King Fahd University of Petroleum and Minerals
Department of Mathematics

Math 208
Major Exam I
Term 253
July 02, 2026

EXAM COVER

Number of versions: 8
Number of questions: 15

King Fahd University of Petroleum and Minerals
Department of Mathematics

Math 208

Major Exam I

Term 253

July 02, 2026

Net Time Allowed: 90 Minutes

MASTER VERSION

1. If the vectors $\mathbf{u} = (1, k, 2)$, $\mathbf{v} = (2, 2, 0)$, and $\mathbf{w} = (1, 2, -2)$ in $\mathbb{R}^3$ are linearly dependent, then $k =$

   (a) 0 ______________________________ (correct)

   (b) 1

   (c) -1

   (d) 2

   (e) -2

2. If $y = y(x)$ is the solution of the initial value problem

$$\left(\frac{2+\sin x}{y+1}\right)\frac{dy}{dx} = -\cos x,\ y(0) = 1,$$

   then $y\left(\frac{\pi}{2}\right)$ equals

   (a) $\frac{1}{3}$ ______________________________ (correct)

   (b) $-\frac{1}{3}$

   (c) $-\frac{2}{3}$

   (d) $\frac{2}{3}$

   (e) $\frac{4}{3}$

3. If the function $g(x)$ with $g(0) = 1$ makes the differential equation

$$[g(x) - x\cos(xy)]\,dy = [e^{2x} + y\cos(xy)]\,dx$$

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

(a) 1 ______ (correct)
(b) $\cos(x)$
(c) $\sin(x) + 1$
(d) e^{2x}
(e) $\cos(2x)$

4. A general solution of the exact differential equation

$$\left(\frac{2x}{y} - \frac{3y^2}{x^4}\right)dx + \left(\frac{2y}{x^3} - \frac{x^2}{y^2} + \frac{1}{\sqrt{y}}\right)dy = 0$$

is

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

5. The general solution of the differential equation

$$\frac{dy}{dx} + y\cot x = \sin x,\ 0 < x < \pi \text{ is}$$

(a) $4y\sin x = 2x - \sin(2x) + c$ ______________________________ (correct)

(b) $2y\sin x = x - \sin(2x) + c$

(c) $4y\sin x = x - 2\sin(2x) + c$

(d) $2y\sin x = 2x + \sin(2x) + c$

(e) $3y\sin x = 4x - \sin(2x) + c$

6. A thermometer with an initial reading of $10°$ is brought into a room maintained at a constant temperature of $30°$. If the thermometer reads $20°$ after 2 minutes, what is the total time required for the thermometer to reach $25°$?

(a) 4 minutes ______________________________ (correct)

(b) 3 minutes

(c) 5 minutes

(d) 6 minutes

(e) 8 minutes

7. The general solution of the differential equation $(x^2 + 3xy + y^2)\, dx - x^2 dy = 0$ is given by

   (a) $\ln|x| + \left(1 + \frac{y}{x}\right)^{-1} = c$ ____ (correct)

   (b) $y = x \ln|x| + cx$

   (c) $\ln|x| + \left(1 + \frac{x}{y}\right)^{-1} = c$

   (d) $y = 2x \ln|x| + c\,x$

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

8. The general solution of the differential equation $xy'' + y' = 4x$, $x > 0$ is given by

   (a) $y(x) = x^2 + A \ln x + B$ ____ (correct)

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

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

   (d) $y(x) = 4x^2 + Ax \ln x + B$

   (e) $y(x) = 2x^2 + Ax \ln x + B$

9. The solution of the initial-value problem

$$x\frac{dy}{dx} - y = y^2 \ln x,\ y(1) = \frac{1}{2}$$

is given by

(a) $\frac{1}{y} = 1 - \ln x + \frac{1}{x}$ ______________________________ (correct)

(b) $y = 1 - \ln x + \frac{1}{x}$

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

(d) $\frac{1}{y} = 1 + 2\ln x + \frac{1}{x}$

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

10. The sum of all values of m for which $y = x^m$ is a solution of the differential equation

$$x^2y'' - 7xy' + 15y = 0$$

is

(a) 8 ______________________________ (correct)

(b) -8

(c) 2

(d) -2

(e) 0

11. By using an appropriate substitution, the differential equation $\dfrac{dy}{dx} = 1+\sqrt{y-4x+1}$ transforms into the separable differential equation

(a) $\dfrac{du}{\sqrt{u}-3} = dx$ ________________ (correct)

(b) $\dfrac{du}{\sqrt{u}+1} = dx$

(c) $\dfrac{du}{\sqrt{u}+2} = 3\,dx$

(d) $\dfrac{du}{\sqrt{u}-1} = 2\,dx$

(e) $\dfrac{du}{\sqrt{u}+3} = dx$

12. Which one of the following subsets is a subspace of $\mathbb{R}^4$?

(a) The set of all vectors (x_1, x_2, x_3, x_4) such that $x_1 - 2x_2 = 0$ and $x_3 + 5x_4 = 0$ (correct)

(b) The set of all vectors (x_1, x_2, x_3, x_4) such that $x_1^2 + x_2^2 = 1$

(c) The set of all vectors (x_1, x_2, x_3, x_4) such that $x_1 + x_2 - x_3 + 2x_4 = 1$

(d) The set of all vectors (x_1, x_2, x_3, x_4) such that $x_1 \geq 0$

(e) The set of all vectors (x_1, x_2, x_3, x_4) such that $x_1 x_3 = 0$

13. If the solution space of the system

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

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

$$\mathbf{u} = (a, b, 0, 0),\ \mathbf{v} = (m, n, 2, l),\ \text{then}\ \frac{a}{b} + \frac{2}{l} =$$

(a) 4 ____ (correct)

(b) 2

(c) 3

(d) 1

(e) 0

14. The solution of the linear differential equation

$$\frac{dy}{dx} = \frac{y}{2y\ln y + y - x} \text{ is given by}$$

(a) $xy = c + y^2 \ln y$ ________________________________ (correct)

(b) $2xy = c + y^2 \ln y$

(c) $xy = c\,x + y^2 \ln y$

(d) $2xy = c\,x + y^2 \ln y$

(e) $xy = c + x^2 \ln y$

15. If a particle is moving in a straight line with an acceleration $a(t) = \dfrac{1}{\sqrt{1-t^2}}$, initial-position $x(0) = 1$, and an initial velocity $v(0) = 0$, then the position of the particle at any time t is given by

(a) $x(t) = t\sin^{-1} t + \sqrt{1-t^2}$ ______ (correct)
(b) $x(t) = 2t\sin^{-1} t + \sqrt{1-t^2}$
(c) $x(t) = 2t\sin^{-1} t + 4\sqrt{1-t^2}$
(d) $x(t) = t\sin^{-1} t + 2\sqrt{1-t^2}$
(e) $x(t) = t\sin^{-1} t + 3\sqrt{1-t^2}$

King Fahd University of Petroleum and Minerals
Department of Mathematics

CODE 1 **CODE 1**

Math 208
Major Exam I
Term 253
July 02, 2026
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.
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. By using an appropriate substitution, the differential equation $\dfrac{dy}{dx} = 1+\sqrt{y-4x+1}$ transforms into the separable differential equation

   (a) $\dfrac{du}{\sqrt{u}-3} = dx$

   (b) $\dfrac{du}{\sqrt{u}+1} = dx$

   (c) $\dfrac{du}{\sqrt{u}-1} = 2\,dx$

   (d) $\dfrac{du}{\sqrt{u}+2} = 3\,dx$

   (e) $\dfrac{du}{\sqrt{u}+3} = dx$

2. Which one of the following subsets is a subspace of $\mathbb{R}^4$?

   (a) The set of all vectors (x_1, x_2, x_3, x_4) such that $x_1x_3 = 0$

   (b) The set of all vectors (x_1, x_2, x_3, x_4) such that $x_1 + x_2 - x_3 + 2x_4 = 1$

   (c) The set of all vectors (x_1, x_2, x_3, x_4) such that $x_1 - 2x_2 = 0$ and $x_3 + 5x_4 = 0$

   (d) The set of all vectors (x_1, x_2, x_3, x_4) such that $x_1^2 + x_2^2 = 1$

   (e) The set of all vectors (x_1, x_2, x_3, x_4) such that $x_1 \geq 0$

3. The sum of all values of m for which $y = x^m$ is a solution of the differential equation

$$x^2y'' - 7xy' + 15y = 0$$

is

(a) 2
(b) -8
(c) 8
(d) -2
(e) 0

4. If $y = y(x)$ is the solution of the initial value problem

$$\left(\frac{2+\sin x}{y+1}\right)\frac{dy}{dx} = -\cos x,\ y(0) = 1,$$

then $y\left(\frac{\pi}{2}\right)$ equals

(a) $-\frac{1}{3}$
(b) $-\frac{2}{3}$
(c) $\frac{4}{3}$
(d) $\frac{2}{3}$
(e) $\frac{1}{3}$

5. If the solution space of the system

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

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

$$\mathbf{u} = (a, b, 0, 0),\ \mathbf{v} = (m, n, 2, l),\ \text{then}\ \frac{a}{b} + \frac{2}{l} =$$

(a) 4
(b) 1
(c) 2
(d) 3
(e) 0

6. The general solution of the differential equation

$$\frac{dy}{dx} + y\cot x = \sin x,\ \ 0 < x < \pi \text{ is}$$

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

7. The solution of the linear differential equation

$$\frac{dy}{dx} = \frac{y}{2y\ln y + y - x} \text{ is given by}$$

(a) $2xy = c\,x + y^2 \ln y$

(b) $2xy = c + y^2 \ln y$

(c) $xy = c + x^2 \ln y$

(d) $xy = c + y^2 \ln y$

(e) $xy = c\,x + y^2 \ln y$

8. If the vectors $\mathbf{u} = (1, k, 2)$, $\mathbf{v} = (2, 2, 0)$, and $\mathbf{w} = (1, 2, -2)$ in $\mathbb{R}^3$ are linearly dependent, then $k =$

(a) 1

(b) 0

(c) -2

(d) -1

(e) 2

9. A thermometer with an initial reading of 10° is brought into a room maintained at a constant temperature of 30°. If the thermometer reads 20° after 2 minutes, what is the total time required for the thermometer to reach 25°?

(a) 6 minutes

(b) 3 minutes

(c) 5 minutes

(d) 8 minutes

(e) 4 minutes

10. If a particle is moving in a straight line with an acceleration $a(t) = \dfrac{1}{\sqrt{1-t^2}}$, initial-position $x(0) = 1$, and an initial velocity $v(0) = 0$, then the position of the particle at any time t is given by

(a) $x(t) = 2t\sin^{-1} t + \sqrt{1-t^2}$

(b) $x(t) = t\sin^{-1} t + 3\sqrt{1-t^2}$

(c) $x(t) = t\sin^{-1} t + \sqrt{1-t^2}$

(d) $x(t) = 2t\sin^{-1} t + 4\sqrt{1-t^2}$

(e) $x(t) = t\sin^{-1} t + 2\sqrt{1-t^2}$

11. The solution of the initial-value problem

$$x\frac{dy}{dx} - y = y^2 \ln x,\ y(1) = \frac{1}{2}$$

is given by

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

(b) $\dfrac{1}{y} = 1 - \ln x + \dfrac{1}{x}$

(c) $\dfrac{1}{y} = 1 + 2\ln x + \dfrac{1}{x}$

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

(e) $y = 1 - \ln x + \dfrac{1}{x}$

12. The general solution of the differential equation $(x^2 + 3xy + y^2)\,dx - x^2 dy = 0$ is given by

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

(b) $y = 2x\ln|x| + c\,x$

(c) $\ln|x| + \left(1 + \dfrac{y}{x}\right)^{-1} = c$

(d) $\ln|x| + \left(1 + \dfrac{x}{y}\right)^{-1} = c$

(e) $y = x\ln|x| + cx$

13. A general solution of the exact differential equation

$$\left(\frac{2x}{y} - \frac{3y^2}{x^4}\right) dx + \left(\frac{2y}{x^3} - \frac{x^2}{y^2} + \frac{1}{\sqrt{y}}\right) dy = 0$$

is

(a) $\dfrac{x^2}{y} - \dfrac{y^2}{x^2} + 2\sqrt{y} = c$

(b) $\dfrac{x^2}{y} + \dfrac{y^2}{x^3} + 2\sqrt{y} = c$

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

(d) $\dfrac{x^2}{y^2} + \dfrac{y^2}{x^3} + \sqrt{y} = c$

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

14. The general solution of the differential equation $xy'' + y' = 4x$, $x > 0$ is given by

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

(b) $y(x) = 4x^2 + Ax \ln x + B$

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

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

(e) $y(x) = 2x^2 + Ax \ln x + B$

15. If the function $g(x)$ with $g(0) = 1$ makes the differential equation

$$[g(x) - x\cos(xy)]\,dy = [e^{2x} + y\cos(xy)]\,dx$$

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

(a) $\cos(x)$

(b) $\sin(x) + 1$

(c) $\cos(2x)$

(d) 1

(e) e^{2x}

King Fahd University of Petroleum and Minerals
Department of Mathematics

CODE 2 **CODE 2**

Math 208
Major Exam I
Term 253
July 02, 2026
Net Time Allowed: 90 Minutes

Name	

ID		**Sec**	

Check that this exam has 15 questions.

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1. The solution of the linear differential equation

$$\frac{dy}{dx} = \frac{y}{2y\ln y + y - x} \text{ is given by}$$

(a) $2xy = c\,x + y^2 \ln y$

(b) $xy = c\,x + y^2 \ln y$

(c) $2xy = c + y^2 \ln y$

(d) $xy = c + y^2 \ln y$

(e) $xy = c + x^2 \ln y$

2. A general solution of the exact differential equation

$$\left(\frac{2x}{y} - \frac{3y^2}{x^4}\right) dx + \left(\frac{2y}{x^3} - \frac{x^2}{y^2} + \frac{1}{\sqrt{y}}\right) dy = 0$$

is

(a) $\dfrac{x^2}{y} - \dfrac{y}{x^3} + \sqrt{y} = c$

(b) $\dfrac{x^2}{y} + \dfrac{y^2}{x^3} + 2\sqrt{y} = c$

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

(d) $\dfrac{x}{y} + \dfrac{y^2}{x^3} + 2\sqrt{y} = c$

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

3. The general solution of the differential equation

$$\frac{dy}{dx} + y \cot x = \sin x,\ \ 0 < x < \pi \text{ is}$$

(a) $4y \sin x = x - 2\sin(2x) + c$

(b) $2y \sin x = x - \sin(2x) + c$

(c) $2y \sin x = 2x + \sin(2x) + c$

(d) $3y \sin x = 4x - \sin(2x) + c$

(e) $4y \sin x = 2x - \sin(2x) + c$

4. If the solution space of the system

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

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

$$\mathbf{u} = (a, b, 0, 0),\ \mathbf{v} = (m, n, 2, l), \text{ then } \frac{a}{b} + \frac{2}{l} =$$

(a) 2

(b) 4

(c) 1

(d) 0

(e) 3

5. If the function $g(x)$ with $g(0) = 1$ makes the differential equation

$$[g(x) - x\cos(xy)]\,dy = [e^{2x} + y\cos(xy)]\,dx$$

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

(a) $\sin(x) + 1$

(b) e^{2x}

(c) $\cos(x)$

(d) $\cos(2x)$

(e) 1

6. If a particle is moving in a straight line with an acceleration $a(t) = \dfrac{1}{\sqrt{1-t^2}}$, initial-position $x(0) = 1$, and an initial velocity $v(0) = 0$, then the position of the particle at any time t is given by

(a) $x(t) = 2t\sin^{-1}t + 4\sqrt{1-t^2}$

(b) $x(t) = 2t\sin^{-1}t + \sqrt{1-t^2}$

(c) $x(t) = t\sin^{-1}t + \sqrt{1-t^2}$

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

(e) $x(t) = t\sin^{-1}t + 2\sqrt{1-t^2}$

7. The solution of the initial-value problem

$$x\frac{dy}{dx} - y = y^2 \ln x,\ y(1) = \frac{1}{2}$$

is given by

(a) $\dfrac{1}{y} = 1 - \ln x + \dfrac{1}{x}$

(b) $\dfrac{1}{y} = 1 + 2\ln x + \dfrac{1}{x}$

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

(d) $y = 1 - \ln x + \dfrac{1}{x}$

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

8. If $y = y(x)$ is the solution of the initial value problem

$$\left(\frac{2 + \sin x}{y + 1}\right)\frac{dy}{dx} = -\cos x,\ y(0) = 1,$$

then $y\left(\frac{\pi}{2}\right)$ equals

(a) $-\dfrac{2}{3}$

(b) $\dfrac{1}{3}$

(c) $-\dfrac{1}{3}$

(d) $\dfrac{2}{3}$

(e) $\dfrac{4}{3}$

9. The sum of all values of m for which $y = x^m$ is a solution of the differential equation

$$x^2y'' - 7xy' + 15y = 0$$

is

(a) -8
(b) 0
(c) 2
(d) -2
(e) 8

10. If the vectors $\mathbf{u} = (1, k, 2)$, $\mathbf{v} = (2, 2, 0)$, and $\mathbf{w} = (1, 2, -2)$ in $\mathbb{R}^3$ are linearly dependent, then $k =$

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

11. The general solution of the differential equation $xy'' + y' = 4x$, $x > 0$ is given by

(a) $y(x) = 4x^2 + Ax\ln x + B$
(b) $y(x) = 2x^2 + A\ln x + B$
(c) $y(x) = 2x^2 + Ax\ln x + B$
(d) $y(x) = 3x^2 + A\ln x + B$
(e) $y(x) = x^2 + A\ln x + B$

12. A thermometer with an initial reading of 10° is brought into a room maintained at a constant temperature of 30°. If the thermometer reads 20° after 2 minutes, what is the total time required for the thermometer to reach 25°?

(a) 8 minutes
(b) 6 minutes
(c) 3 minutes
(d) 4 minutes
(e) 5 minutes

13. The general solution of the differential equation $(x^2 + 3xy + y^2)\,dx - x^2dy = 0$ is given by

(a) $y = x\ln|x| + cx$

(b) $\ln|x| + \left(1 + \dfrac{x}{y}\right)^{-1} = c$

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

(d) $y = 2x\ln|x| + c\,x$

(e) $\ln|x| + \left(1 + \dfrac{y}{x}\right)^{-1} = c$

14. By using an appropriate substitution, the differential equation $\dfrac{dy}{dx} = 1 + \sqrt{y - 4x + 1}$ transforms into the separable differential equation

(a) $\dfrac{du}{\sqrt{u} + 1} = dx$

(b) $\dfrac{du}{\sqrt{u} - 3} = dx$

(c) $\dfrac{du}{\sqrt{u} + 2} = 3\,dx$

(d) $\dfrac{du}{\sqrt{u} - 1} = 2\,dx$

(e) $\dfrac{du}{\sqrt{u} + 3} = dx$

15. Which one of the following subsets is a subspace of $\mathbb{R}^4$?

(a) The set of all vectors (x_1, x_2, x_3, x_4) such that $x_1 \geq 0$

(b) The set of all vectors (x_1, x_2, x_3, x_4) such that $x_1 + x_2 - x_3 + 2x_4 = 1$

(c) The set of all vectors (x_1, x_2, x_3, x_4) such that $x_1 x_3 = 0$

(d) The set of all vectors (x_1, x_2, x_3, x_4) such that $x_1^2 + x_2^2 = 1$

(e) The set of all vectors (x_1, x_2, x_3, x_4) such that $x_1 - 2x_2 = 0$ and $x_3 + 5x_4 = 0$

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Department of Mathematics

CODE 3 **CODE 3**

Math 208
Major Exam I
Term 253
July 02, 2026
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Name			
ID		**Sec**	

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1. A general solution of the exact differential equation

$$\left(\frac{2x}{y} - \frac{3y^2}{x^4}\right) dx + \left(\frac{2y}{x^3} - \frac{x^2}{y^2} + \frac{1}{\sqrt{y}}\right) dy = 0$$

is

(a) $\frac{x^2}{y^2} + \frac{y^2}{x^3} + \sqrt{y} = c$

(b) $\frac{x^2}{y} - \frac{y^2}{x^2} + 2\sqrt{y} = c$

(c) $\frac{x}{y} + \frac{y^2}{x^3} + 2\sqrt{y} = c$

(d) $\frac{x^2}{y} + \frac{y^2}{x^3} + 2\sqrt{y} = c$

(e) $\frac{x^2}{y} - \frac{y}{x^3} + \sqrt{y} = c$

2. If the function $g(x)$ with $g(0) = 1$ makes the differential equation

$$[g(x) - x\cos(xy)]\, dy = [e^{2x} + y\cos(xy)]\, dx$$

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

(a) $\sin(x) + 1$

(b) $\cos(x)$

(c) $\cos(2x)$

(d) e^{2x}

(e) 1

3. The general solution of the differential equation $(x^2 + 3xy + y^2)\,dx - x^2dy = 0$ is given by

   (a) $y = x\ln|x| + cx$

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

   (c) $\ln|x| + \left(1 + \dfrac{x}{y}\right)^{-1} = c$

   (d) $\ln|x| + \left(1 + \dfrac{y}{x}\right)^{-1} = c$

   (e) $y = 2x\ln|x| + c\,x$

4. The general solution of the differential equation

   $$\frac{dy}{dx} + y\cot x = \sin x,\ \ 0 < x < \pi \text{ is}$$

   (a) $4y\sin x = x - 2\sin(2x) + c$

   (b) $2y\sin x = 2x + \sin(2x) + c$

   (c) $3y\sin x = 4x - \sin(2x) + c$

   (d) $2y\sin x = x - \sin(2x) + c$

   (e) $4y\sin x = 2x - \sin(2x) + c$

5. The sum of all values of m for which $y = x^m$ is a solution of the differential equation

$$x^2y'' - 7xy' + 15y = 0$$

is

(a) 8
(b) -2
(c) -8
(d) 2
(e) 0

6. A thermometer with an initial reading of 10° is brought into a room maintained at a constant temperature of 30°. If the thermometer reads 20° after 2 minutes, what is the total time required for the thermometer to reach 25°?

(a) 3 minutes
(b) 8 minutes
(c) 4 minutes
(d) 6 minutes
(e) 5 minutes

7. If the solution space of the system

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

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

$$\mathbf{u} = (a, b, 0, 0),\ \mathbf{v} = (m, n, 2, l), \text{ then } \frac{a}{b} + \frac{2}{l} =$$

(a) 4
(b) 2
(c) 0
(d) 1
(e) 3

8. If the vectors $\mathbf{u} = (1, k, 2)$, $\mathbf{v} = (2, 2, 0)$, and $\mathbf{w} = (1, 2, -2)$ in $\mathbb{R}^3$ are linearly dependent, then $k =$

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

9. If $y = y(x)$ is the solution of the initial value problem

$$\left(\frac{2+\sin x}{y+1}\right)\frac{dy}{dx} = -\cos x,\ y(0) = 1,$$

then $y\left(\frac{\pi}{2}\right)$ equals

(a) $\frac{2}{3}$

(b) $-\frac{2}{3}$

(c) $\frac{1}{3}$

(d) $-\frac{1}{3}$

(e) $\frac{4}{3}$

10. Which one of the following subsets is a subspace of $\mathbb{R}^4$?

(a) The set of all vectors (x_1, x_2, x_3, x_4) such that $x_1 + x_2 - x_3 + 2x_4 = 1$

(b) The set of all vectors (x_1, x_2, x_3, x_4) such that $x_1 \geq 0$

(c) The set of all vectors (x_1, x_2, x_3, x_4) such that $x_1 x_3 = 0$

(d) The set of all vectors (x_1, x_2, x_3, x_4) such that $x_1^2 + x_2^2 = 1$

(e) The set of all vectors (x_1, x_2, x_3, x_4) such that $x_1 - 2x_2 = 0$ and $x_3 + 5x_4 = 0$

11. The general solution of the differential equation $xy'' + y' = 4x$, $x > 0$ is given by

(a) $y(x) = 2x^2 + A \ln x + B$
(b) $y(x) = 4x^2 + Ax \ln x + B$
(c) $y(x) = x^2 + A \ln x + B$
(d) $y(x) = 2x^2 + Ax \ln x + B$
(e) $y(x) = 3x^2 + A \ln x + B$

12. If a particle is moving in a straight line with an acceleration $a(t) = \dfrac{1}{\sqrt{1-t^2}}$, initial-position $x(0) = 1$, and an initial velocity $v(0) = 0$, then the position of the particle at any time t is given by

(a) $x(t) = t \sin^{-1} t + \sqrt{1-t^2}$
(b) $x(t) = 2t \sin^{-1} t + \sqrt{1-t^2}$
(c) $x(t) = 2t \sin^{-1} t + 4\sqrt{1-t^2}$
(d) $x(t) = t \sin^{-1} t + 3\sqrt{1-t^2}$
(e) $x(t) = t \sin^{-1} t + 2\sqrt{1-t^2}$

13. The solution of the linear differential equation

$$\frac{dy}{dx} = \frac{y}{2y\ln y + y - x} \text{ is given by}$$

(a) $2xy = c\,x + y^2 \ln y$
(b) $2xy = c + y^2 \ln y$
(c) $xy = c + x^2 \ln y$
(d) $xy = c + y^2 \ln y$
(e) $xy = c\,x + y^2 \ln y$

14. The solution of the initial-value problem

$$x\frac{dy}{dx} - y = y^2 \ln x,\ y(1) = \frac{1}{2}$$

is given by

(a) $y = 1 + 2\ln x - \dfrac{1}{2x}$
(b) $\dfrac{1}{y} = 1 - \ln x + \dfrac{1}{x}$
(c) $y = 1 - \ln x + \dfrac{1}{x}$
(d) $\dfrac{1}{y} = 1 + 2\ln x + \dfrac{1}{x}$
(e) $\dfrac{1}{y} = 1 - 2\ln x + \dfrac{1}{x}$

15. By using an appropriate substitution, the differential equation $\dfrac{dy}{dx} = 1+\sqrt{y-4x+1}$ transforms into the separable differential equation

(a) $\dfrac{du}{\sqrt{u}+1} = dx$

(b) $\dfrac{du}{\sqrt{u}+3} = dx$

(c) $\dfrac{du}{\sqrt{u}-1} = 2\,dx$

(d) $\dfrac{du}{\sqrt{u}-3} = dx$

(e) $\dfrac{du}{\sqrt{u}+2} = 3\,dx$

King Fahd University of Petroleum and Minerals
Department of Mathematics

CODE 4 **CODE 4**

Math 208
Major Exam I
Term 253
July 02, 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. If the solution space of the system

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

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

$$\mathbf{u} = (a, b, 0, 0),\ \mathbf{v} = (m, n, 2, l), \text{ then } \frac{a}{b} + \frac{2}{l} =$$

(a) 3
(b) 0
(c) 4
(d) 1
(e) 2

2. The general solution of the differential equation $xy'' + y' = 4x$, $x > 0$ is given by

(a) $y(x) = 3x^2 + A \ln x + B$
(b) $y(x) = 4x^2 + Ax \ln x + B$
(c) $y(x) = 2x^2 + A \ln x + B$
(d) $y(x) = x^2 + A \ln x + B$
(e) $y(x) = 2x^2 + Ax \ln x + B$

3. A thermometer with an initial reading of 10° is brought into a room maintained at a constant temperature of 30°. If the thermometer reads 20° after 2 minutes, what is the total time required for the thermometer to reach 25°?

(a) 4 minutes

(b) 5 minutes

(c) 3 minutes

(d) 8 minutes

(e) 6 minutes

4. A general solution of the exact differential equation

$$\left(\frac{2x}{y} - \frac{3y^2}{x^4}\right) dx + \left(\frac{2y}{x^3} - \frac{x^2}{y^2} + \frac{1}{\sqrt{y}}\right) dy = 0$$

is

(a) $\dfrac{x^2}{y^2} + \dfrac{y^2}{x^3} + \sqrt{y} = c$

(b) $\dfrac{x^2}{y} - \dfrac{y}{x^3} + \sqrt{y} = c$

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

(d) $\dfrac{x}{y} + \dfrac{y^2}{x^3} + 2\sqrt{y} = c$

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

5. Which one of the following subsets is a subspace of $\mathbb{R}^4$?

(a) The set of all vectors (x_1, x_2, x_3, x_4) such that $x_1 \geq 0$

(b) The set of all vectors (x_1, x_2, x_3, x_4) such that $x_1 - 2x_2 = 0$ and $x_3 + 5x_4 = 0$

(c) The set of all vectors (x_1, x_2, x_3, x_4) such that $x_1 x_3 = 0$

(d) The set of all vectors (x_1, x_2, x_3, x_4) such that $x_1^2 + x_2^2 = 1$

(e) The set of all vectors (x_1, x_2, x_3, x_4) such that $x_1 + x_2 - x_3 + 2x_4 = 1$

6. The solution of the linear differential equation

$\dfrac{dy}{dx} = \dfrac{y}{2y \ln y + y - x}$ is given by

(a) $2xy = c\,x + y^2 \ln y$

(b) $xy = c\,x + y^2 \ln y$

(c) $xy = c + y^2 \ln y$

(d) $2xy = c + y^2 \ln y$

(e) $xy = c + x^2 \ln y$

7. The general solution of the differential equation $(x^2 + 3xy + y^2)\,dx - x^2 dy = 0$ is given by

(a) $\ln|x| + \left(1 + \dfrac{x}{y}\right)^{-1} = c$

(b) $y = 2x\ln|x| + c\,x$

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

(d) $\ln|x| + \left(1 + \dfrac{y}{x}\right)^{-1} = c$

(e) $y = x\ln|x| + cx$

8. By using an appropriate substitution, the differential equation $\dfrac{dy}{dx} = 1 + \sqrt{y - 4x + 1}$ transforms into the separable differential equation

(a) $\dfrac{du}{\sqrt{u} + 3} = dx$

(b) $\dfrac{du}{\sqrt{u} - 1} = 2\,dx$

(c) $\dfrac{du}{\sqrt{u} + 2} = 3\,dx$

(d) $\dfrac{du}{\sqrt{u} + 1} = dx$

(e) $\dfrac{du}{\sqrt{u} - 3} = dx$

9. The sum of all values of m for which $y = x^m$ is a solution of the differential equation

$$x^2y'' - 7xy' + 15y = 0$$

is

(a) 8
(b) -8
(c) 2
(d) 0
(e) -2

10. The solution of the initial-value problem

$$x\frac{dy}{dx} - y = y^2 \ln x,\ y(1) = \frac{1}{2}$$

is given by

(a) $\dfrac{1}{y} = 1 - 2\ln x + \dfrac{1}{x}$
(b) $y = 1 + 2\ln x - \dfrac{1}{2x}$
(c) $\dfrac{1}{y} = 1 - \ln x + \dfrac{1}{x}$
(d) $y = 1 - \ln x + \dfrac{1}{x}$
(e) $\dfrac{1}{y} = 1 + 2\ln x + \dfrac{1}{x}$

11. If $y = y(x)$ is the solution of the initial value problem

$$\left(\frac{2+\sin x}{y+1}\right)\frac{dy}{dx} = -\cos x,\ y(0) = 1,$$

then $y\left(\frac{\pi}{2}\right)$ equals

(a) $\frac{4}{3}$

(b) $-\frac{2}{3}$

(c) $\frac{2}{3}$

(d) $-\frac{1}{3}$

(e) $\frac{1}{3}$

12. If a particle is moving in a straight line with an acceleration $a(t) = \dfrac{1}{\sqrt{1-t^2}}$, initial-position $x(0) = 1$, and an initial velocity $v(0) = 0$, then the position of the particle at any time t is given by

(a) $x(t) = t\sin^{-1} t + 3\sqrt{1-t^2}$

(b) $x(t) = t\sin^{-1} t + 2\sqrt{1-t^2}$

(c) $x(t) = 2t\sin^{-1} t + 4\sqrt{1-t^2}$

(d) $x(t) = 2t\sin^{-1} t + \sqrt{1-t^2}$

(e) $x(t) = t\sin^{-1} t + \sqrt{1-t^2}$

13. The general solution of the differential equation

$$\frac{dy}{dx} + y\cot x = \sin x,\ \ 0 < x < \pi \text{ is}$$

(a) $2y\sin x = x - \sin(2x) + c$

(b) $4y\sin x = x - 2\sin(2x) + c$

(c) $2y\sin x = 2x + \sin(2x) + c$

(d) $4y\sin x = 2x - \sin(2x) + c$

(e) $3y\sin x = 4x - \sin(2x) + c$

14. If the function $g(x)$ with $g(0) = 1$ makes the differential equation

$$[g(x) - x\cos(xy)]\,dy = [e^{2x} + y\cos(xy)]\,dx$$

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

(a) $\cos(x)$

(b) 1

(c) e^{2x}

(d) $\cos(2x)$

(e) $\sin(x) + 1$

15. If the vectors $\mathbf{u} = (1, k, 2)$, $\mathbf{v} = (2, 2, 0)$, and $\mathbf{w} = (1, 2, -2)$ in $\mathbb{R}^3$ are linearly dependent, then $k =$

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

King Fahd University of Petroleum and Minerals
Department of Mathematics

CODE 5 | CODE 5

Math 208
Major Exam I
Term 253
July 02, 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.
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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. The solution of the initial-value problem

$$x\frac{dy}{dx} - y = y^2 \ln x, \; y(1) = \frac{1}{2}$$

is given by

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

(b) $\dfrac{1}{y} = 1 + 2\ln x + \dfrac{1}{x}$

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

(d) $y = 1 - \ln x + \dfrac{1}{x}$

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

2. The general solution of the differential equation $(x^2 + 3xy + y^2)\,dx - x^2 dy = 0$ is given by

(a) $y = 2x\ln|x| + c\,x$

(b) $\ln|x| + \left(1 + \dfrac{y}{x}\right)^{-1} = c$

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

(d) $y = x\ln|x| + cx$

(e) $\ln|x| + \left(1 + \dfrac{x}{y}\right)^{-1} = c$

3. The general solution of the differential equation $xy'' + y' = 4x$, $x > 0$ is given by

(a) $y(x) = 2x^2 + A\ln x + B$
(b) $y(x) = 3x^2 + A\ln x + B$
(c) $y(x) = x^2 + A\ln x + B$
(d) $y(x) = 2x^2 + Ax\ln x + B$
(e) $y(x) = 4x^2 + Ax\ln x + B$

4. A general solution of the exact differential equation

$$\left(\frac{2x}{y} - \frac{3y^2}{x^4}\right) dx + \left(\frac{2y}{x^3} - \frac{x^2}{y^2} + \frac{1}{\sqrt{y}}\right) dy = 0$$

is

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

5. If the solution space of the system

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

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

$$\mathbf{u} = (a, b, 0, 0),\ \mathbf{v} = (m, n, 2, l), \text{ then } \frac{a}{b} + \frac{2}{l} =$$

(a) 4
(b) 2
(c) 3
(d) 1
(e) 0

6. Which one of the following subsets is a subspace of $\mathbb{R}^4$?

(a) The set of all vectors (x_1, x_2, x_3, x_4) such that $x_1 x_3 = 0$
(b) The set of all vectors (x_1, x_2, x_3, x_4) such that $x_1^2 + x_2^2 = 1$
(c) The set of all vectors (x_1, x_2, x_3, x_4) such that $x_1 + x_2 - x_3 + 2x_4 = 1$
(d) The set of all vectors (x_1, x_2, x_3, x_4) such that $x_1 - 2x_2 = 0$ and $x_3 + 5x_4 = 0$
(e) The set of all vectors (x_1, x_2, x_3, x_4) such that $x_1 \geq 0$

7. If the function $g(x)$ with $g(0) = 1$ makes the differential equation

$$[g(x) - x\cos(xy)]\,dy = [e^{2x} + y\cos(xy)]\,dx$$

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

(a) e^{2x}
(b) $\cos(x)$
(c) 1
(d) $\sin(x) + 1$
(e) $\cos(2x)$

8. If the vectors $\mathbf{u} = (1, k, 2)$, $\mathbf{v} = (2, 2, 0)$, and $\mathbf{w} = (1, 2, -2)$ in $\mathbb{R}^3$ are linearly dependent, then $k =$

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

9. By using an appropriate substitution, the differential equation $\dfrac{dy}{dx} = 1+\sqrt{y-4x+1}$ transforms into the separable differential equation

(a) $\dfrac{du}{\sqrt{u}-3} = dx$

(b) $\dfrac{du}{\sqrt{u}+1} = dx$

(c) $\dfrac{du}{\sqrt{u}+2} = 3\,dx$

(d) $\dfrac{du}{\sqrt{u}+3} = dx$

(e) $\dfrac{du}{\sqrt{u}-1} = 2\,dx$

10. The sum of all values of m for which $y = x^m$ is a solution of the differential equation

$$x^2y'' - 7xy' + 15y = 0$$

is

(a) -2

(b) 2

(c) 8

(d) 0

(e) -8

11. If $y = y(x)$ is the solution of the initial value problem

$$\left(\frac{2+\sin x}{y+1}\right)\frac{dy}{dx} = -\cos x,\ y(0) = 1,$$

then $y\left(\frac{\pi}{2}\right)$ equals

(a) $-\frac{1}{3}$
(b) $-\frac{2}{3}$
(c) $\frac{2}{3}$
(d) $\frac{4}{3}$
(e) $\frac{1}{3}$

12. The general solution of the differential equation

$$\frac{dy}{dx} + y\cot x = \sin x,\ 0 < x < \pi \text{ is}$$

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

13. The solution of the linear differential equation

$$\frac{dy}{dx} = \frac{y}{2y\ln y + y - x} \text{ is given by}$$

(a) $xy = c + x^2 \ln y$
(b) $xy = c\,x + y^2 \ln y$
(c) $xy = c + y^2 \ln y$
(d) $2xy = c + y^2 \ln y$
(e) $2xy = c\,x + y^2 \ln y$

14. If a particle is moving in a straight line with an acceleration $a(t) = \dfrac{1}{\sqrt{1-t^2}}$, initial-position $x(0) = 1$, and an initial velocity $v(0) = 0$, then the position of the particle at any time t is given by

(a) $x(t) = t\sin^{-1} t + 3\sqrt{1-t^2}$
(b) $x(t) = 2t\sin^{-1} t + \sqrt{1-t^2}$
(c) $x(t) = t\sin^{-1} t + \sqrt{1-t^2}$
(d) $x(t) = 2t\sin^{-1} t + 4\sqrt{1-t^2}$
(e) $x(t) = t\sin^{-1} t + 2\sqrt{1-t^2}$

15. A thermometer with an initial reading of 10° is brought into a room maintained at a constant temperature of 30°. If the thermometer reads 20° after 2 minutes, what is the total time required for the thermometer to reach 25°?

(a) 6 minutes

(b) 3 minutes

(c) 5 minutes

(d) 4 minutes

(e) 8 minutes

King Fahd University of Petroleum and Minerals
Department of Mathematics

CODE 6 **CODE 6**

Math 208
Major Exam I
Term 253
July 02, 2026
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. A general solution of the exact differential equation

$$\left(\frac{2x}{y} - \frac{3y^2}{x^4}\right) dx + \left(\frac{2y}{x^3} - \frac{x^2}{y^2} + \frac{1}{\sqrt{y}}\right) dy = 0$$

is

(a) $\dfrac{x^2}{y} + \dfrac{y^2}{x^3} + 2\sqrt{y} = c$

(b) $\dfrac{x^2}{y} - \dfrac{y}{x^3} + \sqrt{y} = c$

(c) $\dfrac{x^2}{y^2} + \dfrac{y^2}{x^3} + \sqrt{y} = c$

(d) $\dfrac{x^2}{y} - \dfrac{y^2}{x^2} + 2\sqrt{y} = c$

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

2. A thermometer with an initial reading of 10° is brought into a room maintained at a constant temperature of 30°. If the thermometer reads 20° after 2 minutes, what is the total time required for the thermometer to reach 25°?

(a) 4 minutes

(b) 3 minutes

(c) 8 minutes

(d) 5 minutes

(e) 6 minutes

3. The solution of the initial-value problem

$$x\frac{dy}{dx} - y = y^2 \ln x, \; y(1) = \frac{1}{2}$$

is given by

(a) $y = 1 - \ln x + \dfrac{1}{x}$

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

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

(d) $\dfrac{1}{y} = 1 + 2\ln x + \dfrac{1}{x}$

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

4. The sum of all values of m for which $y = x^m$ is a solution of the differential equation

$$x^2y'' - 7xy' + 15y = 0$$

is

(a) 0

(b) -2

(c) 2

(d) 8

(e) -8

5. If the function $g(x)$ with $g(0) = 1$ makes the differential equation

$$[g(x) - x\cos(xy)]\,dy = [e^{2x} + y\cos(xy)]\,dx$$

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

(a) 1
(b) $\cos(2x)$
(c) $\sin(x) + 1$
(d) e^{2x}
(e) $\cos(x)$

6. Which one of the following subsets is a subspace of $\mathbb{R}^4$?

(a) The set of all vectors (x_1, x_2, x_3, x_4) such that $x_1 \geq 0$
(b) The set of all vectors (x_1, x_2, x_3, x_4) such that $x_1 x_3 = 0$
(c) The set of all vectors (x_1, x_2, x_3, x_4) such that $x_1 - 2x_2 = 0$ and $x_3 + 5x_4 = 0$
(d) The set of all vectors (x_1, x_2, x_3, x_4) such that $x_1^2 + x_2^2 = 1$
(e) The set of all vectors (x_1, x_2, x_3, x_4) such that $x_1 + x_2 - x_3 + 2x_4 = 1$

7. The general solution of the differential equation $xy'' + y' = 4x$, $x > 0$ is given by

   (a) $y(x) = x^2 + A\ln x + B$
   (b) $y(x) = 3x^2 + A\ln x + B$
   (c) $y(x) = 4x^2 + Ax\ln x + B$
   (d) $y(x) = 2x^2 + A\ln x + B$
   (e) $y(x) = 2x^2 + Ax\ln x + B$

8. If the vectors $\mathbf{u} = (1, k, 2)$, $\mathbf{v} = (2, 2, 0)$, and $\mathbf{w} = (1, 2, -2)$ in $\mathbb{R}^3$ are linearly dependent, then $k =$

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

9. The general solution of the differential equation

$$\frac{dy}{dx} + y\cot x = \sin x,\ \ 0 < x < \pi \text{ is}$$

(a) $2y\sin x = x - \sin(2x) + c$

(b) $2y\sin x = 2x + \sin(2x) + c$

(c) $4y\sin x = x - 2\sin(2x) + c$

(d) $4y\sin x = 2x - \sin(2x) + c$

(e) $3y\sin x = 4x - \sin(2x) + c$

10. The general solution of the differential equation $(x^2 + 3xy + y^2)\,dx - x^2dy = 0$ is given by

(a) $y = x\ln|x| + cx$

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

(c) $\ln|x| + \left(1 + \dfrac{y}{x}\right)^{-1} = c$

(d) $\ln|x| + \left(1 + \dfrac{x}{y}\right)^{-1} = c$

(e) $y = 2x\ln|x| + c\,x$

11. If a particle is moving in a straight line with an acceleration $a(t) = \dfrac{1}{\sqrt{1-t^2}}$, initial-position $x(0) = 1$, and an initial velocity $v(0) = 0$, then the position of the particle at any time t is given by

(a) $x(t) = t\sin^{-1} t + 3\sqrt{1-t^2}$
(b) $x(t) = t\sin^{-1} t + 2\sqrt{1-t^2}$
(c) $x(t) = t\sin^{-1} t + \sqrt{1-t^2}$
(d) $x(t) = 2t\sin^{-1} t + \sqrt{1-t^2}$
(e) $x(t) = 2t\sin^{-1} t + 4\sqrt{1-t^2}$

12. If $y = y(x)$ is the solution of the initial value problem

$$\left(\frac{2+\sin x}{y+1}\right)\frac{dy}{dx} = -\cos x,\ y(0) = 1,$$

then $y\left(\frac{\pi}{2}\right)$ equals

(a) $-\dfrac{1}{3}$
(b) $-\dfrac{2}{3}$
(c) $\dfrac{1}{3}$
(d) $\dfrac{2}{3}$
(e) $\dfrac{4}{3}$

13. If the solution space of the system

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

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

$$\mathbf{u} = (a, b, 0, 0),\ \mathbf{v} = (m, n, 2, l),\ \text{then}\ \frac{a}{b} + \frac{2}{l} =$$

(a) 2
(b) 1
(c) 0
(d) 3
(e) 4

14. By using an appropriate substitution, the differential equation $\dfrac{dy}{dx} = 1 + \sqrt{y - 4x + 1}$ transforms into the separable differential equation

(a) $\dfrac{du}{\sqrt{u} + 3} = dx$
(b) $\dfrac{du}{\sqrt{u} + 2} = 3\,dx$
(c) $\dfrac{du}{\sqrt{u} - 3} = dx$
(d) $\dfrac{du}{\sqrt{u} - 1} = 2\,dx$
(e) $\dfrac{du}{\sqrt{u} + 1} = dx$

15. The solution of the linear differential equation

$$\frac{dy}{dx} = \frac{y}{2y\ln y + y - x} \text{ is given by}$$

(a) $2xy = c + y^2 \ln y$

(b) $xy = c + x^2 \ln y$

(c) $2xy = c\,x + y^2 \ln y$

(d) $xy = c + y^2 \ln y$

(e) $xy = c\,x + y^2 \ln y$

King Fahd University of Petroleum and Minerals
Department of Mathematics

CODE 7 **CODE 7**

Math 208
Major Exam I
Term 253
July 02, 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 solution of the initial-value problem

$$x\frac{dy}{dx} - y = y^2 \ln x,\ y(1) = \frac{1}{2}$$

is given by

(a) $y = 1 - \ln x + \dfrac{1}{x}$

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

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

(d) $\dfrac{1}{y} = 1 + 2\ln x + \dfrac{1}{x}$

(e) $\dfrac{1}{y} = 1 - \ln x + \dfrac{1}{x}$

2. By using an appropriate substitution, the differential equation $\dfrac{dy}{dx} = 1+\sqrt{y - 4x + 1}$ transforms into the separable differential equation

(a) $\dfrac{du}{\sqrt{u} - 1} = 2\,dx$

(b) $\dfrac{du}{\sqrt{u} + 2} = 3\,dx$

(c) $\dfrac{du}{\sqrt{u} + 3} = dx$

(d) $\dfrac{du}{\sqrt{u} + 1} = dx$

(e) $\dfrac{du}{\sqrt{u} - 3} = dx$

3. The general solution of the differential equation $(x^2 + 3xy + y^2)\,dx - x^2dy = 0$ is given by

(a) $\ln|x| + \left(1 + \frac{y}{x}\right)^{-1} = c$

(b) $y = 2x\ln|x| + c\,x$

(c) $\ln|x| + \frac{y}{x} + 1 = c$

(d) $y = x\ln|x| + cx$

(e) $\ln|x| + \left(1 + \frac{x}{y}\right)^{-1} = c$

4. The general solution of the differential equation $xy'' + y' = 4x$, $x > 0$ is given by

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

(b) $y(x) = 2x^2 + Ax\ln x + B$

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

(d) $y(x) = 4x^2 + Ax\ln x + B$

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

5. The general solution of the differential equation

$$\frac{dy}{dx} + y\cot x = \sin x,\ \ 0 < x < \pi \text{ is}$$

(a) $4y\sin x = 2x - \sin(2x) + c$

(b) $2y\sin x = x - \sin(2x) + c$

(c) $3y\sin x = 4x - \sin(2x) + c$

(d) $4y\sin x = x - 2\sin(2x) + c$

(e) $2y\sin x = 2x + \sin(2x) + c$

6. If $y = y(x)$ is the solution of the initial value problem

$$\left(\frac{2+\sin x}{y+1}\right)\frac{dy}{dx} = -\cos x,\ y(0) = 1,$$

then $y\left(\frac{\pi}{2}\right)$ equals

(a) $\frac{2}{3}$

(b) $-\frac{1}{3}$

(c) $\frac{1}{3}$

(d) $-\frac{2}{3}$

(e) $\frac{4}{3}$

7. The solution of the linear differential equation

$$\frac{dy}{dx} = \frac{y}{2y\ln y + y - x} \text{ is given by}$$

(a) $2xy = c + y^2 \ln y$
(b) $xy = c + y^2 \ln y$
(c) $xy = c + x^2 \ln y$
(d) $2xy = c\,x + y^2 \ln y$
(e) $xy = c\,x + y^2 \ln y$

8. A thermometer with an initial reading of 10° is brought into a room maintained at a constant temperature of 30°. If the thermometer reads 20° after 2 minutes, what is the total time required for the thermometer to reach 25°?

(a) 5 minutes
(b) 4 minutes
(c) 6 minutes
(d) 8 minutes
(e) 3 minutes

9. The sum of all values of m for which $y = x^m$ is a solution of the differential equation

$$x^2y'' - 7xy' + 15y = 0$$

is

(a) 8
(b) 2
(c) 0
(d) -8
(e) -2

10. A general solution of the exact differential equation

$$\left(\frac{2x}{y} - \frac{3y^2}{x^4}\right) dx + \left(\frac{2y}{x^3} - \frac{x^2}{y^2} + \frac{1}{\sqrt{y}}\right) dy = 0$$

is

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

11. If the function $g(x)$ with $g(0) = 1$ makes the differential equation

$$[g(x) - x\cos(xy)]\,dy = [e^{2x} + y\cos(xy)]\,dx$$

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

(a) $\sin(x) + 1$
(b) $\cos(x)$
(c) $\cos(2x)$
(d) e^{2x}
(e) 1

12. If a particle is moving in a straight line with an acceleration $a(t) = \dfrac{1}{\sqrt{1-t^2}}$, initial-position $x(0) = 1$, and an initial velocity $v(0) = 0$, then the position of the particle at any time t is given by

(a) $x(t) = 2t\sin^{-1} t + 4\sqrt{1-t^2}$
(b) $x(t) = t\sin^{-1} t + 3\sqrt{1-t^2}$
(c) $x(t) = 2t\sin^{-1} t + \sqrt{1-t^2}$
(d) $x(t) = t\sin^{-1} t + \sqrt{1-t^2}$
(e) $x(t) = t\sin^{-1} t + 2\sqrt{1-t^2}$

13. If the vectors $\mathbf{u} = (1, k, 2)$, $\mathbf{v} = (2, 2, 0)$, and $\mathbf{w} = (1, 2, -2)$ in $\mathbb{R}^3$ are linearly dependent, then $k =$

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

14. If the solution space of the system

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

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

$$\mathbf{u} = (a, b, 0, 0),\ \mathbf{v} = (m, n, 2, l),\text{ then } \frac{a}{b} + \frac{2}{l} =$$

(a) 1
(b) 0
(c) 2
(d) 3
(e) 4

15. Which one of the following subsets is a subspace of $\mathbb{R}^4$?

(a) The set of all vectors (x_1, x_2, x_3, x_4) such that $x_1 + x_2 - x_3 + 2x_4 = 1$

(b) The set of all vectors (x_1, x_2, x_3, x_4) such that $x_1^2 + x_2^2 = 1$

(c) The set of all vectors (x_1, x_2, x_3, x_4) such that $x_1 - 2x_2 = 0$ and $x_3 + 5x_4 = 0$

(d) The set of all vectors (x_1, x_2, x_3, x_4) such that $x_1 \geq 0$

(e) The set of all vectors (x_1, x_2, x_3, x_4) such that $x_1x_3 = 0$

King Fahd University of Petroleum and Minerals
Department of Mathematics

CODE 8 **CODE 8**

Math 208
Major Exam I
Term 253
July 02, 2026
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. The solution of the initial-value problem

$$x\frac{dy}{dx} - y = y^2 \ln x,\ y(1) = \frac{1}{2}$$

is given by

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

(b) $\dfrac{1}{y} = 1 + 2\ln x + \dfrac{1}{x}$

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

(d) $\dfrac{1}{y} = 1 - \ln x + \dfrac{1}{x}$

(e) $y = 1 - \ln x + \dfrac{1}{x}$

2. A thermometer with an initial reading of 10° is brought into a room maintained at a constant temperature of 30°. If the thermometer reads 20° after 2 minutes, what is the total time required for the thermometer to reach 25°?

(a) 3 minutes

(b) 8 minutes

(c) 6 minutes

(d) 4 minutes

(e) 5 minutes

3. The solution of the linear differential equation

$$\frac{dy}{dx} = \frac{y}{2y\ln y + y - x} \text{ is given by}$$

(a) $2xy = c + y^2 \ln y$
(b) $2xy = c\,x + y^2 \ln y$
(c) $xy = c + y^2 \ln y$
(d) $xy = c\,x + y^2 \ln y$
(e) $xy = c + x^2 \ln y$

4. If the vectors $\mathbf{u} = (1, k, 2)$, $\mathbf{v} = (2, 2, 0)$, and $\mathbf{w} = (1, 2, -2)$ in $\mathbb{R}^3$ are linearly dependent, then $k =$

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

5. The general solution of the differential equation

$$\frac{dy}{dx} + y\cot x = \sin x,\ 0 < x < \pi \text{ is}$$

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

6. The general solution of the differential equation $(x^2 + 3xy + y^2)\,dx - x^2dy = 0$ is given by

(a) $\ln|x| + \dfrac{y}{x} + 1 = c$
(b) $\ln|x| + \left(1 + \dfrac{x}{y}\right)^{-1} = c$
(c) $\ln|x| + \left(1 + \dfrac{y}{x}\right)^{-1} = c$
(d) $y = x\ln|x| + cx$
(e) $y = 2x\ln|x| + c\,x$

7. If the function $g(x)$ with $g(0) = 1$ makes the differential equation

$$[g(x) - x\cos(xy)]\,dy = [e^{2x} + y\cos(xy)]\,dx$$

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

(a) 1
(b) e^{2x}
(c) $\cos(2x)$
(d) $\sin(x) + 1$
(e) $\cos(x)$

8. By using an appropriate substitution, the differential equation $\dfrac{dy}{dx} = 1+\sqrt{y - 4x + 1}$ transforms into the separable differential equation

(a) $\dfrac{du}{\sqrt{u}+2} = 3\,dx$
(b) $\dfrac{du}{\sqrt{u}-3} = dx$
(c) $\dfrac{du}{\sqrt{u}+3} = dx$
(d) $\dfrac{du}{\sqrt{u}-1} = 2\,dx$
(e) $\dfrac{du}{\sqrt{u}+1} = dx$

9. The sum of all values of m for which $y = x^m$ is a solution of the differential equation

$$x^2y'' - 7xy' + 15y = 0$$

is

(a) 8
(b) 0
(c) 2
(d) -2
(e) -8

10. If $y = y(x)$ is the solution of the initial value problem

$$\left(\frac{2+\sin x}{y+1}\right)\frac{dy}{dx} = -\cos x,\ y(0) = 1,$$

then $y\left(\frac{\pi}{2}\right)$ equals

(a) $\frac{2}{3}$
(b) $\frac{4}{3}$
(c) $-\frac{1}{3}$
(d) $\frac{1}{3}$
(e) $-\frac{2}{3}$

11. Which one of the following subsets is a subspace of $\mathbb{R}^4$?

(a) The set of all vectors (x_1, x_2, x_3, x_4) such that $x_1^2 + x_2^2 = 1$

(b) The set of all vectors (x_1, x_2, x_3, x_4) such that $x_1 - 2x_2 = 0$ and $x_3 + 5x_4 = 0$

(c) The set of all vectors (x_1, x_2, x_3, x_4) such that $x_1 x_3 = 0$

(d) The set of all vectors (x_1, x_2, x_3, x_4) such that $x_1 \geq 0$

(e) The set of all vectors (x_1, x_2, x_3, x_4) such that $x_1 + x_2 - x_3 + 2x_4 = 1$

12. A general solution of the exact differential equation

$$\left(\frac{2x}{y} - \frac{3y^2}{x^4}\right) dx + \left(\frac{2y}{x^3} - \frac{x^2}{y^2} + \frac{1}{\sqrt{y}}\right) dy = 0$$

is

(a) $\dfrac{x^2}{y} - \dfrac{y^2}{x^2} + 2\sqrt{y} = c$

(b) $\dfrac{x^2}{y} + \dfrac{y^2}{x^3} + 2\sqrt{y} = c$

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

(d) $\dfrac{x^2}{y^2} + \dfrac{y^2}{x^3} + \sqrt{y} = c$

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

13. The general solution of the differential equation $xy'' + y' = 4x$, $x > 0$ is given by

(a) $y(x) = x^2 + A \ln x + B$
(b) $y(x) = 2x^2 + Ax \ln x + B$
(c) $y(x) = 2x^2 + A \ln x + B$
(d) $y(x) = 4x^2 + Ax \ln x + B$
(e) $y(x) = 3x^2 + A \ln x + B$

14. If the solution space of the system

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

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

$$\mathbf{u} = (a, b, 0, 0),\ \mathbf{v} = (m, n, 2, l),\ \text{then}\ \frac{a}{b} + \frac{2}{l} =$$

(a) 2
(b) 4
(c) 3
(d) 1
(e) 0

15. If a particle is moving in a straight line with an acceleration $a(t) = \dfrac{1}{\sqrt{1-t^2}}$, initial-position $x(0) = 1$, and an initial velocity $v(0) = 0$, then the position of the particle at any time t is given by

(a) $x(t) = t\sin^{-1} t + 2\sqrt{1-t^2}$

(b) $x(t) = t\sin^{-1} t + 3\sqrt{1-t^2}$

(c) $x(t) = t\sin^{-1} t + \sqrt{1-t^2}$

(d) $x(t) = 2t\sin^{-1} t + 4\sqrt{1-t^2}$

(e) $x(t) = 2t\sin^{-1} t + \sqrt{1-t^2}$

Answer KEY

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

Answer Counts

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

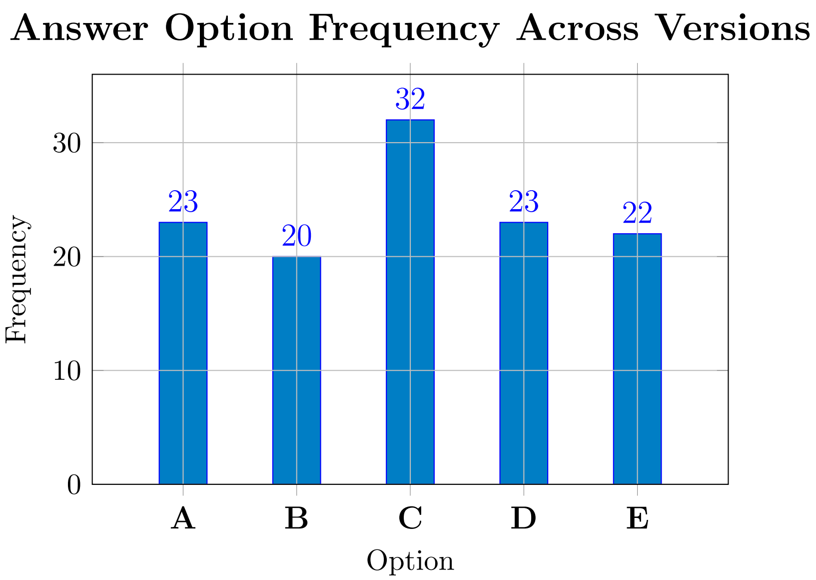

Figure 1: Frequency of Each Answer Option (Excluding MASTER)