King Fahd University of Petroleum and Minerals
Department of Mathematics

Math 371
Major Exam I
Term 252
February 17, 2026

EXAM COVER

Number of versions: 8
Number of questions: 14

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Net Time Allowed: 90 Minutes

MASTER VERSION

1. Let $P_3(x)$ be the third Taylor polynomial of $f(x) = 2x\cos(2x) - (x-2)^2$ about $x_0 = 0$. Then, the **least upper bound** for $|f(0.4) - P_3(0.4)|$ is

    (a) 0.05849 ————————————————————————————————(correct)

    (b) 0.01336

    (c) 0.58546

    (d) 0.03336

    (e) 0.36320

2. Let $f(x) = x^3$, and let $P_2(x)$ be the degree-2 Taylor polynomial about $x_0 = 1$. Compute $f(0.5)$ and $P_2(0.5)$, and then use three-digit rounding arithmetic to approximate the relative error at $x = 0.5$.

    (a) 1.00 ————————————————————————————————(correct)

    (b) 0.125

    (c) 0.015

    (d) 1.12

    (e) 1.15

3. The bound of number of iterations using Bisection method needed to achieve an approximation with accuracy 10^{-2} to the solution of $x^3 - 7x^2 + 14x - 6 = 0$ on the interval $[0, 1]$ is

   (a) $n \geq 7$ ————————————————————————————(correct)
   (b) $n \geq 3$
   (c) $n \geq 5$
   (d) $n \geq 9$
   (e) $n \geq 4$

4. The approximation to $\sqrt{3}$ obtained after three iterations of the Bisection Method applied on the interval $[1.70, 1.78]$ is

   (a) 1.73 ————————————————————————————(correct)
   (b) 1.74
   (c) 1.75
   (d) 1.76
   (e) 1.72

5. Using Fixed point iteration $x_{n+1} = g(x_n)$ to approximate a solution for $f(x) = x^5 - 7 = 0$, which of the following function converges to a fixed point $\alpha \in [1.3, 1.6]$. Assume $p_0 = 1$

(a) $g(x) = x - \dfrac{x^5 - 7}{5x^4}$ ————————————————————————(correct)

(b) $g(x) = x + \dfrac{7 - x^5}{x}$

(c) $g(x) = x - \dfrac{x^5 - 7}{x^2}$

(d) $g(x) = x - 0.1(x^5 - 7)$

(e) $g(x) = x^5 + x - 7$

6. Let p_2 denote the approximation to a root of

$$f(x) = -x^3 - \cos x$$

obtained after two Newton iterations with initial guess $p_0 = -1$. Then p_2, computed using *three-digit chopping arithmetic*, is

(a) -0.865 ————————————————————————(correct)

(b) -0.866

(c) -0.867

(d) 0.866

(e) 0.858

7. The equation

$$x + 1 - 2\sin(\pi x) = 0$$

has a root in the interval $[0, \frac{1}{2}]$. Using the Secant Method with initial guesses $p_0 = 0$ and $p_1 = 0.5$, compute the third iterate p_3.

(a) $p_3 = -0.322781$ _____(correct)

(b) $p_3 = -0.398717$

(c) $p_3 = 0.228213$

(d) $p_3 = 0.311717$

(e) $p_3 = -0.292754$

8. Let $f(x) = \sin(e^x - 2)$ and let $P_2(x) = \sum_{i=0}^{2} f(x_i)L_i(x)$ be the quadratic Lagrange polynomial interpolates $f(x)$ at the nodes

$$x_0 = 0.6, \ x_1 = 0.7, \ x_2 = 0.8.$$

If $L_2(x) = ax^2 + bx + c$. Then, $a + b + c =$

(a) 6 _____(correct)

(b) 3

(c) -4

(d) -31

(e) 34

9. A natural cubic spline S is defined by

$$S(x) = \begin{cases} S_0(x) = 1 + B(x-1) - D(x-1)^3, & 1 \le x < 2, \\ S_1(x) = 1 + b(x-2) - \dfrac{3}{4}(x-2)^2 + d(x-2)^3, & 2 \le x \le 3. \end{cases}$$

If S interpolates the data $(1,1)$, $(2,1)$, and $(3,0)$, find $Bb + Dd =$.

(a) $\dfrac{-1}{16}$ —————————————————————————————————(correct)

(b) $\dfrac{-1}{4}$

(c) $\dfrac{1}{16}$

(d) $\dfrac{1}{8}$

(e) $\dfrac{-1}{8}$

10. Consider the following table of data:

x	1.1	1.2	1.3	1.4
$f(x)$	1.52918	1.64024	1.70470	1.71277

Let $\alpha = f'(1.1)$ and $\beta = f'(1.3)$ be approximated using the most accurate three-point finite-difference formulas available from the table, and let $\gamma = f''(1.2)$ be approximated using the most accurate three-point formula. Compute

$\alpha - \beta + 2\gamma$.

(a) -8.339 ——————————————————————————————(correct)

(b) -0.3625

(c) -6.8420

(d) 3.7860

(e) 5.1280

11. Let $f(x) = e^{2x}$. Then, the upper bound for the error in approximating $f'(1.1)$ using the forward three-point finite-difference formula with step size $h = 0.1$ is

    (a) 0.359033 ————————————————————————————————(correct)

    (b) 0.280322

    (c) 0.310322

    (d) 0.457023

    (e) 0.273103

12. Let

$$I = \int_3^5 \frac{1}{\sqrt{x^2 - 4}}\, dx.$$

Using $n = 4$ equal subintervals, let T be the composite trapezoidal approximation to I, and let S be the composite Simpson approximation to I. Compute $T - S$.

    (a) 4.1943×10^{-3} ————————————————————————————(correct)

    (b) 4.7943×10^{-3}

    (c) 6.1342×10^{-3}

    (d) 2.4943×10^{-3}

    (e) 2.1846×10^{-3}

13. The minimum value of n required to approximate the integral

$$\int_0^\pi \cos x \quad dx$$

to within 2×10^{-5} using composite Simpson's rule is

    (a) 18 ────────────────────────────────────(correct)

    (b) 17

    (c) 14

    (d) 15

    (e) 13

14. Let

$$f(x) = (x - 2)^2 - \ln x.$$

Which of the following intervals guarantees that $f(x) = 0$ has at least one solution in the interval?

    (a) $[e, 4]$ ────────────────────────────────────(correct)

    (b) $[2, 3]$

    (c) $[4, 5]$

    (d) $[0.5, 1]$

    (e) $[1, 1.2]$

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1. The bound of number of iterations using Bisection method needed to achieve an approximation with accuracy 10^{-2} to the solution of $x^3 - 7x^2 + 14x - 6 = 0$ on the interval $[0, 1]$ is

   (a) $n \geq 3$

   (b) $n \geq 5$

   (c) $n \geq 4$

   (d) $n \geq 7$

   (e) $n \geq 9$

2. Let p_2 denote the approximation to a root of

   $$f(x) = -x^3 - \cos x$$

   obtained after two Newton iterations with initial guess $p_0 = -1$. Then p_2, computed using *three-digit chopping arithmetic*, is

   (a) 0.866

   (b) -0.867

   (c) -0.866

   (d) 0.858

   (e) -0.865

3. The equation

$$x + 1 - 2\sin(\pi x) = 0$$

has a root in the interval $[0, \frac{1}{2}]$. Using the Secant Method with initial guesses $p_0 = 0$ and $p_1 = 0.5$, compute the third iterate p_3.

(a) $p_3 = 0.311717$

(b) $p_3 = -0.322781$

(c) $p_3 = -0.398717$

(d) $p_3 = 0.228213$

(e) $p_3 = -0.292754$

4. Consider the following table of data:

x	1.1	1.2	1.3	1.4
$f(x)$	1.52918	1.64024	1.70470	1.71277

Let $\alpha = f'(1.1)$ and $\beta = f'(1.3)$ be approximated using the most accurate three-point finite-difference formulas available from the table, and let $\gamma = f''(1.2)$ be approximated using the most accurate three-point formula. Compute

$$\alpha - \beta + 2\gamma.$$

(a) -0.3625

(b) -8.339

(c) 3.7860

(d) -6.8420

(e) 5.1280

5. Let

$$f(x) = (x - 2)^2 - \ln x.$$

Which of the following intervals guarantees that $f(x) = 0$ has at least one solution in the interval?

(a) $[4, 5]$

(b) $[1, 1.2]$

(c) $[e, 4]$

(d) $[2, 3]$

(e) $[0.5, 1]$

6. Using Fixed point iteration $x_{n+1} = g(x_n)$ to approximate a solution for $f(x) = x^5 - 7 = 0$, which of the following function converges to a fixed point $\alpha \in [1.3, 1.6]$. Assume $p_0 = 1$

(a) $g(x) = x - \dfrac{x^5 - 7}{5x^4}$

(b) $g(x) = x - \dfrac{x^5 - 7}{x^2}$

(c) $g(x) = x - 0.1(x^5 - 7)$

(d) $g(x) = x^5 + x - 7$

(e) $g(x) = x + \dfrac{7 - x^5}{x}$

7. The minimum value of n required to approximate the integral

$$\int_0^\pi \cos x \quad dx$$

to within 2×10^{-5} using composite Simpson's rule is

(a) 15

(b) 14

(c) 17

(d) 18

(e) 13

8. Let

$$I = \int_3^5 \frac{1}{\sqrt{x^2 - 4}} \, dx.$$

Using $n = 4$ equal subintervals, let T be the composite trapezoidal approximation to I, and let S be the composite Simpson approximation to I. Compute $T - S$.

(a) 4.1943×10^{-3}

(b) 2.4943×10^{-3}

(c) 6.1342×10^{-3}

(d) 2.1846×10^{-3}

(e) 4.7943×10^{-3}

9. The approximation to $\sqrt{3}$ obtained after three iterations of the Bisection Method applied on the interval $[1.70,\ 1.78]$ is

    (a) 1.74
    (b) 1.76
    (c) 1.72
    (d) 1.75
    (e) 1.73

10. Let $f(x) = e^{2x}$. Then, the upper bound for the error in approximating $f'(1.1)$ using the forward three-point finite-difference formula with step size $h = 0.1$ is

    (a) 0.457023
    (b) 0.359033
    (c) 0.273103
    (d) 0.280322
    (e) 0.310322

11. Let $f(x) = x^3$, and let $P_2(x)$ be the degree-2 Taylor polynomial about $x_0 = 1$. Compute $f(0.5)$ and $P_2(0.5)$, and then use three-digit rounding arithmetic to approximate the relative error at $x = 0.5$.

    (a) 1.12

    (b) 0.015

    (c) 0.125

    (d) 1.15

    (e) 1.00

12. Let $f(x) = \sin(e^x - 2)$ and let $P_2(x) = \sum_{i=0}^{2} f(x_i)L_i(x)$ be the quadratic Lagrange polynomial interpolates $f(x)$ at the nodes

$$x_0 = 0.6, \ x_1 = 0.7, \ x_2 = 0.8.$$

If $L_2(x) = ax^2 + bx + c$. Then, $a + b + c =$

    (a) 6

    (b) 34

    (c) -4

    (d) 3

    (e) -31

13. A natural cubic spline S is defined by

$$S(x) = \begin{cases} S_0(x) = 1 + B(x-1) - D(x-1)^3, & 1 \le x < 2, \\[2mm] S_1(x) = 1 + b(x-2) - \dfrac{3}{4}(x-2)^2 + d(x-2)^3, & 2 \le x \le 3. \end{cases}$$

If S interpolates the data $(1,1)$, $(2,1)$, and $(3,0)$, find $Bb + Dd =$.

(a) $\dfrac{-1}{16}$

(b) $\dfrac{-1}{4}$

(c) $\dfrac{-1}{8}$

(d) $\dfrac{1}{16}$

(e) $\dfrac{1}{8}$

14. Let $P_3(x)$ be the third Taylor polynomial of $f(x) = 2x\cos(2x) - (x-2)^2$ about $x_0 = 0$. Then, the **least upper bound** for $|f(0.4) - P_3(0.4)|$ is

(a) 0.58546

(b) 0.01336

(c) 0.36320

(d) 0.03336

(e) 0.05849

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1. Let p_2 denote the approximation to a root of

$$f(x) = -x^3 - \cos x$$

obtained after two Newton iterations with initial guess $p_0 = -1$. Then p_2, computed using *three-digit chopping arithmetic*, is

  (a) 0.858

  (b) −0.866

  (c) −0.867

  (d) −0.865

  (e) 0.866

2. Let

$$I = \int_3^5 \frac{1}{\sqrt{x^2 - 4}} \, dx.$$

Using $n = 4$ equal subintervals, let T be the composite trapezoidal approximation to I, and let S be the composite Simpson approximation to I. Compute $T - S$.

  (a) 6.1342×10^{-3}

  (b) 2.1846×10^{-3}

  (c) 2.4943×10^{-3}

  (d) 4.7943×10^{-3}

  (e) 4.1943×10^{-3}

3. Using Fixed point iteration $x_{n+1} = g(x_n)$ to approximate a solution for $f(x) = x^5 - 7 = 0$, which of the following function converges to a fixed point $\alpha \in [1.3, 1.6]$. Assume $p_0 = 1$

   (a) $g(x) = x^5 + x - 7$

   (b) $g(x) = x - \dfrac{x^5 - 7}{5x^4}$

   (c) $g(x) = x - 0.1(x^5 - 7)$

   (d) $g(x) = x + \dfrac{7 - x^5}{x}$

   (e) $g(x) = x - \dfrac{x^5 - 7}{x^2}$

4. The equation

   $$x + 1 - 2\sin(\pi x) = 0$$

   has a root in the interval $[0, \frac{1}{2}]$. Using the Secant Method with initial guesses $p_0 = 0$ and $p_1 = 0.5$, compute the third iterate p_3.

   (a) $p_3 = 0.228213$

   (b) $p_3 = 0.311717$

   (c) $p_3 = -0.292754$

   (d) $p_3 = -0.322781$

   (e) $p_3 = -0.398717$

5. The minimum value of n required to approximate the integral

$$\int_0^\pi \cos x \quad dx$$

to within 2×10^{-5} using composite Simpson's rule is

   (a) 18

   (b) 14

   (c) 13

   (d) 15

   (e) 17

6. Let $f(x) = e^{2x}$. Then, the upper bound for the error in approximating $f'(1.1)$ using the forward three-point finite-difference formula with step size $h = 0.1$ is

   (a) 0.359033

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7. Let $f(x) = \sin(e^x - 2)$ and let $P_2(x) = \sum_{i=0}^{2} f(x_i) L_i(x)$ be the quadratic Lagrange polynomial interpolates $f(x)$ at the nodes

   $$x_0 = 0.6, \ x_1 = 0.7, \ x_2 = 0.8.$$

   If $L_2(x) = ax^2 + bx + c$. Then, $a + b + c =$

   (a) -4

   (b) 34

   (c) 3

   (d) 6

   (e) -31

8. The bound of number of iterations using Bisection method needed to achieve an approximation with accuracy 10^{-2} to the solution of $x^3 - 7x^2 + 14x - 6 = 0$ on the interval $[0, 1]$ is

   (a) $n \geq 5$

   (b) $n \geq 4$

   (c) $n \geq 3$

   (d) $n \geq 9$

   (e) $n \geq 7$

9. Let

$$f(x) = (x-2)^2 - \ln x.$$

Which of the following intervals guarantees that $f(x) = 0$ has at least one solution in the interval?

(a) $[2, 3]$

(b) $[0.5, 1]$

(c) $[4, 5]$

(d) $[1, 1.2]$

(e) $[e, 4]$

10. A natural cubic spline S is defined by

$$S(x) = \begin{cases} S_0(x) = 1 + B(x-1) - D(x-1)^3, & 1 \le x < 2, \\ S_1(x) = 1 + b(x-2) - \dfrac{3}{4}(x-2)^2 + d(x-2)^3, & 2 \le x \le 3. \end{cases}$$

If S interpolates the data $(1,1)$, $(2,1)$, and $(3,0)$, find $Bb + Dd =$.

(a) $\dfrac{1}{8}$

(b) $\dfrac{-1}{16}$

(c) $\dfrac{-1}{4}$

(d) $\dfrac{1}{16}$

(e) $\dfrac{-1}{8}$

11. Let $f(x) = x^3$, and let $P_2(x)$ be the degree-2 Taylor polynomial about $x_0 = 1$. Compute $f(0.5)$ and $P_2(0.5)$, and then use three-digit rounding arithmetic to approximate the relative error at $x = 0.5$.

  (a) 0.125

  (b) 1.00

  (c) 0.015

  (d) 1.12

  (e) 1.15

12. The approximation to $\sqrt{3}$ obtained after three iterations of the Bisection Method applied on the interval $[1.70, 1.78]$ is

  (a) 1.76

  (b) 1.73

  (c) 1.72

  (d) 1.75

  (e) 1.74

13. Consider the following table of data:

x	1.1	1.2	1.3	1.4
$f(x)$	1.52918	1.64024	1.70470	1.71277

Let $\alpha = f'(1.1)$ and $\beta = f'(1.3)$ be approximated using the most accurate three-point finite-difference formulas available from the table, and let $\gamma = f''(1.2)$ be approximated using the most accurate three-point formula. Compute

$\alpha - \beta + 2\gamma.$

(a) 5.1280

(b) -8.339

(c) 3.7860

(d) -6.8420

(e) -0.3625

14. Let $P_3(x)$ be the third Taylor polynomial of $f(x) = 2x\cos(2x) - (x-2)^2$ about $x_0 = 0$. Then, the **least upper bound** for $|f(0.4) - P_3(0.4)|$ is

(a) 0.01336

(b) 0.36320

(c) 0.05849

(d) 0.58546

(e) 0.03336

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1. The minimum value of n required to approximate the integral

$$\int_0^\pi \cos x \quad dx$$

to within 2×10^{-5} using composite Simpson's rule is

(a) 14

(b) 13

(c) 18

(d) 17

(e) 15

2. The approximation to $\sqrt{3}$ obtained after three iterations of the Bisection Method applied on the interval $[1.70, 1.78]$ is

(a) 1.76

(b) 1.72

(c) 1.74

(d) 1.75

(e) 1.73

3. The equation

$$x + 1 - 2\sin(\pi x) = 0$$

has a root in the interval $[0, \frac{1}{2}]$. Using the Secant Method with initial guesses $p_0 = 0$ and $p_1 = 0.5$, compute the third iterate p_3.

(a) $p_3 = -0.398717$

(b) $p_3 = 0.311717$

(c) $p_3 = 0.228213$

(d) $p_3 = -0.292754$

(e) $p_3 = -0.322781$

4. A natural cubic spline S is defined by

$$S(x) = \begin{cases} S_0(x) = 1 + B(x - 1) - D(x - 1)^3, & 1 \le x < 2, \\ S_1(x) = 1 + b(x - 2) - \dfrac{3}{4}(x - 2)^2 + d(x - 2)^3, & 2 \le x \le 3. \end{cases}$$

If S interpolates the data $(1, 1)$, $(2, 1)$, and $(3, 0)$, find $Bb + Dd =$.

(a) $\dfrac{-1}{4}$

(b) $\dfrac{-1}{8}$

(c) $\dfrac{-1}{16}$

(d) $\dfrac{1}{16}$

(e) $\dfrac{1}{8}$

5. Let

$$f(x) = (x-2)^2 - \ln x.$$

Which of the following intervals guarantees that $f(x) = 0$ has at least one solution in the interval?

(a) $[e, 4]$

(b) $[0.5, 1]$

(c) $[2, 3]$

(d) $[4, 5]$

(e) $[1, 1.2]$

6. Consider the following table of data:

x	1.1	1.2	1.3	1.4
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Let $\alpha = f'(1.1)$ and $\beta = f'(1.3)$ be approximated using the most accurate three-point finite-difference formulas available from the table, and let $\gamma = f''(1.2)$ be approximated using the most accurate three-point formula. Compute

$$\alpha - \beta + 2\gamma.$$

(a) 5.1280

(b) 3.7860

(c) -0.3625

(d) -8.339

(e) -6.8420

7. The bound of number of iterations using Bisection method needed to achieve an approximation with accuracy 10^{-2} to the solution of $x^3 - 7x^2 + 14x - 6 = 0$ on the interval $[0, 1]$ is

    (a) $n \geq 3$

    (b) $n \geq 7$

    (c) $n \geq 4$

    (d) $n \geq 9$

    (e) $n \geq 5$

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$$f(x) = -x^3 - \cos x$$

obtained after two Newton iterations with initial guess $p_0 = -1$. Then p_2, computed using *three-digit chopping arithmetic*, is

    (a) 0.866

    (b) -0.866

    (c) 0.858

    (d) -0.867

    (e) -0.865

9. Let $f(x) = \sin(e^x - 2)$ and let $P_2(x) = \sum_{i=0}^{2} f(x_i)L_i(x)$ be the quadratic Lagrange polynomial interpolates $f(x)$ at the nodes

$$x_0 = 0.6, \ x_1 = 0.7, \ x_2 = 0.8.$$

If $L_2(x) = ax^2 + bx + c$. Then, $a + b + c =$

(a) 34

(b) -4

(c) -31

(d) 3

(e) 6

10. Using Fixed point iteration $x_{n+1} = g(x_n)$ to approximate a solution for $f(x) = x^5 - 7 = 0$, which of the following function converges to a fixed point $\alpha \in [1.3, 1.6]$. Assume $p_0 = 1$

(a) $g(x) = x - \dfrac{x^5 - 7}{x^2}$

(b) $g(x) = x - \dfrac{x^5 - 7}{5x^4}$

(c) $g(x) = x^5 + x - 7$

(d) $g(x) = x - 0.1(x^5 - 7)$

(e) $g(x) = x + \dfrac{7 - x^5}{x}$

11. Let $f(x) = x^3$, and let $P_2(x)$ be the degree-2 Taylor polynomial about $x_0 = 1$. Compute $f(0.5)$ and $P_2(0.5)$, and then use three-digit rounding arithmetic to approximate the relative error at $x = 0.5$.

    (a) 1.15
    (b) 1.00
    (c) 0.125
    (d) 0.015
    (e) 1.12

12. Let

$$I = \int_3^5 \frac{1}{\sqrt{x^2 - 4}}\, dx.$$

Using $n = 4$ equal subintervals, let T be the composite trapezoidal approximation to I, and let S be the composite Simpson approximation to I. Compute $T - S$.

    (a) 4.7943×10^{-3}
    (b) 6.1342×10^{-3}
    (c) 2.4943×10^{-3}
    (d) 4.1943×10^{-3}
    (e) 2.1846×10^{-3}

13. Let $f(x) = e^{2x}$. Then, the upper bound for the error in approximating $f'(1.1)$ using the forward three-point finite-difference formula with step size $h = 0.1$ is

   (a) 0.457023
   (b) 0.280322
   (c) 0.359033
   (d) 0.310322
   (e) 0.273103

14. Let $P_3(x)$ be the third Taylor polynomial of $f(x) = 2x\cos(2x) - (x - 2)^2$ about $x_0 = 0$. Then, the **least upper bound** for $|f(0.4) - P_3(0.4)|$ is

   (a) 0.58546
   (b) 0.05849
   (c) 0.03336
   (d) 0.36320
   (e) 0.01336

King Fahd University of Petroleum and Minerals
Department of Mathematics

CODE 4   CODE 4

Math 371
Major Exam I
Term 252
February 17, 2026
Net Time Allowed: 90 Minutes

Name	

ID		Sec	

Check that this exam has 14 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 approximation to $\sqrt{3}$ obtained after three iterations of the Bisection Method applied on the interval $[1.70, 1.78]$ is

   (a) 1.73

   (b) 1.74

   (c) 1.72

   (d) 1.75

   (e) 1.76

2. Let

$$f(x) = (x - 2)^2 - \ln x.$$

Which of the following intervals guarantees that $f(x) = 0$ has at least one solution in the interval?

   (a) $[4, 5]$

   (b) $[2, 3]$

   (c) $[1, 1.2]$

   (d) $[0.5, 1]$

   (e) $[e, 4]$

3. Using Fixed point iteration $x_{n+1} = g(x_n)$ to approximate a solution for $f(x) = x^5 - 7 = 0$, which of the following function converges to a fixed point $\alpha \in [1.3, 1.6]$. Assume $p_0 = 1$

(a) $g(x) = x - \dfrac{x^5 - 7}{5x^4}$

(b) $g(x) = x + \dfrac{7 - x^5}{x}$

(c) $g(x) = x - \dfrac{x^5 - 7}{x^2}$

(d) $g(x) = x^5 + x - 7$

(e) $g(x) = x - 0.1(x^5 - 7)$

4. Let $f(x) = e^{2x}$. Then, the upper bound for the error in approximating $f'(1.1)$ using the forward three-point finite-difference formula with step size $h = 0.1$ is

(a) 0.273103

(b) 0.457023

(c) 0.310322

(d) 0.280322

(e) 0.359033

5. A natural cubic spline S is defined by

$$S(x) = \begin{cases} S_0(x) = 1 + B(x-1) - D(x-1)^3, & 1 \le x < 2, \\ S_1(x) = 1 + b(x-2) - \dfrac{3}{4}(x-2)^2 + d(x-2)^3, & 2 \le x \le 3. \end{cases}$$

If S interpolates the data $(1,1)$, $(2,1)$, and $(3,0)$, find $Bb + Dd =.$

(a) $\dfrac{-1}{4}$

(b) $\dfrac{-1}{8}$

(c) $\dfrac{1}{16}$

(d) $\dfrac{-1}{16}$

(e) $\dfrac{1}{8}$

6. The equation

$$x + 1 - 2\sin(\pi x) = 0$$

has a root in the interval $[0, \frac{1}{2}]$. Using the Secant Method with initial guesses $p_0 = 0$ and $p_1 = 0.5$, compute the third iterate p_3.

(a) $p_3 = 0.311717$

(b) $p_3 = -0.292754$

(c) $p_3 = -0.398717$

(d) $p_3 = 0.228213$

(e) $p_3 = -0.322781$

7. The minimum value of n required to approximate the integral

$$\int_0^\pi \cos x \quad dx$$

to within 2×10^{-5} using composite Simpson's rule is

   (a) 18
   (b) 17
   (c) 13
   (d) 15
   (e) 14

8. Consider the following table of data:

x	1.1	1.2	1.3	1.4
$f(x)$	1.52918	1.64024	1.70470	1.71277

   Let $\alpha = f'(1.1)$ and $\beta = f'(1.3)$ be approximated using the most accurate three-point finite-difference formulas available from the table, and let $\gamma = f''(1.2)$ be approximated using the most accurate three-point formula. Compute

   $$\alpha - \beta + 2\gamma.$$

   (a) -6.8420
   (b) 3.7860
   (c) -0.3625
   (d) -8.339
   (e) 5.1280

9. Let p_2 denote the approximation to a root of

$$f(x) = -x^3 - \cos x$$

obtained after two Newton iterations with initial guess $p_0 = -1$. Then p_2, computed using *three-digit chopping arithmetic*, is

  (a) 0.858

  (b) -0.867

  (c) -0.866

  (d) 0.866

  (e) -0.865

10. Let $f(x) = x^3$, and let $P_2(x)$ be the degree-2 Taylor polynomial about $x_0 = 1$. Compute $f(0.5)$ and $P_2(0.5)$, and then use three-digit rounding arithmetic to approximate the relative error at $x = 0.5$.

  (a) 0.015

  (b) 1.00

  (c) 0.125

  (d) 1.15

  (e) 1.12

11. The bound of number of iterations using Bisection method needed to achieve an approximation with accuracy 10^{-2} to the solution of $x^3 - 7x^2 + 14x - 6 = 0$ on the interval $[0, 1]$ is

    (a) $n \geq 9$

    (b) $n \geq 7$

    (c) $n \geq 4$

    (d) $n \geq 3$

    (e) $n \geq 5$

12. Let $f(x) = \sin(e^x - 2)$ and let $P_2(x) = \sum_{i=0}^{2} f(x_i)L_i(x)$ be the quadratic Lagrange polynomial interpolates $f(x)$ at the nodes

    $$x_0 = 0.6, \ x_1 = 0.7, \ x_2 = 0.8.$$

    If $L_2(x) = ax^2 + bx + c$. Then, $a + b + c =$

    (a) 6

    (b) -31

    (c) 34

    (d) 3

    (e) -4

13. Let

$$I = \int_3^5 \frac{1}{\sqrt{x^2 - 4}} \, dx.$$

Using $n = 4$ equal subintervals, let T be the composite trapezoidal approximation to I, and let S be the composite Simpson approximation to I. Compute $T - S$.

(a) 2.4943×10^{-3}

(b) 2.1846×10^{-3}

(c) 4.1943×10^{-3}

(d) 6.1342×10^{-3}

(e) 4.7943×10^{-3}

14. Let $P_3(x)$ be the third Taylor polynomial of $f(x) = 2x\cos(2x) - (x - 2)^2$ about $x_0 = 0$. Then, the **least upper bound** for $|f(0.4) - P_3(0.4)|$ is

(a) 0.03336

(b) 0.01336

(c) 0.58546

(d) 0.05849

(e) 0.36320

King Fahd University of Petroleum and Minerals
Department of Mathematics

CODE 5

CODE 5

Math 371
Major Exam I
Term 252
February 17, 2026
Net Time Allowed: 90 Minutes

Name	

ID		Sec	

Check that this exam has 14 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 p_2 denote the approximation to a root of

$$f(x) = -x^3 - \cos x$$

obtained after two Newton iterations with initial guess $p_0 = -1$. Then p_2, computed using *three-digit chopping arithmetic*, is

(a) -0.866

(b) 0.858

(c) -0.865

(d) 0.866

(e) -0.867

2. Consider the following table of data:

x	1.1	1.2	1.3	1.4
$f(x)$	1.52918	1.64024	1.70470	1.71277

Let $\alpha = f'(1.1)$ and $\beta = f'(1.3)$ be approximated using the most accurate three-point finite-difference formulas available from the table, and let $\gamma = f''(1.2)$ be approximated using the most accurate three-point formula. Compute

$$\alpha - \beta + 2\gamma.$$

(a) -6.8420

(b) 3.7860

(c) 5.1280

(d) -0.3625

(e) -8.339

3. The approximation to $\sqrt{3}$ obtained after three iterations of the Bisection Method applied on the interval $[1.70, 1.78]$ is

  (a) 1.72
  (b) 1.76
  (c) 1.75
  (d) 1.74
  (e) 1.73

4. The minimum value of n required to approximate the integral

$$\int_0^{\pi} \cos x \quad dx$$

  to within 2×10^{-5} using composite Simpson's rule is

  (a) 18
  (b) 17
  (c) 14
  (d) 13
  (e) 15

5. The equation

$$x + 1 - 2\sin(\pi x) = 0$$

has a root in the interval $[0, \frac{1}{2}]$. Using the Secant Method with initial guesses $p_0 = 0$ and $p_1 = 0.5$, compute the third iterate p_3.

(a) $p_3 = -0.292754$

(b) $p_3 = -0.322781$

(c) $p_3 = 0.228213$

(d) $p_3 = 0.311717$

(e) $p_3 = -0.398717$

6. Let $f(x) = \sin(e^x - 2)$ and let $P_2(x) = \sum_{i=0}^{2} f(x_i)L_i(x)$ be the quadratic Lagrange polynomial interpolates $f(x)$ at the nodes

$$x_0 = 0.6, \ x_1 = 0.7, \ x_2 = 0.8.$$

If $L_2(x) = ax^2 + bx + c$. Then, $a + b + c =$

(a) 3

(b) -4

(c) 6

(d) 34

(e) -31

7. Let $f(x) = x^3$, and let $P_2(x)$ be the degree-2 Taylor polynomial about $x_0 = 1$. Compute $f(0.5)$ and $P_2(0.5)$, and then use three-digit rounding arithmetic to approximate the relative error at $x = 0.5$.

    (a) 1.12
    (b) 1.15
    (c) 1.00
    (d) 0.015
    (e) 0.125

8. Let
$$I = \int_3^5 \frac{1}{\sqrt{x^2 - 4}}\, dx.$$

    Using $n = 4$ equal subintervals, let T be the composite trapezoidal approximation to I, and let S be the composite Simpson approximation to I. Compute $T - S$.

    (a) 4.7943×10^{-3}
    (b) 2.1846×10^{-3}
    (c) 4.1943×10^{-3}
    (d) 6.1342×10^{-3}
    (e) 2.4943×10^{-3}

9. Let $f(x) = e^{2x}$. Then, the upper bound for the error in approximating $f'(1.1)$ using the forward three-point finite-difference formula with step size $h = 0.1$ is

   (a) 0.457023

   (b) 0.310322

   (c) 0.273103

   (d) 0.280322

   (e) 0.359033

10. A natural cubic spline S is defined by

$$S(x) = \begin{cases} S_0(x) = 1 + B(x-1) - D(x-1)^3, & 1 \le x < 2, \\ S_1(x) = 1 + b(x-2) - \dfrac{3}{4}(x-2)^2 + d(x-2)^3, & 2 \le x \le 3. \end{cases}$$

   If S interpolates the data $(1,1)$, $(2,1)$, and $(3,0)$, find $Bb + Dd =$.

   (a) $\dfrac{-1}{4}$

   (b) $\dfrac{1}{16}$

   (c) $\dfrac{1}{8}$

   (d) $\dfrac{-1}{16}$

   (e) $\dfrac{-1}{8}$

11. The bound of number of iterations using Bisection method needed to achieve an approximation with accuracy 10^{-2} to the solution of $x^3 - 7x^2 + 14x - 6 = 0$ on the interval $[0, 1]$ is

    (a) $n \geq 9$

    (b) $n \geq 5$

    (c) $n \geq 7$

    (d) $n \geq 4$

    (e) $n \geq 3$

12. Using Fixed point iteration $x_{n+1} = g(x_n)$ to approximate a solution for $f(x) = x^5 - 7 = 0$, which of the following function converges to a fixed point $\alpha \in [1.3, 1.6]$. Assume $p_0 = 1$

    (a) $g(x) = x - 0.1(x^5 - 7)$

    (b) $g(x) = x^5 + x - 7$

    (c) $g(x) = x + \dfrac{7 - x^5}{x}$

    (d) $g(x) = x - \dfrac{x^5 - 7}{x^2}$

    (e) $g(x) = x - \dfrac{x^5 - 7}{5x^4}$

13. Let

$$f(x) = (x - 2)^2 - \ln x.$$

Which of the following intervals guarantees that $f(x) = 0$ has at least one solution in the interval?

(a) $[0.5, 1]$

(b) $[e, 4]$

(c) $[2, 3]$

(d) $[4, 5]$

(e) $[1, 1.2]$

14. Let $P_3(x)$ be the third Taylor polynomial of $f(x) = 2x\cos(2x) - (x - 2)^2$ about $x_0 = 0$. Then, the **least upper bound** for $|f(0.4) - P_3(0.4)|$ is

(a) 0.05849

(b) 0.01336

(c) 0.58546

(d) 0.36320

(e) 0.03336

King Fahd University of Petroleum and Minerals
Department of Mathematics

CODE 6   CODE 6

Math 371
Major Exam I
Term 252
February 17, 2026
Net Time Allowed: 90 Minutes

Name	

ID		Sec	

Check that this exam has 14 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. Consider the following table of data:

x	1.1	1.2	1.3	1.4
$f(x)$	1.52918	1.64024	1.70470	1.71277

Let $\alpha = f'(1.1)$ and $\beta = f'(1.3)$ be approximated using the most accurate three-point finite-difference formulas available from the table, and let $\gamma = f''(1.2)$ be approximated using the most accurate three-point formula. Compute

$$\alpha - \beta + 2\gamma.$$

   (a) 5.1280

   (b) 3.7860

   (c) −0.3625

   (d) −8.339

   (e) −6.8420

2. The equation

$$x + 1 - 2\sin(\pi x) = 0$$

has a root in the interval $[0, \frac{1}{2}]$. Using the Secant Method with initial guesses $p_0 = 0$ and $p_1 = 0.5$, compute the third iterate p_3.

   (a) $p_3 = -0.292754$

   (b) $p_3 = 0.311717$

   (c) $p_3 = -0.322781$

   (d) $p_3 = 0.228213$

   (e) $p_3 = -0.398717$

3. Let $f(x) = e^{2x}$. Then, the upper bound for the error in approximating $f'(1.1)$ using the forward three-point finite-difference formula with step size $h = 0.1$ is

   (a) 0.273103

   (b) 0.280322

   (c) 0.310322

   (d) 0.359033

   (e) 0.457023

4. The bound of number of iterations using Bisection method needed to achieve an approximation with accuracy 10^{-2} to the solution of $x^3 - 7x^2 + 14x - 6 = 0$ on the interval $[0, 1]$ is

   (a) $n \geq 4$

   (b) $n \geq 9$

   (c) $n \geq 3$

   (d) $n \geq 5$

   (e) $n \geq 7$

5. Let p_2 denote the approximation to a root of

$$f(x) = -x^3 - \cos x$$

obtained after two Newton iterations with initial guess $p_0 = -1$. Then p_2, computed using *three-digit chopping arithmetic*, is

   (a) 0.866
   (b) −0.867
   (c) −0.865
   (d) −0.866
   (e) 0.858

6. The minimum value of n required to approximate the integral

$$\int_0^\pi \cos x \quad dx$$

to within 2×10^{-5} using composite Simpson's rule is

   (a) 14
   (b) 15
   (c) 18
   (d) 13
   (e) 17

7. Let $f(x) = \sin(e^x - 2)$ and let $P_2(x) = \sum_{i=0}^{2} f(x_i)L_i(x)$ be the quadratic Lagrange polynomial interpolates $f(x)$ at the nodes

$$x_0 = 0.6, \; x_1 = 0.7, \; x_2 = 0.8.$$

If $L_2(x) = ax^2 + bx + c$. Then, $a + b + c =$

(a) 3

(b) -31

(c) 34

(d) -4

(e) 6

8. A natural cubic spline S is defined by

$$S(x) = \begin{cases} S_0(x) = 1 + B(x-1) - D(x-1)^3, & 1 \le x < 2, \\ S_1(x) = 1 + b(x-2) - \dfrac{3}{4}(x-2)^2 + d(x-2)^3, & 2 \le x \le 3. \end{cases}$$

If S interpolates the data $(1,1)$, $(2,1)$, and $(3,0)$, find $Bb + Dd =$.

(a) $\dfrac{-1}{8}$

(b) $\dfrac{-1}{4}$

(c) $\dfrac{1}{16}$

(d) $\dfrac{-1}{16}$

(e) $\dfrac{1}{8}$

9. Let

$$I = \int_3^5 \frac{1}{\sqrt{x^2 - 4}}\, dx.$$

Using $n = 4$ equal subintervals, let T be the composite trapezoidal approximation to I, and let S be the composite Simpson approximation to I. Compute $T - S$.

(a) 2.1846×10^{-3}

(b) 4.7943×10^{-3}

(c) 2.4943×10^{-3}

(d) 6.1342×10^{-3}

(e) 4.1943×10^{-3}

10. Using Fixed point iteration $x_{n+1} = g(x_n)$ to approximate a solution for $f(x) = x^5 - 7 = 0$, which of the following function converges to a fixed point $\alpha \in [1.3, 1.6]$. Assume $p_0 = 1$

(a) $g(x) = x - 0.1(x^5 - 7)$

(b) $g(x) = x - \dfrac{x^5 - 7}{x^2}$

(c) $g(x) = x - \dfrac{x^5 - 7}{5x^4}$

(d) $g(x) = x^5 + x - 7$

(e) $g(x) = x + \dfrac{7 - x^5}{x}$

11. The approximation to $\sqrt{3}$ obtained after three iterations of the Bisection Method applied on the interval $[1.70, 1.78]$ is

   (a) 1.75

   (b) 1.76

   (c) 1.74

   (d) 1.72

   (e) 1.73

12. Let

$$f(x) = (x - 2)^2 - \ln x.$$

Which of the following intervals guarantees that $f(x) = 0$ has at least one solution in the interval?

   (a) $[2, 3]$

   (b) $[4, 5]$

   (c) $[e, 4]$

   (d) $[1, 1.2]$

   (e) $[0.5, 1]$

13. Let $f(x) = x^3$, and let $P_2(x)$ be the degree-2 Taylor polynomial about $x_0 = 1$. Compute $f(0.5)$ and $P_2(0.5)$, and then use three-digit rounding arithmetic to approximate the relative error at $x = 0.5$.

   (a) 1.00
   (b) 1.12
   (c) 0.125
   (d) 1.15
   (e) 0.015

14. Let $P_3(x)$ be the third Taylor polynomial of $f(x) = 2x\cos(2x) - (x-2)^2$ about $x_0 = 0$. Then, the **least upper bound** for $|f(0.4) - P_3(0.4)|$ is

   (a) 0.58546
   (b) 0.03336
   (c) 0.05849
   (d) 0.36320
   (e) 0.01336

King Fahd University of Petroleum and Minerals
Department of Mathematics

CODE 7   CODE 7

Math 371
Major Exam I
Term 252
February 17, 2026
Net Time Allowed: 90 Minutes

Name	

ID		Sec	

Check that this exam has 14 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 minimum value of n required to approximate the integral

$$\int_0^\pi \cos x \quad dx$$

to within 2×10^{-5} using composite Simpson's rule is

   (a) 15
   (b) 13
   (c) 18
   (d) 17
   (e) 14

2. Let

$$f(x) = (x - 2)^2 - \ln x.$$

Which of the following intervals guarantees that $f(x) = 0$ has at least one solution in the interval?

   (a) $[e, 4]$
   (b) $[1, 1.2]$
   (c) $[4, 5]$
   (d) $[0.5, 1]$
   (e) $[2, 3]$

3. Let p_2 denote the approximation to a root of

$$f(x) = -x^3 - \cos x$$

obtained after two Newton iterations with initial guess $p_0 = -1$. Then p_2, computed using *three-digit chopping arithmetic*, is

(a) -0.865

(b) 0.858

(c) -0.867

(d) 0.866

(e) -0.866

4. Let

$$I = \int_3^5 \frac{1}{\sqrt{x^2 - 4}}\, dx.$$

Using $n = 4$ equal subintervals, let T be the composite trapezoidal approximation to I, and let S be the composite Simpson approximation to I. Compute $T - S$.

(a) 4.7943×10^{-3}

(b) 2.1846×10^{-3}

(c) 2.4943×10^{-3}

(d) 4.1943×10^{-3}

(e) 6.1342×10^{-3}

5. Consider the following table of data:

x	1.1	1.2	1.3	1.4
$f(x)$	1.52918	1.64024	1.70470	1.71277

Let $\alpha = f'(1.1)$ and $\beta = f'(1.3)$ be approximated using the most accurate three-point finite-difference formulas available from the table, and let $\gamma = f''(1.2)$ be approximated using the most accurate three-point formula. Compute

$$\alpha - \beta + 2\gamma.$$

(a) -0.3625

(b) 5.1280

(c) -8.339

(d) 3.7860

(e) -6.8420

6. Using Fixed point iteration $x_{n+1} = g(x_n)$ to approximate a solution for $f(x) = x^5 - 7 = 0$, which of the following function converges to a fixed point $\alpha \in [1.3, 1.6]$. Assume $p_0 = 1$

(a) $g(x) = x - 0.1(x^5 - 7)$

(b) $g(x) = x + \dfrac{7 - x^5}{x}$

(c) $g(x) = x - \dfrac{x^5 - 7}{5x^4}$

(d) $g(x) = x - \dfrac{x^5 - 7}{x^2}$

(e) $g(x) = x^5 + x - 7$

7. The equation

$$x + 1 - 2\sin(\pi x) = 0$$

has a root in the interval $[0, \frac{1}{2}]$. Using the Secant Method with initial guesses $p_0 = 0$ and $p_1 = 0.5$, compute the third iterate p_3.

(a) $p_3 = -0.322781$

(b) $p_3 = 0.228213$

(c) $p_3 = 0.311717$

(d) $p_3 = -0.398717$

(e) $p_3 = -0.292754$

8. Let $f(x) = e^{2x}$. Then, the upper bound for the error in approximating $f'(1.1)$ using the forward three-point finite-difference formula with step size $h = 0.1$ is

(a) 0.280322

(b) 0.273103

(c) 0.359033

(d) 0.457023

(e) 0.310322

9. Let $f(x) = \sin(e^x - 2)$ and let $P_2(x) = \sum_{i=0}^{2} f(x_i)L_i(x)$ be the quadratic Lagrange polynomial interpolates $f(x)$ at the nodes

$$x_0 = 0.6, \ x_1 = 0.7, \ x_2 = 0.8.$$

If $L_2(x) = ax^2 + bx + c$. Then, $a + b + c =$

   (a) -31
   (b) -4
   (c) 3
   (d) 34
   (e) 6

10. Let $f(x) = x^3$, and let $P_2(x)$ be the degree-2 Taylor polynomial about $x_0 = 1$. Compute $f(0.5)$ and $P_2(0.5)$, and then use three-digit rounding arithmetic to approximate the relative error at $x = 0.5$.

   (a) 0.125
   (b) 1.00
   (c) 1.15
   (d) 0.015
   (e) 1.12

11. The approximation to $\sqrt{3}$ obtained after three iterations of the Bisection Method applied on the interval $[1.70, 1.78]$ is

   (a) 1.74

   (b) 1.73

   (c) 1.75

   (d) 1.76

   (e) 1.72

12. A natural cubic spline S is defined by

$$S(x) = \begin{cases} S_0(x) = 1 + B(x-1) - D(x-1)^3, & 1 \leq x < 2, \\ S_1(x) = 1 + b(x-2) - \dfrac{3}{4}(x-2)^2 + d(x-2)^3, & 2 \leq x \leq 3. \end{cases}$$

   If S interpolates the data $(1,1)$, $(2,1)$, and $(3,0)$, find $Bb + Dd =$.

   (a) $\dfrac{1}{8}$

   (b) $\dfrac{-1}{4}$

   (c) $\dfrac{1}{16}$

   (d) $\dfrac{-1}{8}$

   (e) $\dfrac{-1}{16}$

13. The bound of number of iterations using Bisection method needed to achieve an approximation with accuracy 10^{-2} to the solution of $x^3 - 7x^2 + 14x - 6 = 0$ on the interval $[0, 1]$ is

   (a) $n \geq 4$

   (b) $n \geq 3$

   (c) $n \geq 9$

   (d) $n \geq 5$

   (e) $n \geq 7$

14. Let $P_3(x)$ be the third Taylor polynomial of $f(x) = 2x\cos(2x) - (x - 2)^2$ about $x_0 = 0$. Then, the **least upper bound** for $|f(0.4) - P_3(0.4)|$ is

   (a) 0.58546

   (b) 0.03336

   (c) 0.01336

   (d) 0.05849

   (e) 0.36320

King Fahd University of Petroleum and Minerals
Department of Mathematics

CODE 8

CODE 8

Math 371
Major Exam I
Term 252
February 17, 2026
Net Time Allowed: 90 Minutes

Name

ID

Sec

Check that this exam has 14 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 minimum value of n required to approximate the integral

$$\int_0^\pi \cos x \quad dx$$

to within 2×10^{-5} using composite Simpson's rule is

   (a) 18
   (b) 15
   (c) 17
   (d) 13
   (e) 14

2. Let $f(x) = e^{2x}$. Then, the upper bound for the error in approximating $f'(1.1)$ using the forward three-point finite-difference formula with step size $h = 0.1$ is

   (a) 0.457023
   (b) 0.273103
   (c) 0.310322
   (d) 0.359033
   (e) 0.280322

3. Let

$$f(x) = (x - 2)^2 - \ln x.$$

Which of the following intervals guarantees that $f(x) = 0$ has at least one solution in the interval?

(a) $[0.5, 1]$

(b) $[4, 5]$

(c) $[e, 4]$

(d) $[2, 3]$

(e) $[1, 1.2]$

4. Consider the following table of data:

x	1.1	1.2	1.3	1.4
$f(x)$	1.52918	1.64024	1.70470	1.71277

Let $\alpha = f'(1.1)$ and $\beta = f'(1.3)$ be approximated using the most accurate three-point finite-difference formulas available from the table, and let $\gamma = f''(1.2)$ be approximated using the most accurate three-point formula. Compute

$$\alpha - \beta + 2\gamma.$$

(a) -0.3625

(b) 3.7860

(c) -8.339

(d) -6.8420

(e) 5.1280

5. The bound of number of iterations using Bisection method needed to achieve an approximation with accuracy 10^{-2} to the solution of $x^3 - 7x^2 + 14x - 6 = 0$ on the interval $[0, 1]$ is

   (a) $n \geq 9$

   (b) $n \geq 4$

   (c) $n \geq 3$

   (d) $n \geq 5$

   (e) $n \geq 7$

6. Let $f(x) = x^3$, and let $P_2(x)$ be the degree-2 Taylor polynomial about $x_0 = 1$. Compute $f(0.5)$ and $P_2(0.5)$, and then use three-digit rounding arithmetic to approximate the relative error at $x = 0.5$.

   (a) 1.15

   (b) 0.125

   (c) 1.12

   (d) 1.00

   (e) 0.015

7. The equation

$$x + 1 - 2\sin(\pi x) = 0$$

has a root in the interval $[0, \frac{1}{2}]$. Using the Secant Method with initial guesses $p_0 = 0$ and $p_1 = 0.5$, compute the third iterate p_3.

  (a) $p_3 = -0.322781$

  (b) $p_3 = 0.228213$

  (c) $p_3 = -0.292754$

  (d) $p_3 = -0.398717$

  (e) $p_3 = 0.311717$

8. Let $f(x) = \sin(e^x - 2)$ and let $P_2(x) = \sum_{i=0}^{2} f(x_i)L_i(x)$ be the quadratic Lagrange polynomial interpolates $f(x)$ at the nodes

$$x_0 = 0.6, \ x_1 = 0.7, \ x_2 = 0.8.$$

If $L_2(x) = ax^2 + bx + c$. Then, $a + b + c =$

  (a) 6

  (b) -31

  (c) 34

  (d) 3

  (e) -4

9. Let p_2 denote the approximation to a root of

$$f(x) = -x^3 - \cos x$$

obtained after two Newton iterations with initial guess $p_0 = -1$. Then p_2, computed using *three-digit chopping arithmetic*, is

(a) -0.867

(b) 0.858

(c) 0.866

(d) -0.866

(e) -0.865

10. A natural cubic spline S is defined by

$$S(x) = \begin{cases} S_0(x) = 1 + B(x-1) - D(x-1)^3, & 1 \le x < 2, \\ S_1(x) = 1 + b(x-2) - \dfrac{3}{4}(x-2)^2 + d(x-2)^3, & 2 \le x \le 3. \end{cases}$$

If S interpolates the data $(1,1)$, $(2,1)$, and $(3,0)$, find $Bb + Dd =$.

(a) $\dfrac{-1}{8}$

(b) $\dfrac{-1}{4}$

(c) $\dfrac{1}{8}$

(d) $\dfrac{1}{16}$

(e) $\dfrac{-1}{16}$

11. Let

$$I = \int_3^5 \frac{1}{\sqrt{x^2 - 4}} \, dx.$$

Using $n = 4$ equal subintervals, let T be the composite trapezoidal approximation to I, and let S be the composite Simpson approximation to I. Compute $T - S$.

(a) 2.1846×10^{-3}

(b) 4.1943×10^{-3}

(c) 4.7943×10^{-3}

(d) 6.1342×10^{-3}

(e) 2.4943×10^{-3}

12. Using Fixed point iteration $x_{n+1} = g(x_n)$ to approximate a solution for $f(x) = x^5 - 7 = 0$, which of the following function converges to a fixed point $\alpha \in [1.3, 1.6]$. Assume $p_0 = 1$

(a) $g(x) = x + \dfrac{7 - x^5}{x}$

(b) $g(x) = x^5 + x - 7$

(c) $g(x) = x - \dfrac{x^5 - 7}{5x^4}$

(d) $g(x) = x - \dfrac{x^5 - 7}{x^2}$

(e) $g(x) = x - 0.1(x^5 - 7)$

13. The approximation to $\sqrt{3}$ obtained after three iterations of the Bisection Method applied on the interval $[1.70,\ 1.78]$ is

(a) 1.74

(b) 1.73

(c) 1.72

(d) 1.75

(e) 1.76

14. Let $P_3(x)$ be the third Taylor polynomial of $f(x) = 2x\cos(2x) - (x-2)^2$ about $x_0 = 0$. Then, the **least upper bound** for $|f(0.4) - P_3(0.4)|$ is

(a) 0.58546

(b) 0.05849

(c) 0.01336

(d) 0.36320

(e) 0.03336

Q	MASTER	1	2	3	4	5	6	7	8
1	A	D $_3$	D $_6$	C $_{13}$	A $_4$	C $_6$	D $_{10}$	C $_{13}$	A $_{13}$
2	A	E $_6$	E $_{12}$	E $_4$	E $_{14}$	E $_{10}$	C $_7$	A $_{14}$	D $_{11}$
3	A	B $_7$	B $_5$	E $_7$	A $_5$	E $_4$	D $_{11}$	A $_6$	C $_{14}$
4	A	B $_{10}$	D $_7$	C $_9$	E $_{11}$	A $_{13}$	E $_3$	D $_{12}$	C $_{10}$
5	A	C $_{14}$	A $_{13}$	A $_{14}$	D $_9$	B $_7$	C $_6$	C $_{10}$	E $_3$
6	A	A $_5$	A $_{11}$	D $_{10}$	E $_7$	C $_8$	C $_{13}$	C $_5$	D $_2$
7	A	D $_{13}$	D $_8$	B $_3$	A $_{13}$	C $_2$	E $_8$	A $_7$	A $_7$
8	A	A $_{12}$	E $_3$	E $_6$	D $_{10}$	C $_{12}$	D $_9$	C $_{11}$	A $_8$
9	A	E $_4$	E $_{14}$	E $_8$	E $_6$	E $_{11}$	E $_{12}$	E $_8$	E $_6$
10	A	B $_{11}$	B $_9$	B $_5$	B $_2$	D $_9$	C $_5$	B $_2$	E $_9$
11	A	E $_2$	B $_2$	B $_2$	B $_3$	C $_3$	E $_4$	B $_4$	B $_{12}$
12	A	A $_8$	B $_4$	D $_{12}$	A $_8$	E $_5$	C $_{14}$	E $_9$	C $_5$
13	A	A $_9$	B $_{10}$	C $_{11}$	C $_{12}$	B $_{14}$	A $_2$	E $_3$	B $_4$
14	A	E $_1$	C $_1$	B $_1$	D $_1$	A $_1$	C $_1$	D $_1$	B $_1$

Answer Counts

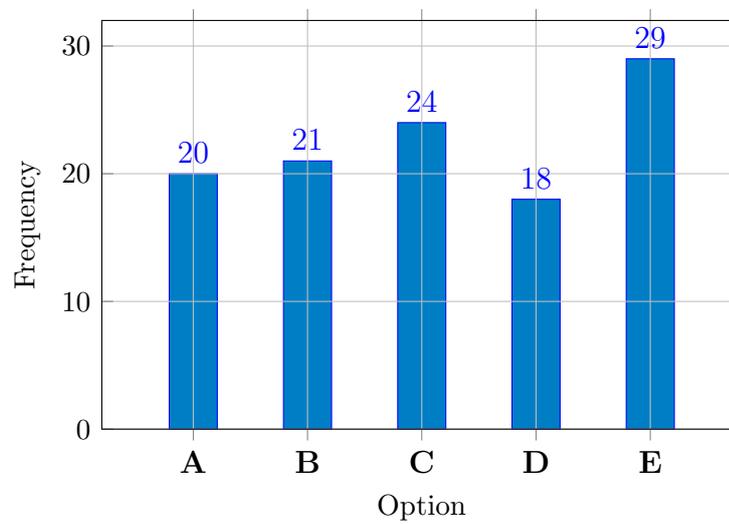| V	A	B	C	D	E
1	4	3	1	2	4
2	2	5	1	3	3
3	1	4	3	2	4
4	4	2	1	3	4
5	2	2	5	1	4
6	1	0	6	3	4
7	3	2	4	2	3
8	3	3	3	2	3

Answer Option Frequency Across Versions

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