

**FIRST ROUND MATHEMSTICS MODEL EXAM FOR GRADE 12, 2018/2026.**

**TIME ALLOWED: 3:00 HOURS.**

**GENERAL DIRECTIONS**

FOLLOW THE FOLLOWING RULES AND REGULATIONS IN DOING THE EXAMINATION:

- WRITE THE NECESSARY INFORMATION (NAME, SECTION AND ROLL NUMBER ) ON ANSWER SHEET.
- ENSURE YOU UNDERSTAND THE FORMAT OF THE EXAM AND THE TYPES OF QUESTIONS INCLUDED.
- THE EXAM CONSISTS OF **60** OBJECTIVE QUESTIONS. CHOOSE ONLY THE **CORRECT** ANSWER FOR EACH QUESTION.
- NO OTHER MATERIALS OR ELECTRONIC DEVICES ARE PERMITTED EXCEPT PEN/PENCIL.
- ANY FORM OF **CHEATING** IS **PROHIBITED** AND RESULTS IN THE CANCELLATION OF YOUR SCORES.
- **STOP** WORKING IMMEDIATELY WHEN THE ALLOTED TIME IS UP.

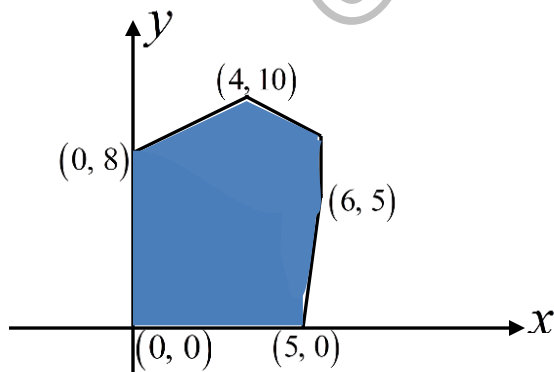
**DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.**

**DIRECTION:** CHOOSE THE **CORRECT** ANSWER FROM THE SUGGESTED OPTIONS AND WRITE THE LETTER OF YOUR CHOICE ON THE ANSWER SHEET PROVIDED.

- Which of the following statement defines an arithmetic progression?
  - It is a sequence in which the ratio between consecutive terms is a positive constant.
  - It is a sequence in which the difference between consecutive terms is a non-zero constant.
  - It is a sequence in which the difference between consecutive terms is a constant.
  - It is a sequence in which the ratio between consecutive terms is a non-zero constant.
- The simplified form of the expression  $\frac{\sqrt{32} + \sqrt{48}}{\sqrt{8} + \sqrt{12}}$  is equal to:
  - $\sqrt{2}$
  - 4
  - 1
  - 2
- Which of the following system of linear equations has a unique solution?
  - $\begin{cases} 4x - 2y = -6 \\ -2x + y = 3 \end{cases}$
  - $\begin{cases} x - 2y = 2 \\ 5x - 10y = -10 \end{cases}$
  - $\begin{cases} 2x + 6y = 20 \\ x - 3y = 10 \end{cases}$
  - $\begin{cases} 2x + 3y = 0 \\ x + \frac{3}{2}y = 0 \end{cases}$
- Which one of the following pairs of numbers are irrational numbers between 11 and 13?
  - $\sqrt{120}$  and  $\sqrt{168}$
  - $3 + \sqrt{81}$  and  $2\sqrt{37}$
  - $2 + \sqrt{112}$  and  $3\sqrt{17}$
  - $\sqrt{125}$  and  $\sqrt{175}$
- If a polynomial function  $f(x) = x^3 + ax^2 + bx + 3$  is divided by  $x + 2$  the remainder is 15 and  $x - 1$  is a factor of  $f(x)$ , then what are the values of  $a$  and  $b$  respectively?
  - 6, 2
  - 6, 2
  - 2, 6
  - 2, -6
- Which of the following is a one-to-one correspondence function?
  - $f: \mathbb{R} \rightarrow \mathbb{R}, f(x) = 3^x$
  - $h: [0, \infty) \rightarrow [3, \infty), h(x) = |x - 3|$
  - $g: [0, \infty) \rightarrow [1, \infty), g(x) = x^2 + 1$
  - $r: [0, \infty) \rightarrow [0, \infty), r(x) = x$
- Which of the following ordered pairs of numbers gives the coordinates of the point that divides a line segment with end points  $A(-1, 5)$  and  $B(5, 2)$  in the ratio of 1:2?
  - (3, 3)
  - (-3, -3)
  - (-4, -1)
  - (1, 4)
- Given sets  $A = \{x: x^2 - 12x + 20 = 0\}$  and  $B = \{x: x^2 + 5x - 14 = 0\}$ , then which of the following is the relative complement of A with respect to B?
  - $\{-7\}$
  - $\{10\}$
  - $\{-7, 10\}$
  - $\{-10, 7\}$
- Which one of the following statements is necessarily **true**?
  - If a feasible region of a linear programming problem is unbounded, then there is no optimal value.
  - If a feasible region of a linear programming problem is bounded, then the objective function has either maximum value or minimum value.
  - If a feasible region of a linear programming problem is bounded, then the objective function must have optimal value(s).
  - At corner points of a feasible region of any linear programming problem there are always optimal values.

10. A group of 30 men participate in a survey on language skills. The number of men who know both English and Afan Oromo was equal to the number of men who know neither of these languages. The number of men who know English is 4 more than those who know Afan Oromo. How many know Afan Oromo?
- A. 26                      B. 14                      C. 13                      D. 11
11. Tola purchased a TV stand for Birr 5000 and paid Birr 250 for transportation. If he sold the TV stand for Birr 5075, then which one of the following statement is **true**?
- A. Tola gain 3.33%.                      C. Tola gain Birr 175.  
B. Tola gain Birr 75.                      D. Tola loss 3.33%.
12. The cost of an electronic device reduces at the rate of 5% per annum. If its present cost is Birr 32490, then what was its cost (*in Birr*) before two years?
- A. 36,000                      B. 37,200                      C. 35,400                      D. 29,469
13. If three positive numbers are in the ratio of 1:3:5 and the sum of their squares is 875, then which of the following is the sum of the three numbers?
- A. 45                      B. 75                      C. 90                      D. 99
14. If a man saves Birr 135 in the first year, Birr 150 in the second year, Birr 165 in the third year and so on, then in what time (*in year*) is his total saving be Birr 5,550?
- A. 362                      B. 37                      C. 20                      D. 360
15. If the 6<sup>th</sup> and 11<sup>th</sup> terms of an arithmetic progression are 52 and 112 respectively, then which of the following is the common difference of this sequence?
- A. 12                      B. 15                      C. 20                      D. 4
16. If the first term of an arithmetic sequence is 3 and the sum of its first four terms is equal to one-fifth of the sum of the next four terms, then which of the following is the sum of the first 20 terms?
- A. -1040                      B. -1080                      C. -1200                      D. -2160
17. The domain of the function  $f$  defined by  $f(x) = \sqrt{4-x} + \frac{1}{\sqrt{x^2-1}}$  is equal to:
- A.  $(-\infty, -1) \cup [1, 4]$                       C.  $(-\infty, -1) \cup [1, 4)$   
B.  $(-\infty, -1) \cup (1, 4]$                       D.  $(-\infty, -1) \cup (1, 4)$
18. What is the absolute maximum of  $f(x) = 2x^3 - 6x^2 - 48x + 7$  on  $[-6, 8]$ ?
- A. 353                      B. 263                      C. 63                      D. -353
19. If  $\int_0^k (2kx - x^2) dx = 18$ , then which of the following is the value of  $k$ ?
- A. -3                      B. 0                      C. 9                      D. 3
20. If  $F$  and  $f$  are defined functions on  $[a, b]$  such that  $F'(x) = f(x)$  for all  $x$ , then  $\int_a^b f(x) dx$  is equal to:
- A.  $F'(a) - F'(b)$                       B.  $F'(b) - F'(a)$                       C.  $F(a) - F(b)$                       D.  $F(b) - F(a)$
21. Which of the following is the area (*in square units*) of the region enclosed by the curve  $f(x) = 4x^3$  and x-axis between  $x = -2$  and  $x = 3$ ?
- A. 65                      B. 81                      C. 97                      D. 107

22. On the interval  $[0, 2\pi]$ , which of the following is the value of  $\theta$  which satisfy the equation  $2\cos\theta + \sqrt{3} = 0$ ?
- A.  $\frac{4\pi}{3}, \frac{5\pi}{3}$       B.  $\frac{2\pi}{3}, \frac{4\pi}{3}$       C.  $\frac{5\pi}{6}, \frac{7\pi}{6}$       D.  $\frac{8\pi}{6}, \frac{11\pi}{6}$
23. The solution set of  $\log(x+4) + \log 4 = \log 48 - \log x$  is equal to:
- A.  $\{2\}$       B.  $\{-6, 2\}$       C.  $\{-6\}$       D.  $\{-2, 6\}$
24. If  $f(x) = \sin x$  and  $g(x) = \cos x$ , then which of the following statement is **NOT** true about the graphs of  $f$  and  $g$ ?
- A. Both functions have the same range.      C. The domain of both functions is  $\mathbb{R}$ .  
 B. The value of both functions can be less than  $-1$ .      D. They have the same period.
25. Let  $f(x) = \frac{2x-3}{x+1}$ , for  $x \neq -1$ . Which of the following is the inverse of  $f$ ?
- A.  $f^{-1}(x) = \frac{x+3}{2-x}, x \neq 2$       C.  $f^{-1}(x) = \frac{x+3}{x-2}, x \neq 2$   
 B.  $f^{-1}(x) = \frac{x+1}{2x-3}, x \neq \frac{3}{2}$       D.  $f^{-1}(x) = \frac{x+1}{2x+3}, x \neq -\frac{3}{2}$
26. The domain and range respectively for the power function  $f$  defined by  $f(x) = \frac{1}{3}x^{-\frac{6}{5}}$  are:
- A.  $\mathbb{R} \setminus \{0\}$  and  $(0, \infty)$       C.  $(0, \infty)$  and  $(0, \infty)$   
 B.  $\mathbb{R} \setminus \{0\}$  and  $\mathbb{R} \setminus \{0\}$       D.  $[0, \infty)$  and  $[0, \infty)$
27. Which of the following is the largest interval on which the function  $f(x) = -2x^3 - 9x^2 - 12x + 1$  is increasing?
- A.  $(-\infty, -2] \cup [-1, \infty)$       B.  $[-2, -1]$       C.  $(-\infty, -2] \cup [1, \infty)$       D.  $[-2, \infty)$
28. The feasible region (shaded) for a linear programming problem is shown in the figure below. The minimum value of  $Z = 3x - 4y$  is occurs at:



- A.  $(5, 0)$   
 B.  $(0, 8)$   
 C.  $(4, 10)$   
 D.  $(6, 5)$

29. Suppose the mean, the median and the mode of a certain distribution are 32, 30.5 and 29.5 respectively, then which of the following is **true**?
- A. The distribution is positively skewed.      C. The Pearson's coefficient of skewness is zero.  
 B. The Bowley's coefficient of skewness  $\beta < 0$ .      D. The distribution is negatively skewed.

30. Which one of the following is non-random sampling?

- A. Stratified Sampling  
B. Systematic Sampling  
C. Convenience Sampling  
D. Cluster Sampling

31. A company manufactures two types of sweaters; type A and type B. It costs Birr 360 to make a type A sweater and Birr 120 to make a type B sweater. The company can make at most 300 sweaters and spend at most Birr 72,000 a day. The number of sweaters of type B cannot exceed the number of sweaters of type A by more than 100. The company makes a profit of Birr 200 for each sweater type A and Birr 120 for every sweater of type B. If  $x$  = the number of type A sweater and  $y$  = the number of type sweater, then which one of the following standard forms of linear programming models should be used to maximize the profit?

A. Maximize  $P = 200x + 120y$ ,

$$\text{subject to: } \begin{cases} x + y \leq 300 \\ 3x + y \leq 600 \\ y \leq x + 100 \\ x \geq 0, y \geq 0 \end{cases}$$

C. Maximize  $P = 200x + 120y$ ,

$$\text{subject to: } \begin{cases} x + y \geq 300 \\ 3x + y \geq 600 \\ y \geq x + 100 \\ x \geq 0, y \geq 0 \end{cases}$$

B. Maximize  $P = 120x + 200y$ ,

$$\text{subject to: } \begin{cases} x + y \leq 300 \\ 3x + y \leq 600 \\ y \leq x + 100 \\ x \geq 0, y \geq 0 \end{cases}$$

D. Maximize  $P = 200x + 120y$ ,

$$\text{subject to: } \begin{cases} x + y \leq 300 \\ 3x + y \leq 600 \\ y \leq x - 100 \\ x \geq 0, y \geq 0 \end{cases}$$

32. A circular plate of metal is being expanding by heating. If the radius of the plate increases at a rate of  $0.5\text{cm/sec}$ , then which one of the following is the rate of increase of its area when the radius is  $20\text{cm}$ ?

- A.  $80\pi\text{cm}^2/\text{sec}$       B.  $20\pi\text{cm}^2/\text{sec}$       C.  $10\pi\text{cm}^2/\text{sec}$       D.  $200\pi\text{cm}^2/\text{sec}$

33. On selling an article for Birr 450, a dealer lost 10%. The cost price of the article is equal to:

- A. Birr 405      B. Birr 500      C. Birr 550      D. Birr 454.55

34. What is the solution set of the equation  $\frac{3x}{x+4} + \frac{2}{x^2+6x+8} = \frac{1}{x+2}$ ?

- A.  $\emptyset$       B.  $\left\{-2, \frac{1}{3}\right\}$       C.  $\{-2\}$       D.  $\left\{\frac{1}{3}\right\}$

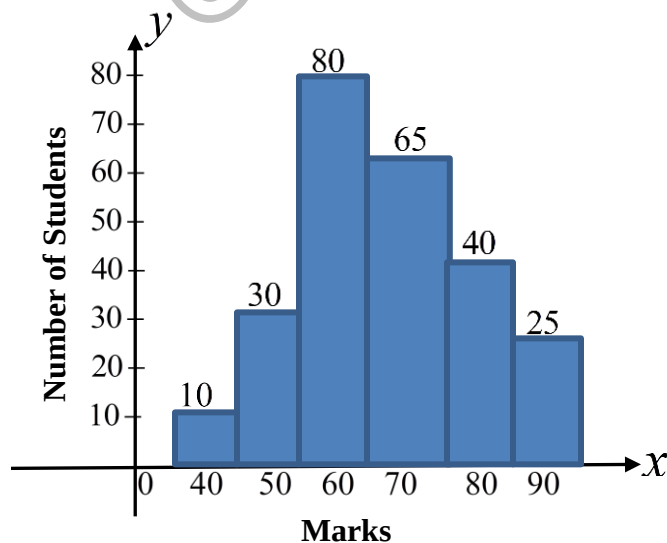
35. If in increasing geometric progression, the  $6^{\text{th}}$  term is 32 and its  $8^{\text{th}}$  term is 128, then what is the value of the common ratio?

- A. -2      B. 4      C. 2      D.  $\pm 1$

36. What is the solution set of the system of linear equations given by  $\begin{cases} x - y - 2z = 1 \\ x + 2y + z = -2 \\ 2x - 2y - 4z = 2 \end{cases}$ ?

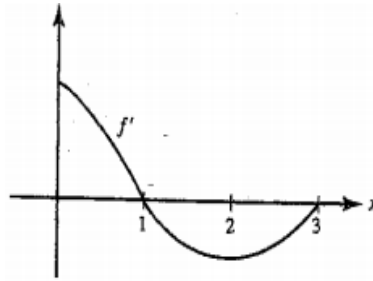
- A.  $\{(z, -1-z, z): z \in \mathbb{R}\}$       C.  $\{(z, 1+z, z): z \in \mathbb{R}\}$   
B.  $\{(-1-z, z, z): z \in \mathbb{R}\}$       D.  $\{(1+z, z, z): z \in \mathbb{R}\}$

37. What is the image of the point  $(2, -3)$  when reflected about the line  $y = -x$  ?
- A.  $(-3, 2)$                       B.  $(2, 3)$                       C.  $(3, -2)$                       D.  $(-2, -3)$
38. Let  $A$  and  $B$  be two vectors given by  $A = 3i - 2j$  and  $B = 5i + \frac{1}{2}j$ , then the vector  $\frac{1}{2}A - \frac{2}{3}B =$  \_\_\_\_
- A.  $\frac{9}{2}i - \frac{4}{3}j$                       B.  $-\frac{11}{6}i - \frac{4}{3}j$                       C.  $\frac{11}{6}i - \frac{4}{3}j$                       D.  $-\frac{11}{6}i + \frac{4}{3}j$
39. If  $Q_3 = 50$  and  $Q_1 = 35$ , then find the coefficient of quartile deviation.
- A.  $\frac{3}{17}$                       B.  $\frac{15}{2}$                       C.  $\frac{5}{17}$                       D.  $\frac{17}{3}$
40. Consider the matrix  $A = \begin{pmatrix} 1 & 2 & 3 \\ 6 & 1 & 9 \\ 4 & 0 & 5 \end{pmatrix}$ . Which of the following is the  $\det(A)$  and the cofactor of entry  $a_{32}$  respectively?
- A.  $5, 0$                       B.  $-19, -9$                       C.  $-19, 7$                       D.  $5, 9$
41. If  $\vec{u} = i - j$  and  $\vec{v} = 2i + j$  are two vectors, then which of the following is the cosine of the angle between  $\vec{u}$  and  $\vec{v}$  ?
- A.  $\frac{3\sqrt{10}}{10}$                       B.  $\sqrt{10}$                       C.  $3\sqrt{10}$                       D.  $\frac{\sqrt{10}}{10}$
42. If Bona's income is Birr 180,000 per year and he pays 20% of this as house rent and 15% of the remainder on his child's education, then find the money left with he.
- A. Birr 144,000                      B. Birr 158,000                      C. Birr 21,000                      D. Birr 122,400
43. The following histogram presents the marks of grade 12 students of a certain secondary school out of 100. Based on the given data in the histogram, what percentage of students secured less than marks 60?



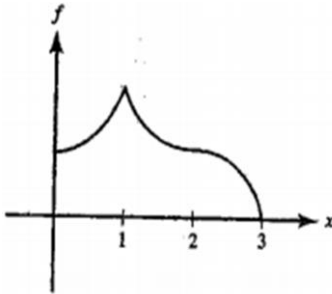
- A. 16%                      B. 48%                      C. 36%                      D. 60%

44. The following graph is the graph of  $f'$ .

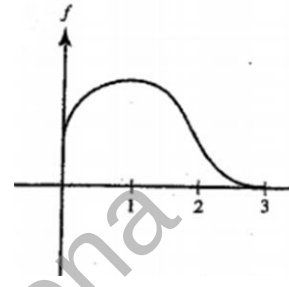


Which of the following could be the graph of  $f$ ?

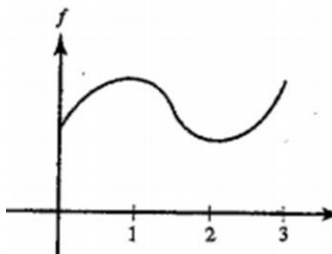
A.



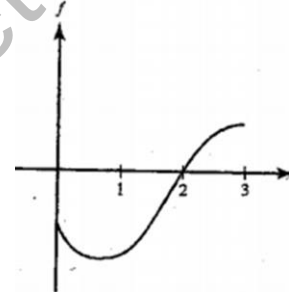
C.



B.



D.



45. The areas of two similar triangles are  $144\text{cm}^2$  and  $81\text{cm}^2$ . If one side of the first triangle is  $6\text{cm}$ , then which of the following is the length of the corresponding side of the second triangle?

A.  $\frac{81}{4}\text{cm}$

B.  $\frac{9}{2}\text{cm}$

C.  $\frac{3}{2}\text{cm}$

D.  $\frac{9}{4}\text{cm}$

46. The following table shows marks of 100 students in Mathematics and Physics.

|                    | Mathematics | Physics |
|--------------------|-------------|---------|
| Mean               | 20          | 25      |
| Standard Deviation | 2           | 3       |

Which subject shows the highest variability in marks?

A. Mathematics

B. Physics

C. Both are equal

D. Cannot determine

47. If a frustum of a right circular cone with base radii  $3\text{cm}$  and  $4\text{cm}$  and a slant height of  $6\text{cm}$  is given, then what is the total surface area of this frustum?

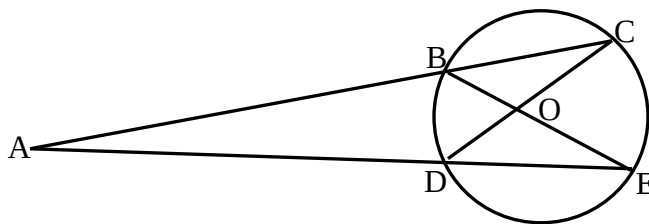
A.  $67\pi\text{cm}^2$

B.  $74\pi\text{cm}^2$

C.  $56\pi\text{cm}^2$

D.  $36\pi\text{cm}^2$

48. In the circle O shown below, if  $m(\angle CBE) = 63^\circ$  and  $m(\angle BED) = 28^\circ$ , which of the following is  $m(\angle BAD)$ ?



- A.  $91^\circ$                       B.  $56^\circ$                       C.  $70^\circ$                       D.  $35^\circ$
49. What is the solution set of the equation  $\sqrt[3]{64^{x+1}} = \left(\frac{1}{16}\right)^{2x-3}$ ?
- A.  $\{-1\}$                       B.  $\{-2\}$                       C.  $\{2\}$                       D.  $\{1\}$
50. Which of the following is **true** about the graph of  $f(x) = \frac{x-2}{x^2-5x+6}$ ?
- A.  $x=2$  and  $x=3$  are its vertical asymptotes.                      C.  $y=0$  is its oblique asymptote.  
 B. The  $x$ -axis is its horizontal asymptote.                      D. The  $x$ -intercept is  $(2, 0)$ .
51. Let  $A$  be a  $3 \times 3$  matrix and  $k$  be scalar. Which of the following is **true**?
- A. If  $B$  is obtained by multiplying one row of  $A$  by  $k$ , then  $|B| = |A|$ .  
 B. If  $B$  is obtained by interchanging two rows of  $A$ , then  $|B| = |A|$   
 C. If  $B = kA$ , then  $|B| = k^3|A|$ .  
 D. If  $B$  is obtained by adding  $k$  times one row of  $A$  onto another row of  $A$ , then  $|B| = k|A|$ .
52. Let  $\vec{u} = i + 3j + 2k$  and  $\vec{v} = i - 3k$  be two vectors. Then  $|\vec{u} \times \vec{v}|$  is equal to:
- A. 115                      B.  $\sqrt{115}$                       C. 125                      D.  $\sqrt{125}$
53. Which of the following is the equation of the tangent line to the circle  $x^2 + y^2 + 2x - 4y = 0$  at the point  $(-2, 4)$ ?
- A.  $2x - y + 8 = 0$                       C.  $x - 2y - 10 = 0$   
 B.  $x + 2y - 6 = 0$                       D.  $x - 2y + 10 = 0$
54. If a translation  $T$  takes the origin to the point  $(0, 4)$ , then what is the image of the line  $2x - y = 3$  under  $T$ ?
- A.  $2x - y = -1$                       B.  $2x - y = 1$                       C.  $2x + y = -1$                       D.  $2x + y = 1$
55. What is the image of the circle  $(x-1)^2 + (y+2)^2 = 4$  when it is rotated through  $\theta = \frac{3\pi}{2}$  about the origin?
- A.  $(x+2)^2 + (y-1)^2 = 4$                       C.  $(x+1)^2 + (y+2)^2 = 4$   
 B.  $(x-2)^2 + (y+1)^2 = 4$                       D.  $(x+2)^2 + (y+1)^2 = 4$
56. Which of the following is a discrete data?
- A. Volume of water in a glass                      C. Temperature in the classroom  
 B. Number of students in the class                      D. Time taken to complete a test

57. The following table presents the scores of grade 12 students of a certain school in a Mathematics Exam.

| Score          | 31–40 | 41–50 | 51–60 | 61–70 | 71–80 | 81–90 | 91–100 |
|----------------|-------|-------|-------|-------|-------|-------|--------|
| No of students | 10    | 9     | 15    | 12    | 10    | 4     | 2      |

What is the middle quartile for this data?

- A. 55.5                      B. 50.5                      C. 60.5                      D. 58.5

58. What is the coefficient of  $x^3y^5$  in the expansion of  $(2x-y)^8$ ?

- A. 448                      B. 8                      C. -448                      D. -8

59. If two dice are rolled, then what is the probability of getting a sum greater than 10 or doubles?

- A.  $\frac{4}{9}$                       B.  $\frac{2}{9}$                       C.  $\frac{1}{4}$                       D.  $\frac{1}{9}$

60. Which of the following is the partial fraction form of the rational expression  $\frac{x^2+3}{x^3-x^2+x-1}$ ?

- A.  $\frac{2}{x-1} - \frac{x+1}{x^2+1}$                       B.  $\frac{2}{x-1} + \frac{1-x}{x^2+1}$                       C.  $\frac{2}{x-1} - \frac{1-x}{x^2+1}$                       D.  $\frac{2}{x-1} + \frac{x+1}{x^2+1}$

**THE END**