx - x\sin y\, dy = 0,\ y(1) = 0$$

is

(a) $\ln|x| + 4x + \tan^{-1}(\cos y) = 1 + \dfrac{\pi}{4}$
(b) $\ln|x| + x + \tan^{-1}(\cos y) = 1 + \dfrac{\pi}{4}$
(c) $\ln|x| + 2x + \tan^{-1}(\cos y) = 1 + \dfrac{\pi}{4}$
(d) $\ln|x| + 3x + \tan^{-1}(\cos y) = 1 + \dfrac{\pi}{3}$
(e) $\ln|x| + 5x + \tan^{-1}(\cos y) = 1 + \dfrac{\pi}{2}$

7. At 4:00 pm, a thermometer reading $20°C$ is put into a freezer where the temperature is $-10°C$. If the reading is $5°C$ at 4:02 pm, then the reading at 4:06 pm is

(a) $0°C$
(b) $-8.25°C$
(c) $-7.25°C$
(d) $-4.25°C$
(e) $-6.25°C$

8. By making a suitable substitution, the differential equation $\dfrac{dy}{dx} = 1 + e^{y-x+5}$ can be transformed into a separable differential equation

(a) $e^{v}\,dv = 2\,dx$
(b) $e^{-v}\,dv = dx$
(c) $e^{-v}\,dv = 2\,dx$
(d) $e^{v}\,dv = dx$
(e) $e^{-v}\,dv = x\,dx$

9. If the vectors $\mathbf{u} = (5, -4, 3)$, $\mathbf{v} = (-2, 0, 3)$ and $\mathbf{w} = (a, -8, 1)$ are linearly dependent, then $3a =$

   (a) 42
   (b) -42
   (c) -40
   (d) 36
   (e) 40

10. The general solution of the differential equation $x^2y'' + 3xy' = 2$ is given by (Note: A and B are constants, and $x > 0$)

   (a) $y(x) = \ln x + \dfrac{A}{x^2} + B$
   (b) $y(x) = \ln x + \dfrac{A}{x^2} + Bx$
   (c) $y(x) = 2\ln x + \dfrac{A}{x^3} + B$
   (d) $y(x) = \ln x + \dfrac{A}{x^3} + B$
   (e) $y(x) = 2\ln x + \dfrac{A}{x^2} + B$

11. The general solution of the linear differential equation

$$(x^2+1)\frac{dy}{dx}+3x^3y=6x\,e^{-\frac{3}{2}x^2}$$

is

(a) $y(x)=[-4+c(x^2+1)^{\frac{3}{2}}]\,e^{-\frac{3}{2}x^2}$
(b) $y(x)=[-2+c(x^2+1)^{\frac{3}{2}}]\,e^{-\frac{3}{2}x^2}$
(c) $y(x)=[-3+c(x^2+1)^{\frac{3}{2}}]\,e^{-\frac{3}{2}x^2}$
(d) $y(x)=[-6+c(x^2+1)^{\frac{3}{2}}]\,e^{-\frac{3}{2}x^2}$
(e) $y(x)=[1+c(x^2+1)^{\frac{3}{2}}]\,e^{-\frac{3}{2}x^2}$

12. If the function $k(x)$ with $k(0)=0$ makes

$$\frac{dy}{dx}=\frac{y\cos x+2xe^y+3}{k(x)-x^2e^y+2x}$$

an exact differential equation, then $k(x)=$

(a) $-\sin x+4x$
(b) $-\sin x-2x$
(c) $\sin x+2x$
(d) $\sin x-2x$
(e) $-\sin x+3x$

13. Let $\mathbf{v}_1 = (5, 3, 4)$, $\mathbf{v}_2 = (3, 2, 5)$ and $\mathbf{w} = (1, 0, -7)$ be three vectors in $\mathbb{R}^3$.
If $\mathbf{w} = a\mathbf{v}_1 + b\mathbf{v}_2$, then $ab =$

(a) -6
(b) 6
(c) 0
(d) -8
(e) 10

14. A general solution of the exact differential equation

$$(y^2 + 3x^2 - 2xy^3)\,dx - (1 - 2xy + 3x^2y^2)\,dy = 0$$

is

(a) $y - xy^2 + x^2y^3 - x^3 = c$
(b) $y - xy^2 - x^2y^3 - x^3 = c$
(c) $y + xy^2 + x^2y^3 - x^3 = c$
(d) $y - xy^2 + x^2y^3 + x^3 = c$
(e) $y - 2xy^2 + x^2y^3 + x^3 = c$

15. The general solution of the differential equation

$$(2xy + 3y^2)\,dx - (2xy + x^2)\,dy = 0$$

is given by

(a) $y^2 + xy = cx^3$
(b) $y^2 + 2xy = cx^3$
(c) $y^3 + xy = cx^2$
(d) $y^2 - xy = cx^2$
(e) $y^2 + xy = cx^4$

King Fahd University of Petroleum and Minerals
Department of Mathematics

CODE 5 **CODE 5**

MATH 208
Major Exam I
Term 251
30 September 2025
Net Time Allowed: 90 Minutes

Name	
ID		Sec	

Check that this exam has 15 questions.

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8. When erasing a bubble, make sure that you do not leave any trace of penciling.

1. The solution of the initial-value problem

$$(1 + x\cos^2 y + x + \cos^2 y)\,dx - x\sin y\,dy = 0,\ y(1) = 0$$

is

(a) $\ln|x| + 5x + \tan^{-1}(\cos y) = 1 + \dfrac{\pi}{2}$

(b) $\ln|x| + 2x + \tan^{-1}(\cos y) = 1 + \dfrac{\pi}{4}$

(c) $\ln|x| + x + \tan^{-1}(\cos y) = 1 + \dfrac{\pi}{4}$

(d) $\ln|x| + 3x + \tan^{-1}(\cos y) = 1 + \dfrac{\pi}{3}$

(e) $\ln|x| + 4x + \tan^{-1}(\cos y) = 1 + \dfrac{\pi}{4}$

2. The general solution of the differential equation $x^2y'' + 3xy' = 2$ is given by (Note: A and B are constants, and $x > 0$)

(a) $y(x) = \ln x + \dfrac{A}{x^2} + Bx$

(b) $y(x) = \ln x + \dfrac{A}{x^2} + B$

(c) $y(x) = 2\ln x + \dfrac{A}{x^3} + B$

(d) $y(x) = \ln x + \dfrac{A}{x^3} + B$

(e) $y(x) = 2\ln x + \dfrac{A}{x^2} + B$

3. A general solution of the exact differential equation

$$(y^2 + 3x^2 - 2xy^3)\,dx - (1 - 2xy + 3x^2y^2)\,dy = 0$$

is

(a) $y - 2xy^2 + x^2y^3 + x^3 = c$
(b) $y + xy^2 + x^2y^3 - x^3 = c$
(c) $y - xy^2 + x^2y^3 + x^3 = c$
(d) $y - xy^2 + x^2y^3 - x^3 = c$
(e) $y - xy^2 - x^2y^3 - x^3 = c$

4. Let $y = x^m$ be a solution of the differential equation $xy^{(4)} + 6y''' = 0$, then the sum of all values of m is equal to

(a) 3
(b) 0
(c) 2
(d) 1
(e) -1

5. If the vectors $\mathbf{u} = (5, -4, 3)$, $\mathbf{v} = (-2, 0, 3)$ and $\mathbf{w} = (a, -8, 1)$ are linearly dependent, then $3a =$

   (a) 40
   (b) -42
   (c) 36
   (d) 42
   (e) -40

6. By using a suitable substitution, we can transform the differential equation

$$(2y\cos^2 x - 2\sqrt{y})\,dx + x\cos^2 x\,dy = 0$$

into the linear differential equation

   (a) $v' + \frac{2}{x}v = \frac{1}{x}\sec^2 x$
   (b) $v' - \frac{2}{x}v = \frac{1}{x}\sec^2 x$
   (c) $v' + \frac{2}{x}v = \frac{1}{x}\cos^2 x$
   (d) $v' + \frac{1}{x}v = \frac{1}{x}\sec^2 x$
   (e) $v' - \frac{1}{x}v = \frac{1}{x}\sec^2 x$

7. A particle is moving in a straight line with acceleration $a(t) = t^2 \ln t$ and an initial velocity $v(1) = 0$. The velocity at any time $t > 1$ is given by

(a) $\frac{t^4}{4} \ln t - \frac{t^4}{9} + \frac{1}{9}$
(b) $\frac{t^4}{4} \ln t - \frac{t^4}{8} + \frac{1}{8}$
(c) $\frac{t^3}{3} \ln t - \frac{t^3}{9} + \frac{1}{9}$
(d) $\frac{t^2}{2} \ln t - \frac{t^2}{8} + \frac{1}{8}$
(e) $\frac{t^3}{3} \ln t - \frac{t^3}{8} + \frac{1}{8}$

8. At 4:00 pm, a thermometer reading $20°C$ is put into a freezer where the temperature is $-10°C$. If the reading is $5°C$ at 4:02 pm, then the reading at 4:06 pm is

(a) $-4.25°C$
(b) $-8.25°C$
(c) $-7.25°C$
(d) $0°C$
(e) $-6.25°C$

9. By making a suitable substitution, the differential equation $\dfrac{dy}{dx} = 1 + e^{y-x+5}$ can be transformed into a separable differential equation

   (a) $e^{v}\,dv = 2\,dx$
   (b) $e^{-v}\,dv = x\,dx$
   (c) $e^{-v}\,dv = 2\,dx$
   (d) $e^{v}\,dv = dx$
   (e) $e^{-v}\,dv = dx$

10. If the solution space of the system

$$\begin{aligned} x_1 - 4x_2 - 3x_3 - 7x_4 &= 0 \\ 2x_1 - x_2 + x_3 + 7x_4 &= 0 \\ x_1 + 2x_2 + 3x_3 + 11x_4 &= 0 \end{aligned}$$

   is the set of all linear combinations of the form $s\mathbf{u} + t\mathbf{v}$ where s, t are real numbers, then

   (a) $\mathbf{u} = (-5, -3, 0, -1)$ and $\mathbf{v} = (-1, -1, 1, 0)$
   (b) $\mathbf{u} = (-5, -3, 0, 1)$ and $\mathbf{v} = (1, -1, 1, 0)$
   (c) $\mathbf{u} = (-5, -3, 0, 1)$ and $\mathbf{v} = (-1, -1, 1, 0)$
   (d) $\mathbf{u} = (5, -3, 0, 1)$ and $\mathbf{v} = (-1, -1, 1, 0)$
   (e) $\mathbf{u} = (-5, -3, 0, -1)$ and $\mathbf{v} = (1, 1, -1, 0)$

11. Which one of the following subsets is not a subspace of $\mathbb{R}^3$

(a) The set of all vectors (x_1, x_2, x_3) such that $x_3 = 0$
(b) The set of all vectors (x_1, x_2, x_3) such that $x_3 = x_1 + x_2$
(c) The set of all vectors (x_1, x_2, x_3) such that $x_1 + x_2 = 0$
(d) The set of all vectors (x_1, x_2, x_3) such that $x_1 + x_2 + x_3 = 0$
(e) The set of all vectors (x_1, x_2, x_3) such that $x_3 = 1$

12. The general solution of the linear differential equation

$$(x^2+1)\frac{dy}{dx} + 3x^3 y = 6x\, e^{-\frac{3}{2}x^2}$$

is

(a) $y(x) = [-3 + c(x^2+1)^{\frac{3}{2}}]\, e^{-\frac{3}{2}x^2}$
(b) $y(x) = [-4 + c(x^2+1)^{\frac{3}{2}}]\, e^{-\frac{3}{2}x^2}$
(c) $y(x) = [1 + c(x^2+1)^{\frac{3}{2}}]\, e^{-\frac{3}{2}x^2}$
(d) $y(x) = [-6 + c(x^2+1)^{\frac{3}{2}}]\, e^{-\frac{3}{2}x^2}$
(e) $y(x) = [-2 + c(x^2+1)^{\frac{3}{2}}]\, e^{-\frac{3}{2}x^2}$

13. Let $\mathbf{v}_1 = (5, 3, 4)$, $\mathbf{v}_2 = (3, 2, 5)$ and $\mathbf{w} = (1, 0, -7)$ be three vectors in $\mathbb{R}^3$.
If $\mathbf{w} = a\mathbf{v}_1 + b\mathbf{v}_2$, then $ab =$

(a) -6
(b) 6
(c) 0
(d) -8
(e) 10

14. If the function $k(x)$ with $k(0) = 0$ makes

$$\frac{dy}{dx} = \frac{y\cos x + 2xe^y + 3}{k(x) - x^2e^y + 2x}$$

an exact differential equation, then $k(x) =$

(a) $-\sin x + 3x$
(b) $-\sin x - 2x$
(c) $\sin x + 2x$
(d) $-\sin x + 4x$
(e) $\sin x - 2x$

15. The general solution of the differential equation

$$(2xy + 3y^2)\,dx - (2xy + x^2)\,dy = 0$$

is given by

(a) $y^2 + 2xy = cx^3$
(b) $y^2 - xy = cx^2$
(c) $y^3 + xy = cx^2$
(d) $y^2 + xy = cx^4$
(e) $y^2 + xy = cx^3$

King Fahd University of Petroleum and Minerals
Department of Mathematics

CODE 6 **CODE 6**

MATH 208
Major Exam I
Term 251
30 September 2025
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. Let $y = x^m$ be a solution of the differential equation $xy^{(4)} + 6y''' = 0$, then the sum of all values of m is equal to

(a) 2
(b) 0
(c) 3
(d) 1
(e) -1

2. If the function $k(x)$ with $k(0) = 0$ makes

$$\frac{dy}{dx} = \frac{y \cos x + 2xe^y + 3}{k(x) - x^2 e^y + 2x}$$

an exact differential equation, then $k(x) =$

(a) $\sin x + 2x$
(b) $-\sin x + 3x$
(c) $-\sin x + 4x$
(d) $-\sin x - 2x$
(e) $\sin x - 2x$

3. Which one of the following subsets is not a subspace of $\mathbb{R}^3$

(a) The set of all vectors (x_1, x_2, x_3) such that $x_1 + x_2 = 0$
(b) The set of all vectors (x_1, x_2, x_3) such that $x_3 = x_1 + x_2$
(c) The set of all vectors (x_1, x_2, x_3) such that $x_3 = 1$
(d) The set of all vectors (x_1, x_2, x_3) such that $x_3 = 0$
(e) The set of all vectors (x_1, x_2, x_3) such that $x_1 + x_2 + x_3 = 0$

4. By using a suitable substitution, we can transform the differential equation

$$(2y\cos^2 x - 2\sqrt{y})\,dx + x\cos^2 x\,dy = 0$$

into the linear differential equation

(a) $v' + \frac{2}{x}v = \frac{1}{x}\cos^2 x$
(b) $v' + \frac{1}{x}v = \frac{1}{x}\sec^2 x$
(c) $v' + \frac{2}{x}v = \frac{1}{x}\sec^2 x$
(d) $v' - \frac{2}{x}v = \frac{1}{x}\sec^2 x$
(e) $v' - \frac{1}{x}v = \frac{1}{x}\sec^2 x$

5. If the vectors $\mathbf{u} = (5, -4, 3)$, $\mathbf{v} = (-2, 0, 3)$ and $\mathbf{w} = (a, -8, 1)$ are linearly dependent, then $3a =$

(a) 36
(b) -42
(c) -40
(d) 40
(e) 42

6. The solution of the initial-value problem

$$(1 + x\cos^2 y + x + \cos^2 y)\, dx - x \sin y\, dy = 0,\ y(1) = 0$$

is

(a) $\ln|x| + 3x + \tan^{-1}(\cos y) = 1 + \dfrac{\pi}{3}$
(b) $\ln|x| + x + \tan^{-1}(\cos y) = 1 + \dfrac{\pi}{4}$
(c) $\ln|x| + 2x + \tan^{-1}(\cos y) = 1 + \dfrac{\pi}{4}$
(d) $\ln|x| + 5x + \tan^{-1}(\cos y) = 1 + \dfrac{\pi}{2}$
(e) $\ln|x| + 4x + \tan^{-1}(\cos y) = 1 + \dfrac{\pi}{4}$

7. A particle is moving in a straight line with acceleration $a(t) = t^2 \ln t$ and an initial velocity $v(1) = 0$. The velocity at any time $t > 1$ is given by

(a) $\dfrac{t^3}{3}\ln t - \dfrac{t^3}{8} + \dfrac{1}{8}$

(b) $\dfrac{t^3}{3}\ln t - \dfrac{t^3}{9} + \dfrac{1}{9}$

(c) $\dfrac{t^4}{4}\ln t - \dfrac{t^4}{9} + \dfrac{1}{9}$

(d) $\dfrac{t^2}{2}\ln t - \dfrac{t^2}{8} + \dfrac{1}{8}$

(e) $\dfrac{t^4}{4}\ln t - \dfrac{t^4}{8} + \dfrac{1}{8}$

8. The general solution of the differential equation $x^2y'' + 3xy' = 2$ is given by (Note: A and B are constants, and $x > 0$)

(a) $y(x) = 2\ln x + \dfrac{A}{x^3} + B$

(b) $y(x) = 2\ln x + \dfrac{A}{x^2} + B$

(c) $y(x) = \ln x + \dfrac{A}{x^3} + B$

(d) $y(x) = \ln x + \dfrac{A}{x^2} + Bx$

(e) $y(x) = \ln x + \dfrac{A}{x^2} + B$

9. A general solution of the exact differential equation

$$(y^2 + 3x^2 - 2xy^3)\,dx - (1 - 2xy + 3x^2y^2)\,dy = 0$$

is

(a) $y - xy^2 - x^2y^3 - x^3 = c$
(b) $y + xy^2 + x^2y^3 - x^3 = c$
(c) $y - xy^2 + x^2y^3 + x^3 = c$
(d) $y - 2xy^2 + x^2y^3 + x^3 = c$
(e) $y - xy^2 + x^2y^3 - x^3 = c$

10. At 4:00 pm, a thermometer reading $20°C$ is put into a freezer where the temperature is $-10°C$. If the reading is $5°C$ at 4:02 pm, then the reading at 4:06 pm is

(a) $-7.25°C$
(b) $-8.25°C$
(c) $-6.25°C$
(d) $-4.25°C$
(e) $0°C$

11. The general solution of the linear differential equation

$$(x^2+1)\frac{dy}{dx}+3x^3y=6x\,e^{-\frac{3}{2}x^2}$$

is

(a) $y(x)=[-4+c(x^2+1)^{\frac{3}{2}}]\,e^{-\frac{3}{2}x^2}$

(b) $y(x)=[-2+c(x^2+1)^{\frac{3}{2}}]\,e^{-\frac{3}{2}x^2}$

(c) $y(x)=[-6+c(x^2+1)^{\frac{3}{2}}]\,e^{-\frac{3}{2}x^2}$

(d) $y(x)=[1+c(x^2+1)^{\frac{3}{2}}]\,e^{-\frac{3}{2}x^2}$

(e) $y(x)=[-3+c(x^2+1)^{\frac{3}{2}}]\,e^{-\frac{3}{2}x^2}$

12. By making a suitable substitution, the differential equation $\frac{dy}{dx}=1+e^{y-x+5}$ can be transformed into a separable differential equation

(a) $e^{-v}\,dv=dx$

(b) $e^{v}\,dv=2\,dx$

(c) $e^{v}\,dv=dx$

(d) $e^{-v}\,dv=x\,dx$

(e) $e^{-v}\,dv=2\,dx$

13. Let $\mathbf{v}_1 = (5, 3, 4)$, $\mathbf{v}_2 = (3, 2, 5)$ and $\mathbf{w} = (1, 0, -7)$ be three vectors in $\mathbb{R}^3$.
If $\mathbf{w} = a\mathbf{v}_1 + b\mathbf{v}_2$, then $ab =$

(a) -6
(b) 6
(c) 0
(d) -8
(e) 10

14. If the solution space of the system

$$\begin{aligned} x_1 - 4x_2 - 3x_3 - 7x_4 &= 0 \\ 2x_1 - x_2 + x_3 + 7x_4 &= 0 \\ x_1 + 2x_2 + 3x_3 + 11x_4 &= 0 \end{aligned}$$

is the set of all linear combinations of the form $s\mathbf{u} + t\mathbf{v}$ where s, t are real numbers, then

(a) $\mathbf{u} = (5, -3, 0, 1)$ and $\mathbf{v} = (-1, -1, 1, 0)$
(b) $\mathbf{u} = (-5, -3, 0, -1)$ and $\mathbf{v} = (-1, -1, 1, 0)$
(c) $\mathbf{u} = (-5, -3, 0, 1)$ and $\mathbf{v} = (-1, -1, 1, 0)$
(d) $\mathbf{u} = (-5, -3, 0, -1)$ and $\mathbf{v} = (1, 1, -1, 0)$
(e) $\mathbf{u} = (-5, -3, 0, 1)$ and $\mathbf{v} = (1, -1, 1, 0)$

15. The general solution of the differential equation

$$(2xy + 3y^2)\,dx - (2xy + x^2)\,dy = 0$$

is given by

(a) $y^3 + xy = cx^2$
(b) $y^2 - xy = cx^2$
(c) $y^2 + xy = cx^3$
(d) $y^2 + xy = cx^4$
(e) $y^2 + 2xy = cx^3$

King Fahd University of Petroleum and Minerals
Department of Mathematics

CODE 7 **CODE 7**

MATH 208
Major Exam I
Term 251
30 September 2025
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.
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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. By making a suitable substitution, the differential equation $\dfrac{dy}{dx} = 1 + e^{y-x+5}$ can be transformed into a separable differential equation

   (a) $e^{v}\,dv = dx$
   (b) $e^{-v}\,dv = 2\,dx$
   (c) $e^{-v}\,dv = x\,dx$
   (d) $e^{-v}\,dv = dx$
   (e) $e^{v}\,dv = 2\,dx$

2. Which one of the following subsets is not a subspace of $\mathbb{R}^3$

   (a) The set of all vectors (x_1, x_2, x_3) such that $x_1 + x_2 = 0$
   (b) The set of all vectors (x_1, x_2, x_3) such that $x_1 + x_2 + x_3 = 0$
   (c) The set of all vectors (x_1, x_2, x_3) such that $x_3 = 1$
   (d) The set of all vectors (x_1, x_2, x_3) such that $x_3 = x_1 + x_2$
   (e) The set of all vectors (x_1, x_2, x_3) such that $x_3 = 0$

3. The solution of the initial-value problem

$$(1 + x\cos^2 y + x + \cos^2 y)\, dx - x\sin y\, dy = 0,\ y(1) = 0$$

is

(a) $\ln|x| + 5x + \tan^{-1}(\cos y) = 1 + \dfrac{\pi}{2}$
(b) $\ln|x| + 2x + \tan^{-1}(\cos y) = 1 + \dfrac{\pi}{4}$
(c) $\ln|x| + x + \tan^{-1}(\cos y) = 1 + \dfrac{\pi}{4}$
(d) $\ln|x| + 4x + \tan^{-1}(\cos y) = 1 + \dfrac{\pi}{4}$
(e) $\ln|x| + 3x + \tan^{-1}(\cos y) = 1 + \dfrac{\pi}{3}$

4. A general solution of the exact differential equation

$$(y^2 + 3x^2 - 2xy^3)\, dx - (1 - 2xy + 3x^2y^2)\, dy = 0$$

is

(a) $y - xy^2 - x^2y^3 - x^3 = c$
(b) $y + xy^2 + x^2y^3 - x^3 = c$
(c) $y - xy^2 + x^2y^3 + x^3 = c$
(d) $y - xy^2 + x^2y^3 - x^3 = c$
(e) $y - 2xy^2 + x^2y^3 + x^3 = c$

5. Let $y = x^m$ be a solution of the differential equation $xy^{(4)} + 6y''' = 0$, then the sum of all values of m is equal to

(a) 0

(b) 2

(c) -1

(d) 1

(e) 3

6. If the vectors $\mathbf{u} = (5, -4, 3)$, $\mathbf{v} = (-2, 0, 3)$ and $\mathbf{w} = (a, -8, 1)$ are linearly dependent, then $3a =$

(a) -42

(b) 42

(c) 36

(d) -40

(e) 40

7. By using a suitable substitution, we can transform the differential equation

$$(2y\cos^2 x - 2\sqrt{y})\,dx + x\cos^2 x\,dy = 0$$

into the linear differential equation

(a) $v' + \frac{1}{x}v = \frac{1}{x}\sec^2 x$

(b) $v' - \frac{1}{x}v = \frac{1}{x}\sec^2 x$

(c) $v' + \frac{2}{x}v = \frac{1}{x}\cos^2 x$

(d) $v' + \frac{2}{x}v = \frac{1}{x}\sec^2 x$

(e) $v' - \frac{2}{x}v = \frac{1}{x}\sec^2 x$

8. The general solution of the linear differential equation

$$(x^2+1)\frac{dy}{dx} + 3x^3y = 6x\,e^{-\frac{3}{2}x^2}$$

is

(a) $y(x) = [1 + c(x^2+1)^{\frac{3}{2}}]\,e^{-\frac{3}{2}x^2}$

(b) $y(x) = [-6 + c(x^2+1)^{\frac{3}{2}}]\,e^{-\frac{3}{2}x^2}$

(c) $y(x) = [-2 + c(x^2+1)^{\frac{3}{2}}]\,e^{-\frac{3}{2}x^2}$

(d) $y(x) = [-4 + c(x^2+1)^{\frac{3}{2}}]\,e^{-\frac{3}{2}x^2}$

(e) $y(x) = [-3 + c(x^2+1)^{\frac{3}{2}}]\,e^{-\frac{3}{2}x^2}$

9. If the solution space of the system

$$\begin{aligned} x_1 - 4x_2 - 3x_3 - 7x_4 &= 0 \\ 2x_1 - x_2 + x_3 + 7x_4 &= 0 \\ x_1 + 2x_2 + 3x_3 + 11x_4 &= 0 \end{aligned}$$

is the set of all linear combinations of the form $s\mathbf{u} + t\mathbf{v}$ where s, t are real numbers, then

(a) $\mathbf{u} = (-5, -3, 0, -1)$ and $\mathbf{v} = (1, 1, -1, 0)$

(b) $\mathbf{u} = (-5, -3, 0, 1)$ and $\mathbf{v} = (1, -1, 1, 0)$

(c) $\mathbf{u} = (5, -3, 0, 1)$ and $\mathbf{v} = (-1, -1, 1, 0)$

(d) $\mathbf{u} = (-5, -3, 0, -1)$ and $\mathbf{v} = (-1, -1, 1, 0)$

(e) $\mathbf{u} = (-5, -3, 0, 1)$ and $\mathbf{v} = (-1, -1, 1, 0)$

10. The general solution of the differential equation $x^2y'' + 3xy' = 2$ is given by (Note: A and B are constants, and $x > 0$)

(a) $y(x) = 2\ln x + \dfrac{A}{x^3} + B$

(b) $y(x) = \ln x + \dfrac{A}{x^3} + B$

(c) $y(x) = 2\ln x + \dfrac{A}{x^2} + B$

(d) $y(x) = \ln x + \dfrac{A}{x^2} + Bx$

(e) $y(x) = \ln x + \dfrac{A}{x^2} + B$

11. At 4:00 pm, a thermometer reading $20°C$ is put into a freezer where the temperature is $-10°C$. If the reading is $5°C$ at 4:02 pm, then the reading at 4:06 pm is

(a) $-4.25°C$
(b) $-8.25°C$
(c) $-6.25°C$
(d) $-7.25°C$
(e) $0°C$

12. If the function $k(x)$ with $k(0) = 0$ makes

$$\frac{dy}{dx} = \frac{y\cos x + 2xe^y + 3}{k(x) - x^2e^y + 2x}$$

an exact differential equation, then $k(x) =$

(a) $-\sin x + 4x$
(b) $-\sin x - 2x$
(c) $-\sin x + 3x$
(d) $\sin x - 2x$
(e) $\sin x + 2x$

13. Let $\mathbf{v}_1 = (5, 3, 4)$, $\mathbf{v}_2 = (3, 2, 5)$ and $\mathbf{w} = (1, 0, -7)$ be three vectors in $\mathbb{R}^3$.
If $\mathbf{w} = a\mathbf{v}_1 + b\mathbf{v}_2$, then $ab =$

(a) -6
(b) 6
(c) 0
(d) -8
(e) 10

14. A particle is moving in a straight line with acceleration $a(t) = t^2 \ln t$ and an initial velocity $v(1) = 0$. The velocity at any time $t > 1$ is given by

(a) $\frac{t^4}{4}\ln t - \frac{t^4}{8} + \frac{1}{8}$
(b) $\frac{t^3}{3}\ln t - \frac{t^3}{8} + \frac{1}{8}$
(c) $\frac{t^2}{2}\ln t - \frac{t^2}{8} + \frac{1}{8}$
(d) $\frac{t^4}{4}\ln t - \frac{t^4}{9} + \frac{1}{9}$
(e) $\frac{t^3}{3}\ln t - \frac{t^3}{9} + \frac{1}{9}$

15. The general solution of the differential equation

$$(2xy + 3y^2)\,dx - (2xy + x^2)\,dy = 0$$

is given by

(a) $y^3 + xy = cx^2$

(b) $y^2 + xy = cx^3$

(c) $y^2 + 2xy = cx^3$

(d) $y^2 - xy = cx^2$

(e) $y^2 + xy = cx^4$

King Fahd University of Petroleum and Minerals
Department of Mathematics

CODE 8 **CODE 8**

MATH 208
Major Exam I
Term 251
30 September 2025
Net Time Allowed: 90 Minutes

Name	
ID		**Sec**	

Check that this exam has 15 questions.

Important Instructions:

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3. Use a good eraser. DO NOT use the erasers attached to the pencil.
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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. A general solution of the exact differential equation

$$(y^2 + 3x^2 - 2xy^3)\,dx - (1 - 2xy + 3x^2y^2)\,dy = 0$$

is

(a) $y + xy^2 + x^2y^3 - x^3 = c$
(b) $y - xy^2 + x^2y^3 - x^3 = c$
(c) $y - xy^2 - x^2y^3 - x^3 = c$
(d) $y - 2xy^2 + x^2y^3 + x^3 = c$
(e) $y - xy^2 + x^2y^3 + x^3 = c$

2. By using a suitable substitution, we can transform the differential equation

$$(2y\cos^2 x - 2\sqrt{y})\,dx + x\cos^2 x\,dy = 0$$

into the linear differential equation

(a) $v' - \frac{1}{x}v = \frac{1}{x}\sec^2 x$
(b) $v' - \frac{2}{x}v = \frac{1}{x}\sec^2 x$
(c) $v' + \frac{2}{x}v = \frac{1}{x}\cos^2 x$
(d) $v' + \frac{2}{x}v = \frac{1}{x}\sec^2 x$
(e) $v' + \frac{1}{x}v = \frac{1}{x}\sec^2 x$

3. The general solution of the differential equation $x^2y'' + 3xy' = 2$ is given by (Note: A and B are constants, and $x > 0$)

   (a) $y(x) = 2\ln x + \dfrac{A}{x^3} + B$

   (b) $y(x) = 2\ln x + \dfrac{A}{x^2} + B$

   (c) $y(x) = \ln x + \dfrac{A}{x^3} + B$

   (d) $y(x) = \ln x + \dfrac{A}{x^2} + B$

   (e) $y(x) = \ln x + \dfrac{A}{x^2} + Bx$

4. A particle is moving in a straight line with acceleration $a(t) = t^2 \ln t$ and an initial velocity $v(1) = 0$. The velocity at any time $t > 1$ is given by

   (a) $\dfrac{t^3}{3}\ln t - \dfrac{t^3}{9} + \dfrac{1}{9}$

   (b) $\dfrac{t^4}{4}\ln t - \dfrac{t^4}{9} + \dfrac{1}{9}$

   (c) $\dfrac{t^3}{3}\ln t - \dfrac{t^3}{8} + \dfrac{1}{8}$

   (d) $\dfrac{t^2}{2}\ln t - \dfrac{t^2}{8} + \dfrac{1}{8}$

   (e) $\dfrac{t^4}{4}\ln t - \dfrac{t^4}{8} + \dfrac{1}{8}$

5. Which one of the following subsets is not a subspace of $\mathbb{R}^3$

(a) The set of all vectors (x_1, x_2, x_3) such that $x_1 + x_2 = 0$

(b) The set of all vectors (x_1, x_2, x_3) such that $x_1 + x_2 + x_3 = 0$

(c) The set of all vectors (x_1, x_2, x_3) such that $x_3 = 1$

(d) The set of all vectors (x_1, x_2, x_3) such that $x_3 = x_1 + x_2$

(e) The set of all vectors (x_1, x_2, x_3) such that $x_3 = 0$

6. The solution of the initial-value problem

$$(1 + x\cos^2 y + x + \cos^2 y)\,dx - x\sin y\,dy = 0,\ y(1) = 0$$

is

(a) $\ln|x| + 4x + \tan^{-1}(\cos y) = 1 + \dfrac{\pi}{4}$

(b) $\ln|x| + 2x + \tan^{-1}(\cos y) = 1 + \dfrac{\pi}{4}$

(c) $\ln|x| + 5x + \tan^{-1}(\cos y) = 1 + \dfrac{\pi}{2}$

(d) $\ln|x| + x + \tan^{-1}(\cos y) = 1 + \dfrac{\pi}{4}$

(e) $\ln|x| + 3x + \tan^{-1}(\cos y) = 1 + \dfrac{\pi}{3}$

7. By making a suitable substitution, the differential equation $\dfrac{dy}{dx} = 1 + e^{y-x+5}$ can be transformed into a separable differential equation

(a) $e^{-v}\,dv = dx$

(b) $e^{-v}\,dv = 2\,dx$

(c) $e^{v}\,dv = dx$

(d) $e^{v}\,dv = 2\,dx$

(e) $e^{-v}\,dv = x\,dx$

8. If the solution space of the system

$$\begin{aligned} x_1 - 4x_2 - 3x_3 - 7x_4 &= 0 \\ 2x_1 - x_2 + x_3 + 7x_4 &= 0 \\ x_1 + 2x_2 + 3x_3 + 11x_4 &= 0 \end{aligned}$$

is the set of all linear combinations of the form $s\mathbf{u} + t\mathbf{v}$ where s, t are real numbers, then

(a) $\mathbf{u} = (-5, -3, 0, 1)$ and $\mathbf{v} = (1, -1, 1, 0)$

(b) $\mathbf{u} = (-5, -3, 0, -1)$ and $\mathbf{v} = (-1, -1, 1, 0)$

(c) $\mathbf{u} = (-5, -3, 0, -1)$ and $\mathbf{v} = (1, 1, -1, 0)$

(d) $\mathbf{u} = (-5, -3, 0, 1)$ and $\mathbf{v} = (-1, -1, 1, 0)$

(e) $\mathbf{u} = (5, -3, 0, 1)$ and $\mathbf{v} = (-1, -1, 1, 0)$

9. If the vectors $\mathbf{u} = (5, -4, 3)$, $\mathbf{v} = (-2, 0, 3)$ and $\mathbf{w} = (a, -8, 1)$ are linearly dependent, then $3a =$

   (a) 42
   (b) -42
   (c) 36
   (d) -40
   (e) 40

10. If the function $k(x)$ with $k(0) = 0$ makes

$$\frac{dy}{dx} = \frac{y\cos x + 2xe^y + 3}{k(x) - x^2e^y + 2x}$$

   an exact differential equation, then $k(x) =$

   (a) $-\sin x - 2x$
   (b) $-\sin x + 3x$
   (c) $\sin x - 2x$
   (d) $-\sin x + 4x$
   (e) $\sin x + 2x$

11. At 4:00 pm, a thermometer reading $20°C$ is put into a freezer where the temperature is $-10°C$. If the reading is $5°C$ at 4:02 pm, then the reading at 4:06 pm is

(a) $-4.25°C$
(b) $-6.25°C$
(c) $0°C$
(d) $-7.25°C$
(e) $-8.25°C$

12. The general solution of the linear differential equation

$$(x^2+1)\frac{dy}{dx} + 3x^3 y = 6x\, e^{-\frac{3}{2}x^2}$$

is

(a) $y(x) = [1 + c(x^2+1)^{\frac{3}{2}}]\, e^{-\frac{3}{2}x^2}$
(b) $y(x) = [-4 + c(x^2+1)^{\frac{3}{2}}]\, e^{-\frac{3}{2}x^2}$
(c) $y(x) = [-6 + c(x^2+1)^{\frac{3}{2}}]\, e^{-\frac{3}{2}x^2}$
(d) $y(x) = [-2 + c(x^2+1)^{\frac{3}{2}}]\, e^{-\frac{3}{2}x^2}$
(e) $y(x) = [-3 + c(x^2+1)^{\frac{3}{2}}]\, e^{-\frac{3}{2}x^2}$

13. Let $\mathbf{v}_1 = (5, 3, 4)$, $\mathbf{v}_2 = (3, 2, 5)$ and $\mathbf{w} = (1, 0, -7)$ be three vectors in $\mathbb{R}^3$.
If $\mathbf{w} = a\mathbf{v}_1 + b\mathbf{v}_2$, then $ab =$

(a) -6

(b) 6

(c) 0

(d) -8

(e) 10

14. Let $y = x^m$ be a solution of the differential equation $xy^{(4)} + 6y''' = 0$, then the sum of all values of m is equal to

(a) 1

(b) 0

(c) 3

(d) -1

(e) 2

15. The general solution of the differential equation

$$(2xy + 3y^2)\,dx - (2xy + x^2)\,dy = 0$$

is given by

(a) $y^2 - xy = cx^2$

(b) $y^2 + 2xy = cx^3$

(c) $y^3 + xy = cx^2$

(d) $y^2 + xy = cx^4$

(e) $y^2 + xy = cx^3$

MATH 208, Term 251, Major Exam I **Answer KEY**

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

Answer Counts

V	A	B	C	D	E
1	6	2	2	4	1
2	1	4	2	3	5
3	4	2	3	4	2
4	6	4	0	1	4
5	2	3	3	2	5
6	2	5	4	2	2
7	3	2	4	2	4
8	4	3	1	4	3