Mathematica Quiz, AY26-1

Weight: This quiz is worth 60 points.

Scope: The quiz covers the "Getting Started" Document.

Instructions: There is no time limit for this assignment. You may not get assistance from any other cadets or instructors. You may refer to the "Getting Started" document as much as necessary. You may also search the documentation center or google as much as necessary. Submit your completed Mathematica notebook file in Canvas with a cover sheet.

Suspense: 1159 PM 20 August 2025

Problem 1

(3 points each.) In Part (a), define the function $f(x) = \sin(x^2)$ in Mathematica, and then use *f(x)* to evaluate the limits in Parts (b) through (d) below.

(a)

Out[ ]//TraditionalForm=

$$f(x) = \sin(x^2)$$

(b)

Out[ ]//TraditionalForm=

$$\lim_{\Delta x \to 0} \frac{f(x + \Delta x) - f(x)}{\Delta x}$$

(c)

Out[ ]//TraditionalForm=

$$\lim_{x \to \frac{\pi}{2}} f(x)$$

(d)

Out[ ]//TraditionalForm=

$$\lim_{x \to \sqrt{\pi}} f'(x)$$

Problem 2

(3 points each.) Use Mathematic to find an exact solution for *x* for each of the given functions in Parts (a) through (d).

(a)

Out[ ]//TraditionalForm=

$$7x^2 + 3x - 5 = a$$

(b)

Out[ ]//TraditionalForm=

$$x^2 + 6x + 9 = 0$$

(c)

Out[ ]//TraditionalForm=

$$x^2 - 2x + 5 = 0$$

(d)

Out[ ]//TraditionalForm=

$$x^3 - 2x^2 + 7x + 26 = a$$

Problem 3

(3 points each.) Enter the following expressions in Mathematica and then use the *ReplaceAll* function to make the substitution a=1 in each of the three expressions.

(a)

Out[ ]//TraditionalForm=

$$x^3 - 2x^2 + 7x + 26 = a$$

(b)

Out[ ]//TraditionalForm=

$$\sin(a\,x^2) + \cos(a\,x^2) = 0$$

(c)

Out[ ]//TraditionalForm=

$$e^{-a\,t}$$

Problem 4

(3 points each.)

(a) For the following function, find all exact solutions for *x* (the answer is a list of three rules):

Out[ ]//TraditionalForm=

$$3x^3 - 3x^2 + 17x + 6 = a$$

(b) Use the list of rules (solutions) from part (a) and the "Part" function to isolate the real solution.

(c) Use your answer for part (b) and the "N" function to create a new function that reports the approximate numerical value of *x* as a function of *a*.

(d) Use your function from part (c) to create a plot of *x* versus *a*, with *a* varying from negative infinity to positive infinity and with a *PlotRange* of -5 to 5.

(e) Use your function from part (c) and "Solve" to find the value of *a* that makes *x=0*.

Problem 5

(2 points each.) Use the natural language function to find the following:

(a) Heat capacity of water.

(b) Critical pressure of argon.

(c) Critical temperature of oxygen.

(d) Van der Waals constants for nitrogen.

(e) SRK equation of state.

(f) Convert 1.01 grams per mL to lbs per cubic foot.