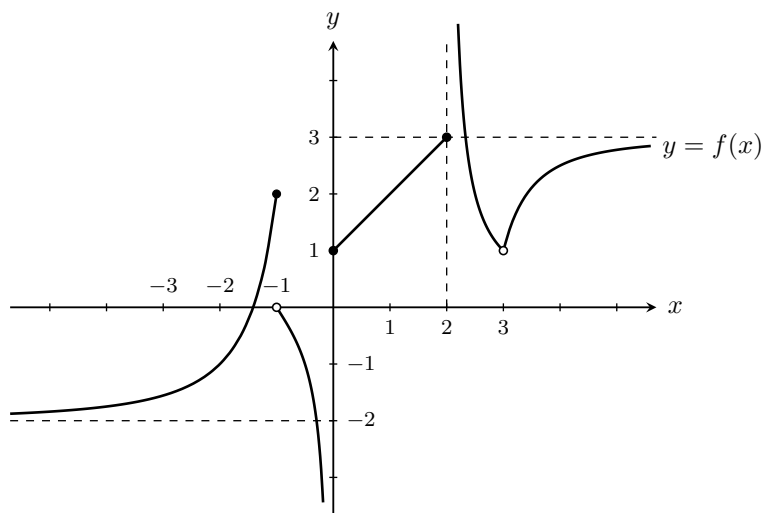


**Question 1: (10 pts)** For the function  $f(x)$  given in the graph below, find each of the following limits. Write DNE,  $-\infty$  or  $+\infty$  where appropriate.



a)  $\lim_{x \rightarrow -\infty} f(x) =$

b)  $\lim_{x \rightarrow -1^-} f(x) =$

c)  $\lim_{x \rightarrow 0^+} f(x) =$

d)  $\lim_{x \rightarrow -1^+} f(x) =$

e)  $\lim_{x \rightarrow 3} f(x) =$

f)  $\lim_{x \rightarrow 2} f(x) =$

g)  $\lim_{x \rightarrow 0^-} f(x) =$

h)  $\lim_{x \rightarrow +\infty} f(x) =$

i) List the points of discontinuity

**Question 2: (5 pts)** Solve the following system of equations for each unknown:

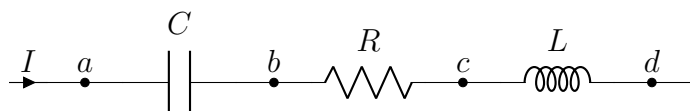
$$\begin{cases} 2x + 4y + 8z = -6 \\ -2x + 6z = 0 \\ -5x - 7y - 11z = 9 \end{cases}$$

**Question 3: (6 pts)** Solve the following equations for  $x$ :

a)  $\log_3(2x + 3) + \log_3(x - 2) = 2$

b)  $8^{x+1} = \left(\frac{1}{32}\right)^{2x-5}$

**Question 4: (8 pts)** Consider the electrical circuit below:



- The current is  $I = 0.450\text{A}$   
(with a frequency of  $50.0\text{Hz}$ );
- The capacitance is  $C = 84.2 \times 10^{-6}\text{F}$ ;
- The resistance is  $R = 45.2\Omega$ ;
- The inductance is  $L = 61.4 \times 10^{-3}\text{H}$ ;

- Determine the voltage across the capacitor (between points  $a$  and  $b$ ).
- Determine the voltage across the inductor (between points  $c$  and  $d$ ).
- Determine the voltage across the CRL combination (between points  $a$  and  $d$ ).
- Determine if the voltage leads or lags the current, and by what angle.

**Question 5: (6 pts)** Perform the indicated operations, and write your answers in the rectangular form  $x + yj$ .

a)  $(3 + 5j^7 - j^{14} + 2j^{21})(2j^{24} - j^{35})$

b)  $\frac{6 - j}{4 - j} + \frac{3 + 2j}{1 + 4j}$

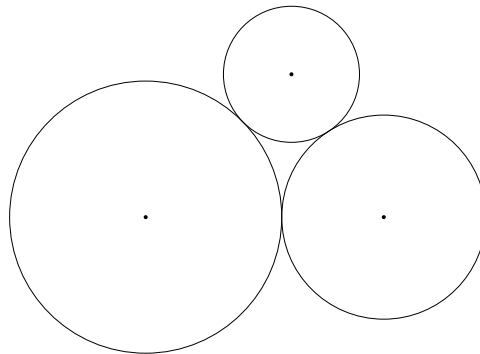
**Question 6: (4 pts)** Use DeMoivre's Theorem to find all the cubic roots of  $-2 + 3j$ . Write your answers in rectangular form  $x + yj$ . (Round to 3 decimals)

**Question 7: (4 pts)** Consider the 3 following vectors:

- Vector  $A$  has a magnitude of 53.1, and a direction of  $28.5^\circ$  N of W;
- Vector  $B$  has a magnitude of 32.7, and a direction of  $43.9^\circ$  S of E;
- Vector  $C$  has a magnitude of 44.6, and a direction of  $71.3^\circ$  N of E;

Find the magnitude and the direction of the resultant vector obtained by adding  $A$ ,  $B$  and  $C$ .

**Question 8: (5 pts)** Three pipes with radii 2.50cm, 3.25cm and 4.25cm are welded together lengthwise (see picture for cross-section). Find all three angles between the lines connecting the centers.



**Question 9: (3 pts)** What is the area of a paper label that is used to cover the lateral surface of a cylindrical can 8.50cm in diameter and 11.5cm high? The ends of the label must **overlap** 0.50cm when the label is placed on the can.

**Question 10: (4 pts)** Find the equation of the tangent line to the graph of  $xy^2 + 3x^2 - y^2 + 15 = 0$  at the point  $(-1, 3)$ .

**Question 11: (4 pts)** Consider the function  $f(x) = -7 \cos(3x - 9)$ . Find:

- |                                   |                                     |
|-----------------------------------|-------------------------------------|
| a) the amplitude of the function. | b) the period of the function.      |
| c) the frequency of the function. | d) the phase shift of the function. |

**Question 12: (3 pts)** Solve for  $z$  **only**, using Cramer's rule: 
$$\begin{cases} 5x - 3y + 4z = -2 \\ 3x + 2y - z = 5 \\ x - 5y - 3z = -7 \end{cases}$$

**Question 13: (6 pts)** Solve the following equations for  $x$  such that  $0 \leq x < 2\pi$ . Round your answers to 4 decimals.

a)  $2 \cos^2(x) + 7 \cos(x) = 4 - 2 \sin^2(x)$

b)  $\tan(x) = 5 \cot(x)$

**Question 14: (12 pts)** Evaluate the following limits:

a)  $\lim_{x \rightarrow 4} \frac{x^3 - 7x^2 + 9x + 12}{x^2 - 3x - 4}$

b)  $\lim_{x \rightarrow -2} \frac{x^2 - 4}{5 - \sqrt{3x^2 + 13}}$

c)  $\lim_{x \rightarrow -\infty} \frac{(3x + 2)(4 - 5x^2)}{2 - x^4}$

d)  $\lim_{x \rightarrow 3} \frac{4x + 5}{x^3 - 4x^2 - 3x + 18}$

**Question 15: (5 pts)** The number  $n$  of grams of a compound formed during a chemical reaction is given by  $n = \frac{2t}{t+1}$ , where  $t$  is the time (in minutes) after the start of the reaction. Evaluate  $\frac{d^2n}{dt^2}$  at  $t = 4.00$ min.

**Question 16: (15 pts)** Find  $y'$ . Do not simplify your answers.

a)  $y = 3 + 7x^4 - \frac{4}{\sqrt[5]{x}} + \ln(\pi)$

b)  $\cot(x^2y) = ye^x$

c)  $y = \frac{\cos(x) \sin(x^2)}{(2x^2 + 5)^3}$

d)  $y = \log_{\pi}(4x^3 + 11) - 7^{\tan(x)}$

e)  $y = \ln \left( \frac{(6x - 5)^7 \csc(x)}{(3x + 8)^4 \sqrt[9]{x^2 + 1}} \right)$

Hint: Simplify using properties of  $\ln$  before differentiating.

**ANSWERS:**

1.) a) -2 b) 2 c) 1 d) 0 e) 1 f) DNE g)  $-\infty$  h) 3 i) -1, 0, 2, 3

2.)  $x = 3, y = -5, z = 1$  3.) a) 3 b)  $\frac{22}{13}$

4.) a) 17.0V b) 8.69V c) 22.0V d) Lags by  $-22.3^\circ$  5.) a)  $11 - 2j$  b)  $\frac{36}{17} - \frac{8}{17}j$

6.)  $1.153 + 1.011j, -1.452 + 0.493j, 0.299 - 1.504j$  7.)  $45.8 \angle 101.1^\circ$

8.)  $47.3^\circ, 59.5^\circ, 73.2^\circ$  9.)  $313\text{cm}^2$  10.)  $y = \frac{1}{4}x + \frac{13}{4}$

11.) a) 7 b)  $\frac{2\pi}{3}$  c)  $\frac{3}{2\pi}$  d) 3 12.)  $\frac{-11}{147}$

13.) a) 1.2810, 5.0021 b) 1.1503, 1.9913, 4.2919, 5.1329

14.) a)  $\frac{1}{5}$  b)  $\frac{-10}{3}$  c) 0 d)  $+\infty$  15.)  $\frac{-4}{125}\text{g}/\text{min}^2$

16.) a)  $28x^3 + \frac{4}{5\sqrt[5]{x^6}}$

b)  $\frac{-ye^x - 2xy \csc^2(x^2y)}{e^x + x^2 \csc^2(x^2y)}$

c)  $\frac{[2x \cos(x) \cos(x^2) - \sin(x) \sin(x^2)](2x^2 + 5) - 12x \cos(x) \sin(x^2)}{(2x^2 + 5)^4}$

d)  $\frac{12x^2}{(4x^3 + 11) \ln(\pi)} - 7^{\tan(x)} \ln(7) \sec^2(x)$

e)  $\frac{42}{6x - 5} - \cot(x) - \frac{12}{3x + 8} - \frac{2x}{9(x^2 + 1)}$