The exam consists of 40 multiple choice questions, each of equal value. You may do calculations on this question booklet paper but not on the opscan sheet. Mark beside the number of the opscan sheet corresponding to the test question number in pencil only. Mark only one answer; otherwise the answer will be counted as incorrect. You are not penalized for guessing. Please make sure that your name and student ID appear on the opscan sheet in the spaces provided.

Questions begin on page 1 and be sure to check the back of each page for questions.

At the end of the examination you MUST hand in this booklet, your answer sheet and all scratch paper.

You may use the following formulae:

**Factoring:** \( x^3 - a^3 = (x - a)(x^2 + xa + a^2) \)  \( x^3 + a^3 = (x + a)(x^2 - xa + a^2) \)

**Circle:** \( (x - h)^2 + (y - k)^2 = r^2 \)

**Quadratic formula:** \( \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \)

**Difference quotient:** \( \frac{f(x + h) - f(x)}{h} \)

**Compound Interest:** \( A = P \left(1 + \frac{r}{n}\right)^{nt} \)

**Exponential Growth:** \( A(t) = A_0e^{rt}, r > 0 \)

**Logarithms:**
\[
\begin{align*}
\log_b(xy) &= \log_b(x) + \log_b(y) \\
\log_b(x^p) &= p \log_b(x) \\
\log_b(a^a) &= a = b^{\log_b a}
\end{align*}
\]

**Lines:** \( y - y_0 = m(x - x_0); y = mx + b \)

**Parabola Vertex:** \( \left( \frac{-b}{2a}, f\left(\frac{-b}{2a}\right) \right), a \neq 0 \)

**Average rate of change on \([a, b]\):** \( \frac{f(b) - f(a)}{b - a} \)

**Continuous Interest:** \( A = Pe^{rt} \)

**Exponential Decay:** \( A(t) = A_0e^{-rt}, r > 0 \)

\[
\begin{align*}
\ln(x) &= \log_e(x) \\
\log_b\left(\frac{x}{y}\right) &= \log_b(x) - \log_b(y) \\
\log_b(x) &= \frac{\ln x}{\ln b} = \frac{\log_{10} x}{\log_{10} b} \\
\ln e^a &= a = e^{\ln a}
\end{align*}
\]
1. Simplify.

\[
\frac{1-\frac{2}{x}}{\frac{x}{x-2}}
\]

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

2. Solve the equation.

\[
\frac{2x}{5} = \frac{x}{3} + 1
\]

(a) 11
(b) 12
(c) 13
(d) 14
(e) 15.


\[
\frac{\sqrt{18a^4}}{\sqrt{2ab^2}}
\]

(a) \( 3a^2 \)
(b) \( 9a^2 \)
(c) \( 3a^4 \)
(d) \( 9a^4 \)
(e) 3.
4. Rationalize the denominator.

\[
\frac{2}{\sqrt{3} - 1}
\]

(a) \(\frac{\sqrt{3} - 1}{2}\)
(b) \(\sqrt{3} + 1\)
(c) \(\sqrt{3} - 1\)
(d) \(2\sqrt{3} + 2\)
(e) \(2\sqrt{3} - 1\).

5. Find the product of the polynomial \((3x + 2)^2\)

(a) \(9x^2 - 12x + 4\)
(b) \(9x^2 - 12x - 4\)
(c) \(9x^2 + 12x - 4\)
(d) \(9x^2 + 12x + 4\)
(e) \(9x^2 + 4\)

6. Which statement best describes the graph of the polynomial function \(p(x) = -\frac{1}{2}(x^3 + x^2)\)

(a) the graph has down / up end-behavior
(b) There are two zeros and both are crossing
(c) There are two zeros, one touches and one crosses
(d) There are no zeros
(e) The graph is a parabola that opens up
7. List all possible rational zeros for \( P(x) = 5x^4 - x^3 + x^2 - 5x - 2 \).

(a) \{\pm \frac{1}{5}, \pm \frac{2}{5}, \pm 1, \pm 2\}
(b) \{\pm \frac{1}{2}, \pm \frac{3}{2}, \pm 1, \pm 2\}
(c) \{\pm \frac{1}{3}, \pm \frac{2}{3}, \pm 1, \pm 5\}
(d) \{\pm \frac{1}{3}, \pm \frac{1}{3}, \pm 1, \pm 3\}
(e) \{\pm \frac{1}{6}, \pm \frac{3}{6}, \pm 1, \pm 8\}.

8. Describe the transformation steps needed to obtain the graph of \( g(x) = \sqrt{x - 2} + 3 \) from the graph of \( f(x) = \sqrt{x} \).

(a) shift left by 2, shift up by 3
(b) shift right by 2, shift up by 3
(c) shift left by \( \sqrt{2} \), shift up by 3
(d) shift right by 3, shift up by 2
(e) shift right by 3, shift down by 2

9. Solve the formula for \( b \).

\[ A = \frac{1}{2}(4b + h) \]

(a) \( b = 2A - \frac{1}{2}h \)
(b) \( b = \frac{2A - 2h}{3} \)
(c) \( b = \frac{3 - 4h}{2} \)
(d) \( b = \frac{2A - h}{4} \)
(e) \( b = \frac{2A + h}{4} \)
10. Vinegar can be purchased in concentrations of 20% and 5%. How much of each must be combined to obtain a 10 gallon mixture that has concentration 17%?

(a) 8 gal of 20% and 2 gal of 5%.
(b) 5 gal of 20% and 5 gal of 5%.
(c) 6 gal of 20% and 4 gal of 5%.
(d) 3 gal of 20% and 7 gal of 5%.
(e) 7 gal of 20% and 3 gal of 5%.

11. Solve the radical equation and then choose the correct statement.

\[ \sqrt{1 - 4x} - 5 = x \]

(a) The equation has a negative real solution.
(b) The equation has a positive solution.
(c) The equation has two solutions.
(d) The equation has three solution.
(e) The equation has no solution.

12. Solve the inequality.

\[ 4 - 3x < 10 \]

(a) \((-\infty, 5)\)
(b) \((-\infty, 5]\)
(c) \((-2, \infty)\)
(d) \([5, \infty)\)
(e) \((-3, 3)\)
13. Solve the inequality.

\[ |x - 1| + 7 \leq -5 \]

(a) \((-\infty, -1] \cup [3, \infty)\)
(b) \([-\infty, 3) \cup (5, \infty)\)
(c) \((3, \infty)\)
(d) \((-\infty, -1)\)
(e) No solutions.

14. Solve the quadratic inequality.

\[ x^2 - x - 2 \geq 0 \]

(a) \((-\infty, -1] \cup [2, \infty)\)
(b) \((-\infty, -2] \cup [1, \infty)\)
(c) \((-\infty, 2] \cup [3, \infty)\)
(d) \((-\infty, -2]\)
(e) \([-1, 2]\).

15. Solve the rational inequality.

\[ \frac{x-3}{3x+2} \leq 0 \]

(a) \((\infty, -3) \cup [\frac{3}{2}, \infty)\)
(b) \((-\frac{2}{3}, 3]\)
(c) \((\infty, -3) \cup [3, \infty)\)
(d) \((\infty, -\frac{3}{2}) \cup (\frac{3}{2}, \infty)\)
(e) \([-\frac{2}{3}, 3]\)
16. Find the distance $AB$ where $A = (-1, 1)$ and $B = (2, -3)$.

(a) $\sqrt{7}$
(b) 3
(c) 4
(d) 5
(e) 6.

17. A line $L$ is parallel to the line passing through $A(4, -3)$ and $B(1, -1)$. Find the slope $m$ of the line $L$.

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

18. Find the equation of the line passing through $Q(0, -5)$ and perpendicular to the line $x - 2y = 3$.

(a) $y = 2x + 1$
(b) $y = -2x - 5$
(c) $y = -\frac{1}{3}x + 5$
(d) $y = -\frac{1}{2}x - 5$
(e) $y = \frac{1}{2}x + 5$

19. Which of the following functions is even?

(a) $y = x^2 - \frac{2}{x}$
(b) $y = 2x - 1$
(c) $y = 2x^3 - 3x$
(d) $y = x^4 - x^2$
(e) $y = x^4 - x^3$. 

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20. Find the center and radius of the following circle.

\[ x^2 + y^2 + 10x - 6y - 15 = 0 \]

(a) \((5, -3), r = \sqrt{7}\)
(b) \((-5, 3), r = 7\)
(c) \((5, 6), r = 64\)
(d) \((5, -6), r = 8\)
(e) \((-10, 5), r = 8\).

21. \(A(-1, 4)\) and \(B(9, -4)\) are the end points of a diameter for a circle. Find the equation of the circle.

(a) \((x - 4)^2 + (y - 8)^2 = 75\)
(b) \(x^2 + y^2 = 25\)
(c) \((x + 4)^2 + y^2 = 100\)
(d) \((x - 4)^2 + y^2 = 41\)
(e) \((x - 4)^2 + (y + 3)^2 = 36\).

22. Evaluate the quantity \(A = f(0) + f(3)\) where the function \(f(x)\) is defined as following

\[
f(x) = \begin{cases} 
2x - 1 & \text{if } x \leq 1 \\
2x^3 + 3x - 1 & \text{if } x > 1 
\end{cases}
\]

(a) 8
(b) 16
(c) 12
(d) 10
(e) 9.
23. If the points \((1, 3), (3, -2)\) and \((-2, 1)\) are on the graph of a one-to-one function \(f(x)\), find the value of \(f(1) + f^{-1}(-2)\).

(a) 2  
(b) \(\frac{1}{2}\)  
(c) 10  
(d) 8  
(e) 6.

24. For \(f(x) = \sqrt{5x - 1}\) and \(g(x) = x^2 - x + 1\), evaluate \(f \circ g(1)\).

(a) 6  
(b) 5  
(c) 4  
(d) 3  
(e) 2.

25. Find the domain of the function \(f(x)\).

\[ f(x) = \sqrt{x + 1} \]

(a) \([-1, \infty)\)  
(b) \((-\infty, -1)\)  
(c) \([1, \infty)\)  
(d) \([3, \infty)\)  
(e) \([-1, 1]\).
26. Determine the remainder $R$ that results when $4x^{2017} - 6x^2 - 5x + 9$ is divided by $x - 1$. You may use the remainder theorem.

(a) $R = 3$
(b) $R = 1$
(c) $R = 2$
(d) $R = 12$
(e) $R = 241$.

27. Find the vertex $(h, k)$ of the parabola $f(x)$.

$$f(x) = 2x^2 - 4x + 1$$

(a) $(1, -1)$
(b) $(2, 9)$
(c) $(1, -8)$
(d) $(1, -3)$
(e) $(2, -9)$.

28. Find the inverse function for $f(x) = \frac{1}{2}x^3 - 3$.

(a) $f^{-1}(x) = \sqrt{2x - 6}$
(b) $f^{-1}(x) = 2x + \frac{1}{4}$
(c) $f^{-1}(x) = \frac{1}{2}x - 3$
(d) $f^{-1}(x) = \sqrt[3]{2x + 6}$
(e) $f^{-1}(x) = \frac{1}{2x - 8}$. 
29. The graph of polynomial function \( f(x) = a(x - 1)^3(x + 2) \) passes through the point \((2, 3)\). Find the value \(a\).

(a) 5  
(b) \(\frac{3}{2}\)  
(c) \(\frac{1}{4}\)  
(d) \(\frac{3}{4}\)  
(e) 1.

30. Solve the equation for all real solutions given that \(x = -1\) is a zero.

\[x^3 - 7x^2 - 2x + 6 = 0.\]

Hint: \((x + 1)\) is a factor.

(a) \{-1, 1, 6\}  
(b) \{-1, 4 - \sqrt{10}, 4 + \sqrt{10}\}  
(c) \{-1, 0.7, 9\}  
(d) \{-1, 1.5, 7.5\}  
(e) No solution.

31. Find all horizontal asymptotes for the function \(f(x) = \frac{3x-2}{x^2-x-2}\).

(a) \(x = 0\)  
(b) \(y = 0\)  
(c) \(y = 1\)  
(d) \(y = -2\)  
(e) \(x = 3\)
32. Find all vertical asymptotes for the function \( f(x) = \frac{2x^2 + x - 1}{x^3 - 5x + 6} \).

(a) \( y = 2 \)
(b) \( x = -2, x = -3 \)
(c) \( x = -2, x = 3 \)
(d) \( x = 2, x = 3 \)
(e) No vertical asymptote.

33. Let \( P(x) = 10000 + 20x - 0.01x^2 \) be the profit in US dollars for producing and selling \( x \) cars. Find the number \( x \) so that the profit will be maximal.

(a) 1,100
(b) 900
(c) 1,050
(d) 1,000
(e) 1,200.

34. Solve equation \( 3 \cdot 5^x - 7 = 0 \) and round your answer to four decimal digits.

(a) 0.2500
(b) 2.5021
(c) 1.3031
(d) 0.5265
(e) No solution.

35. Use the properties of logarithms to write \( \ln \left( \frac{2\sqrt{x}}{x-3} \right) \) as a sum or difference of simple logarithmic terms.

(a) \( \ln 2 + \ln x + \ln(x + 3) \)
(b) \( \ln 2 + 2\ln x + \frac{1}{2} \ln(x - 3) \)
(c) \( \ln 2 + \ln x - \ln 3 \)
(d) \( \ln 2 + \frac{1}{2} \ln x - \ln(x - 3) \)
(e) \( \ln 4 + \ln x - \ln(x - 3) \)
36. Solve the equation \( \left( \frac{1}{3} \right)^{(-2x)} = 3^{x+9} \) and round your answer to two decimal digits.

(a) 1
(b) 2
(c) 3
(d) 13
(e) 7

37. Use your calculator to calculate \( \log_6 2017 \). Round your answer to the fourth decimal place.

(a) 1.7117
(b) 4.7280
(c) 5.1978
(d) 2.0899
(e) 6.5528

38. Solve the equation \( 1 - \log_6(2x + 1) = 0 \).

(a) 1.22
(b) 0
(c) 2
(d) 3
(e) 38.
39. How much money would you have if you invested $1,000 at 4% compounded quarterly for 7 years?

(a) $1,331.89
(b) $1,992.33
(c) $1,500
(d) $1,032.71
(e) $1,321.29

40. Solve the system of linear equations for $x$ and $y$. Then calculate $y - x$.

\[
\begin{aligned}
    x + y &= 7 \\
    3x + 2y &= 17.
\end{aligned}
\]

(a) $y - x = 1$
(b) $y - x = 2$
(c) $y - x = 3$
(d) $y - x = 4$
(e) $y - x = 5$. 
|------|------|------|------|