Math SL PROBLEM SET 16

Section A (Short Answer)

1. **(F2.6, F2.7 - R) (CA)** Mr. S has $12,500 that he puts into an investment that earns K% p.a. compounded monthly. *(Cirrito 7.2, p209)*
   a. Determine the value of his investment if he keeps this investment for 10 years and the interest rate, K, is equal to 6%.
   b. Interest is now compounded continuously. What would the value of K have to be if Mr S wants the investment value to be $20,000 in 15 years?

2. **(T3.4 - R) (CA)** The monthly sales, S (in hundreds of litres of milk) is modelled by the function $S(t) = 13 + 5.5cos\left(\frac{\pi t}{6} - 3\right)$, $t > 0$ where t is the time in months with $t = 0$ corresponding to January 1st, 2010. (HINT: switch TI-84 to radian mode) *(Cirrito 10.5, p361)*
   a. Find the minimum and maximum sales during 2011.
   b. Find the value of t for which the sales first exceed 1500 litres. Solve algebraically.
   c. During which months do the weekly sales exceed 1500 litres? Solve graphically.

3. **(SP5.1, SP5.2, SP5.3 - R) (CI)** Consider the following data set: *(Cirrito 13.2, p471)*
   12, 4, 9, 10, 12, 13, 15, 11, 12, 15, 14, 8, 9, 10, 12, 9, 10, 16, 14, 13, 12, 15, 9, 10, 12
   a. Construct a:
      i. A histogram using an interval width of 2
      ii. The corresponding frequency polygon to Q a. i.
      iii. The cumulative frequency polygon
   b. Calculate the mean of the data set.
   c. Determine the median and mode and the interquartile range.
   d. Construct a box-whisker plot

4. **(F2.2, F2.6 - E) (CI)** The function $y = f(x)$ is defined as $f(x) = 2e^x - 1$. *(Cirrito 7.1.5, p207; Cirrito 5.3.3, p131)*
   a. Determine the equation of the horizontal asymptote of f.
   b. Determine the x- and y-intercept(s) of f.
   c. Sketch $f(x) = 2e^x - 1$, labeling the features you found in Qa and Qb.
   d. Sketch the inverse, $y = f^{-1}(x)$, given your work in Qc.
   e. Determine the equation of the inverse of f.

5. **(T3.4 - E) (CI)** If $\sin(\theta) = -\frac{3}{5}$ and $\cos(\theta) < 0$, find: *(Cirrito 10.1.2, p316)*
   a. what quadrant the angle θ is in,
   b. the values for $\cos(\theta)$ and $\tan(\theta)$,
   c. hence, evaluate $5 - \frac{2}{\sin^2\theta} + \frac{2}{\tan^2\theta}$

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6. **(V4.1 - N) (CA)** Use online resources to find out what a **position vector** is. Then, complete the following questions: *(Cirrito 12.4, p423)*

   a. Consider the vector whose initial point is P(2,3) and whose terminal point is Q(6,4).
      i. Plot the points and draw the position vectors OP and OQ.
      ii. Draw vector PQ. Explain why PQ = OQ - OP.
      iii. Write vector PQ in unit vector notation.
      iv. Determine the magnitude of the vector PQ.
      v. Find the angle that PQ vector makes with respect to the x-axis

   b. The vector PQ has an initial point at P(-8,1) and a terminal point at Q(-2,-5)
      i. Draw the two points and the vector PQ.
      ii. Draw the position vector, OP as well as the position vector OQ.
      iii. Write vector PQ in column form and find the magnitude of vector PQ

Section B (Extended Response/Investigation)

7. **(F2.4, F2.6, F2.7, F2.8 - R) (CA)** A biologist is observing the growth of two bacterial populations during an experiment testing a new drug. The first bacterial population, $A(t)$, is modelled by the function $A(t) = at^2 + b$, where t is time in hours after the experiment started. This population started with 900 bacteria and the biologist notices that after 5 hours all these bacteria have died. *(Cirrito 7.2, p209)*

   a. Find the values of a and b in the equation $A(t) = at^2 + b$.

   The second population, $B(t)$, is modelled by the function $B(t) = \frac{1000}{1 + 49e^{-2t}}$

   b. Complete the table of values for $B(t)$ for $0 \leq t \leq 6$.
   c. What is the initial number for the population of $B(t)$?
   d. As time increases, what appears to be the limiting value of the number of bacteria for $B(t)$?
   e. After what time is the population of $B(t) = 500$ (try this one algebraically)
   f. Draw the graphs of $A(t)$ and $B(t)$ and state a solution for $A(t) > B(t)$. Interpret your answer.

8. **(SP5.2 - N) (CA)** The CAC varsity soccer team played ten games. Find the standard deviation for the number of goals scored by the team for the ten games: 8, 4, 6, 6, 7, 7, 9, 4, 8, 5. Follow the steps below to calculate the standard deviation. *(Cirrito 13.4.2, p478)*

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a. Step 1: Sort the scores in the Score column of the table below in order from the smallest to the largest.
b. Step 2: Find the mean of the data set and place your answer below on Line A.
c. Step 3: Subtract the mean from each of the scores. Record the difference in the **Difference From The Mean** column in the table below. Be sure to record whether the answer is positive or negative. (i.e. 4 - 5 = -1 ,7 - 5 = 2)
d. Step 4: Find the square of each number in the **Difference From The Mean** column and record the result in the **Square of the Difference** column (i.e. $(1)^2 = 1$)
e. Step 5: The number of items in the data set is labeled ***n***. Record the number in this data set on Line B below.
f. Step 6: Find the sum of the numbers in the **Square of the Difference** and record your answer in the table.
g. Step 7: Take the Sum of the (**Difference from the Mean**)^2 and divide it by ***n***. Record your answer on Line C below.
h. Step 8: The square root of Line C is the standard deviation. Record your answer on Line D

Score	Difference from the mean	(Difference from the mean)^2
	Sum of (Difference from the mean)^2	

A. Mean:_____ **B. *n*:**_____

C. Sum of (Difference from the Mean)^2 divided by (*n*):_____

D. Standard deviation $\left(\sqrt{\frac{diff.fromMean)^2}{n}}\right)$ **is**_____