Math SL PROBLEM SET 44

Section A (Short Answer)

1. **(C6.1 - N) (CI)** Sara is working with the cubic function $g(x) = x^3 + x^2 - 5x + 2$. She would like to use calculus to determine: **(Cirrito 20.2, p649)**
   a. the equation of the line that is normal to the cubic at the point (2,4) (What does a line that is normal mean in the first place?)
   b. the x-coordinate(s) at which the line(s) that are tangent to $g(x)$ have a slope of 3.

2. **(V4.1 - N) (CI)** A unit vector is defined as a vector whose **length is one unit**. Given the following vectors, find their respective unit vectors. **(Cirrito 12.5.2, p430)**
   a. $\overrightarrow{AB} = \begin{bmatrix} -3 \\ 5 \end{bmatrix}$ b. $\overrightarrow{AB} = \begin{bmatrix} 5 \\ 2 \\ 4 \end{bmatrix}$

3. **(T.3.2, T3.3 - R) (CI)** Jana has mastered the "unit circle" and wants to apply this understanding to working through the following trig identities question: Given the fact that $\sin(x) = -\frac{3}{8}$ and $180° < x < 270°$, find each value: **(Oxford 13E, p460)**
   a. $\sin(2x)$ b. $\cos(2x)$ c. $\tan(2x)$ d. $\sin(90° - x)$

4. **(C6.3 - N) (CI)** Maylis knows that the derivative of a function is $\frac{dy}{dx} = (x+2)(x-3)(e^x - 1)$. So, she needs help in determining the: **(Cirrito 20.2, p649)**
   a. x-coordinates of the extrema of the original function, $y = f(x)$.
   b. intervals of increase and decrease of the original function.
   c. classification of the extrema as being either maximums or minimums or neither.

5. **(F2.3 - R) (CI)** Given a function f, each solution of the equation $f(x) = 0$ is called ***a zero of f***. Find the zeroes of each of the following functions: **(Cirrito 6.1, 6.2, p173 & p177)**
   a. $s(x) = \sin(x)$ b. $L(x) = \log_5(x - 3)$ c. $r(x) = \sqrt{2x + 5}$ d. $p(x) = x^3 - 4x$

6. **(F2.2, F2.4, F2.6 - R) (CA)** For the following "parent functions" ⇒ $E(x) = e^x$, $L(x) = \ln(x)$ and $r(x) = \sqrt{x}$, graph them and then for each function, determine (if applicable) their:
   a. intercept(s) b. Asymptotes c. Domain and range

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Section B (Extended Response/Investigation)

7. **(F2.2, C6.1) (CA)** The total cost, $C(x)$ in thousands of dollars, for manufacturing specialized cars is tabulated below: **(Cirrito 21.2, p689)**

Number of cars produced (x)	0	10	20	30	40	50
Total cost (in 000s) C(x)	580	805	980	1105	1180	1205

   a. Plot the points on a scatterplot (on your TI-84) & show me the scatterplot
   b. Use second differences to verify that a quadratic model is appropriate in this situation.
   c. Determine the equation of the quadratic that is appropriate in this situation.
   d. What is the average rate of increase in production costs for the first 10 cars?
   e. How much did it cost to produce (i) 10 cars? (ii) 11 cars?
   f. How much did it cost to produce the 11th car?
   g. Find the derivative of the cost function and then evaluate $\frac{dC}{dx}$ at $x = 11$. Interpret your result.

8. **(C6.3, C6.6) (CI)** From the following velocity-time graph, answer the following questions:

   a. Find the speed of the bus at $t = 2$ s and at $t = 8$ s and at $t = 12$ s.
   b. Find the average rate of change of speed between t = 2 s and t = 8 s.
   c. Find the instantaneous rate of change of speed of the bus at $t = 2$ s, $t = 8$ s and $t = 12$ s.
   d. What is the rate of change of speed called?
   e. How far did the bus travel in the first 5 seconds?
   f. How far did the bus travel in the first 10 seconds?
   g. Find the average speed of the bus in the first 10 seconds.