Math SL PROBLEM SET 64

1. **(T3.6 - R)** **(CA)** Three towns are positioned so that Blacktown is 15 km directly north of Acton and Capetown is 32 km N45°E (on a bearing of 45°) of Acton. **(Cirrito 9.6, p307)**

    a. Draw a triangle representing the locations of the three towns and label all information.
    b. Calculate the distance between Blacktown and Capetown.
    c. Determine the measure of angle BCA.

    An airplane is 3.0 km directly above Blacktown at point P. The points A, P, C form a triangle.

    d. Determine how far the plane is from Acton.
    e. Calculate the size of angle APC.

2. **(T3.5 - R)** **(CI)** Solve $1 + \sqrt{3}\tan 2(x - \frac{\pi}{3}) = 0$ on the domain of $0 < x < \pi$. **(Cirrito 10.4, p351)**

3. **(V4.3,V4.4 - R)** **(CA)** Given $r = \begin{pmatrix} 1 \\ 2 \\ 4 \end{pmatrix} + \lambda \begin{pmatrix} 4 \\ 3 \\ 1 \end{pmatrix}$ and $r = \begin{pmatrix} -1 \\ -4 \\ 1 \end{pmatrix} + \mu \begin{pmatrix} 3 \\ 2 \\ 3 \end{pmatrix}$

    a. Do these two lines intersect? **(Cirrito 12.7, p444)**
    b. If so, where?
    c. Find the measure of the acute angle between the direction vectors of these two lines.

4. **(F2.7, C6.2, C6.4 - R)** **(CI)** Let the function f be defined by $f(x) = x - 3 + \frac{4}{x^2}$, where $x \neq 0$. **(Cirrito 19.1, p601 & 22.1, p723)**

    a. Find the values for x for which $f(x) \geq 0$.
    b. Find the values for x for which $\frac{df}{dx} \geq 0$.
    c. If the function f represents a **derivative** of $g(x)$, determine the equation for $g(x)$.

5. **(SP5.6 - R)** **(CA)** Mr D. walks home after teaching and takes either Road 253 or Road 206 to get home. He varies his route so that he takes Road 253 two-thirds of the time. If he walks along Road 253, he arrives home before 6:00 pm 90% of the time. If he takes Road 206, he gets home by 6:00 pm only 60% of the time. What is the probability that: **(Oxford 3.5, p89)**

    a. he gets home after 6:00 pm?
    b. he travelled along Road 206, if he gets home before 6:00 pm?

6. **(SP5.7 - R)** **(CA)** A discrete random variable, X, may take on the values 0, 1 or 2. The probability distribution of X is defined by $P(X = x) = \frac{k}{x!}$. Find **(Cirrito 16.1, p527)**

    a. the value of k b. the mean and variance of X.

7. **(A1.1 - R)** **(CA)** Three companies A, B and C are competitors and are comparing sales figures for the period July 1st, 2013 to June 30th, 2014 (so, one year). **(Cirrito 8.2.3, p261)**

    Company A had sales of $35,400 in July of 2013 and increased sales by an average of 3% per month over this period.
    Company B had sales of $32,000 in July of 2013 and increased sales by an average of $1859 per month over this period.
    Company C had sales of $48,000 in July of 2013 and unfortunately, their sales decreased by an average of 8% per month over this period.

    a. Calculate to the nearest hundred dollars:
        i.   The sales figures for each of the companies in June of 2014.
        ii. The **total** sales figures for each of the companies for this 12 month period.

    b. Calculate, correct to one decimal place, the average percentage increase in sales per month over this one year period for Company B.

    c. Assuming the sales trends **continue** beyond June 2014,
        i.   calculate how many months from July 2013 it would take Company A to reach a **total sales** of $600,000.
        ii. will Company C ever reach a **total sales** target of $600,000? Give reasons.

8. **(T3.4 - R)** **(CA)** The depth of the water at a certain point on the coast, at time t hours after 12:00 (noon) on any given day is modeled by $h(t) = 2.5 + \frac{1}{2} \cos \frac{4\pi}{25} (t + 2)$, $t \geq 0$ **(Cirrito 10.5, p361)**

    a. What is the depth of the water at noon?
    b. What is the depth of the water at (i) high tide? (ii) low tide?
    c. At what time on the afternoon of the first day will low tide occur?
    d. Sketch a graph of $h(t)$ for $0 \leq t \leq 12.5$
    e. At what rate is the depth of the water changing at 3:00 pm on the first day? Show/explain your answer.
    f. At what times in that first day will the water depth be at least 2.25 m?