Math SL PROBLEM SET 40

Section A (Skills/Concepts Consolidation)

1. **(F2.1, F2.2, F2.4, F2.5, F2.6 - R) (CI)** Find the equation of the inverse functions of the following functions: **(Cirrito 5.4.2, p160)**
   a. $f(t) = 3e^{-0.25t} + 4$. b. $g(x) = \frac{2x-3}{x+4}$. c. $h(x) = 2x^2 + 4x - 6$

2. **(V4.1 - E) (CI)** Given that the vector $\boldsymbol{a}$ is defined as $\boldsymbol{a} = 3\boldsymbol{i} - \boldsymbol{j} - 2\boldsymbol{k}$ and that vector $\boldsymbol{b}$ is defined as $\boldsymbol{b} = 5\boldsymbol{i} - \boldsymbol{k}$, determine the following: **(Cirrito 12.3, p415)**
   a. The resultant vector $\boldsymbol{a} + \boldsymbol{b}$.
   b. The magnitude of $\boldsymbol{b}$ and then the magnitude of $4\boldsymbol{b}$.
   c. The magnitude of $\boldsymbol{a}$ and then the magnitude of $-3\boldsymbol{a}$.
   d. The resultant vector $5\boldsymbol{a} - 3\boldsymbol{b}$ and its magnitude.
   e. Explain what happens to a vector when you multiply it by a scalar.

3. **(T3.6 - E) (CA)** For the ΔHKJ, side HK = 18 cm and side JK = 15 cm and $\angle$ JHK = 53°. Determine the measure of side HJ and hence the area of the triangle. **(Cirrito 9.5.2, p297)**

4. **(C6.1 - N) (CA)** Determine the value of the following "limits" ⇒ i.e. determine the limiting value of $f(x)$ as per $\lim_{n\to\infty} f(x)$, where $f(x)$ is:
   a. Let $f(x) = \frac{2x-1}{x+3}$, so in other words, evaluate $\lim_{x\to\infty} \frac{2x-1}{x+3}$.
   b. Let $f(x) = 20\left(\frac{3}{4}\right)^x$, so in other words, evaluate $\lim_{x\to\infty} 20\left(\frac{3}{4}\right)^x$.
   c. Let $f(x) = 2x^3 - x$, so in other words, evaluate $\lim_{x\to\infty} 2x^3 - x$.
   d. Let $f(x) = \tan^{-1}(x)$, so in other words, evaluate $\lim_{x\to\infty} \tan^{-1}(x)$

5. **(F2.6, F2.8, C6.1 - R,N) (CA)** We know from experience as consumers that the demand for a product tends to decrease as the price increases. This "fact" can be represented by a **demand function**. The demand function for a particular product is given by $p(x) = 500 - \frac{3}{5}e^{0.0004x}$, where p is the price per unit and x is total demand in number of units. **(Cirrito 7.2, p210)**

   a. Find the price, p, to the nearest dollar for a demand of:
      i. 1000 units ii. 5000 units iii. 10,000 units
   b. Sketch a graph of the demand function
   c. What level of production will produce a price per unit of $200?
   d. Determine the value of $\lim_{x\to\infty} p(x)$ and interpret the meaning of this limiting value.
   e. Use your calculator to draw the tangent line to the function at $x = 15{,}000$ and interpret the meaning of the slope of the tangent line.

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Section B (Skills/Concepts Practice)

6. **(V4.3 - N) (CI) SKILL**: Vector Equations of Lines. Using the information given about each line, write the equation of the line in: (i) vector form, (ii) parametric form, (iii) Cartesian form.
   a. The vector through $A(2,3)$ and $B(4,8)$
   b. The vector whose parametric equation is $x(\lambda) = 9 + \lambda$ and $y(\lambda) = 5 - 3\lambda$.
   c. The vector whose equation is $\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 1 \\ 3 \end{pmatrix} + \mu \begin{pmatrix} 7 \\ -5 \end{pmatrix}$
   d. Find the angle that each vector makes with the positive x-axis.

7. **(T3.5 - E) (CI) SKILL**: Quadratic Trig Equations. Solve the following given $0 \leq x \leq 2\pi$
   a. $2\cos^2 x + \cos x - 1 = 0$ b. $2\sin^2 x - 3\sin x + 1 = 0$ **(Oxford, Chap 13D, p455)**

8. **(T3.5 - N) (CI) SKILL**: Quadratic Trig Equations. Given $2\sin^2(x) - \cos(x) + 1 = 0$, use a substitution of a trigonometric identity to create an equivalent equation in one trigonometric function and hence solve the equation on $0 \leq x \leq 2\pi$. **(Oxford, Chap 13D, p455)**

9. **(V4.1, V4.2 - E,N) (CI) SKILL**: Vector Basics. You are working with two vectors. Vector 1 goes through A(4,-2) and B(7,10) and Vector 2 goes through C(-3,2) and D(-7,7). Determine: **(Cirrito 12.7, p444)**

   a. the equation vector AB, expressed in parametric form.
   b. the magnitude of the vector AB.
   c. Draw an equivalent **position vector** for the direction vector of AB.

   For the vector through C and D, determine:

   d. The equation vector CD, expressed in vector form.
   e. The magnitude of vector CD.
   f. Draw an equivalent **position vector** for the direction vector of CD.

   Draw a third vector, connecting the heads of the two position vectors you have just drawn, thereby completing a triangle.

   g. Use appropriate triangle trigonometry to find the angle between the two position vectors and hence, find the angle between the original two lines. Find the length of this vector as well.