1. Find the remainder when \( f(x) \) is divided by \( p(x) \),

\[
 f(x) = 3x^3 - 5x^2 - 4x - 8 \quad \quad p(x) = x^2 + x
\]

A. \( r(x) = -2x - 8 \)
B. \( r(x) = -6x - 8 \)
C. \( r(x) = 2x - 8 \)
D. \( r(x) = 6x - 8 \)
E. \( r(x) = 4x - 8 \)

2. The frame for a shipping crate is to be constructed from 32 feet of lumber. If the crate is to have square ends of sides \( x \), for what values of \( x \) would the volume of the box be greater than zero?

A. \((0, 4)\)
B. \((0, \infty)\)
C. \((0, 32)\)
D. \((0, 8)\)
E. \((0, 16)\)

3. Find a polynomial \( f(x) \) of degree 4 that has zeros at \( x = -2, x = 1, \) and \( x = 3 \) that satisfies the condition that \( f(0) = 12 \) and \( f(x) < 0 \) on \((-\infty, -2) \cup (3, \infty)\).

A. \( f(x) = 2(x + 2)(x - 1)(x - 3) \)
B. \( f(x) = -2(x + 2)(x - 1)^2(x - 3) \)
C. \( f(x) = (x + 2)^2(x - 1)(x - 3) \)
D. \( f(x) = -\frac{2}{3}(x + 2)(x - 1)(x - 3)^2 \)
E. \( f(x) = -(x - 2)^2(x - 1)(x - 3) \)
4. Find an equation of a rational function \( f \) that satisfies the given conditions.

vertical asymptotes: \( x = -3, x = 1 \)
horizontal asymptote: \( y = 0 \)
\( x \)-intercept: \(-1\)
\( f(0) = -\frac{1}{2} \)
hole at \( x = 2 \)

A. \( f(x) = \frac{2(x + 3)(x - 1)(x - 2)}{3(x + 1)(x - 2)} \)

B. \( f(x) = \frac{3(x + 1)(x - 2)}{2(x + 3)(x - 1)(x - 2)} \)

C. \( f(x) = \frac{-2(x + 3)(x - 1)(x - 2)}{(x + 1)(x - 2)} \)

D. \( f(x) = \frac{-2(x + 1)(x - 2)}{(x + 3)(x - 1)(x - 2)} \)

E. None of the above

5. Find the vertical asymptote(s) of the rational function \( f(x) = \frac{x^2 + 4x + 4}{x^2 + 3x + 2} \).

A. \( x = -2 \)
B. \( x = -2, -1 \)
C. \( x = -2, x = 2 \)
D. \( x = -1 \)
E. There are no vertical asymptotes

6. Over what interval(s) is the rational function \( f(x) = \frac{x^2 + 4x - 5}{x^2 + 2x - 3} \) decreasing?

A. \( (-\infty, -3) \cup (-3, \infty) \)
B. \( (-\infty, -3) \)
C. \( (-3, \infty) \)
D. \( (-\infty, -3) \cup (-3, 1) \cup (1, \infty) \)
E. \( f(x) \) is never decreasing
7. Given \( f(x) = \frac{2x - 3}{3x + 4} \), find the inverse function \( f^{-1}(x) \).

A. \( f^{-1}(x) = \frac{3x + 4}{2x - 3} \)
B. \( f^{-1}(x) = \frac{3 - 2x}{3x - 4} \)
C. \( f^{-1}(x) = \frac{3x - 3}{2x - 4} \)
D. \( f^{-1}(x) = \frac{-3x - 4}{-3 - 2x} \)
E. \( f^{-1}(x) = \frac{4x + 3}{2 - 3x} \)

8. Given \( f(x) = \frac{3x + 2}{x - 5} \), find the range of the inverse function \( f^{-1}(x) \).

A. \( (-\infty, \infty) \)
B. \( (-\infty, 0) \cup (0, \infty) \)
C. \( (-\infty, 5) \cup (5, \infty) \)
D. \( (-\infty, 3) \cup (3, \infty) \)
E. \( (-\infty, -\frac{3}{2}) \cup (-\frac{3}{2}, \infty) \)

9. The number of bacteria in a certain culture increased from 600 to 1800 between 7:00am and 9:00am. Assuming the growth is exponential, the number \( f(t) \) of bacteria \( t \) hours after 7:00am is given by \( f(t) = 600 \left(3^{t/2}\right) \). Estimate the number of bacteria in the culture at 11:00am.

A. 3,600
B. 2,400
C. 48,600
D. 5,400
E. 7,200
10. How much money invested at a rate of 6.4% interest compounded continuously will amount to $100,000 after 10 years?
   A. $52,729.24
   B. $64,264.21
   C. $66,421.89
   D. $71,239.56
   E. $73,435.20

11. Solve the equation for $x$: $e^{3 + \ln x} = 4$
   A. $x = \ln 4 - 3$
   B. $x = e^4 - 3$
   C. $x = 4e^{-3}$
   D. $x = \ln \left(\frac{4}{3}\right)$
   E. $x = \frac{1}{3} \ln 4$

12. Starting with $q_0$ milligrams of a radioactive substance, the amount $q$ remaining after $t$ years is given by the formula $q = q_0 \left(\frac{2}{20}\right)^{-t/20}$. Express $t$ in terms of $q$ and $q_0$.
   A. $t = \log_2 \left(\frac{-20q}{q_0}\right)$
   B. $t = -\frac{20}{q_0} \log_2 q$
   C. $t = -20 \log_2 \left(\frac{q}{q_0}\right)$
   D. $t = -\log_2 \left(\frac{q}{20q_0}\right)$
   E. $t = -\frac{1}{20} \log_2 \left(\frac{q}{q_0}\right)$
13. Write the expression as one logarithm.

\[2 \ln xy^2 - 4 \ln \sqrt{x}y + 2 \ln x^2y^3\]

A. \(\ln (x^4y^8)\)
B. \(\ln (x^8y^{12})\)
C. \(\ln \left(\frac{1}{x^4y^4}\right)\)
D. \(\ln (x^6y^{22})\)
E. \(\ln \left(\frac{x^4}{y^4}\right)\)

14. Find the exact solution to the logarithmic equation.

\[\log(5x + 1) = 2 + \log(2x - 3)\]

A. \(x = \frac{301}{205}\)
B. \(x = \frac{299}{205}\)
C. \(x = \frac{301}{195}\)
D. \(x = \frac{299}{195}\)
E. No solutions exist

15. Solve for \(x\):

\[4^{1-2x} = \left(\frac{1}{8}\right)^x\]

A. \(x = 1\)
B. \(x = 2\)
C. \(x = 3\)
D. \(x = 4\)
E. \(x = 5\)
Answers:

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