Math SL PROBLEM SET 24

Section A (Short Answer)

1. **(SP 5.4 - R)** **(CA)** The following data set relates the fuel consumption of a small car compared to the speed at which the car was driven. *(Oxford 10.3, p345; Oxford 10.4, p349)*

Speed (km/hr)	60	65	70	75	80	85	90	95	100	105	110	120	130	140	150
Fuel consumption (km/L)	16.9	16.8	15.9	15.9	14.4	14.3	13.2	14.3	12.1	12.0	10.2	9.8	9.0	8.0	7.1

   a. Assuming this relationship is linear, determine the equation of the line of best fit.
   b. Determine the value of the correlation coefficient and hence, describe the relationship.
   c. Assuming this relationship is exponential, determine the equation of the line of best fit.
   d. Determine the value of the correlation coefficient and hence, explain whether the relationship is best modeled with a linear or exponential function..

2. **(T3.6 - R)** **(CA)** From a point due south of a radio tower, an observer measures the angle of elevation to the top of a tower to be 41°. A second observer is standing on a bearing of 130° from the base of the tower and on a bearing of 50° from the first observer. If the height of the tower is 45m, find the: *(Cirrito 9.6, p307)*

   a. Distance between the 2 observers
   b. The angle of elevation of the top of the tower as measured by the second observer.

3. **(A1.1 - E)** **(CA)** Omar and Mohamed begin a training program. In the first week, Mohamed will run 10 km, in the second week, he will run 11.5 km and in the third week 13 km and so on, in an arithmetic progression. Omar will run 5 km in the first week and will increase his distance by 20% in each succeeding week. *(Cirrito 8.2.3, p261)*

   a. In which week does Omar's weekly distance first exceed Mohamed's?
   b. In with week does Omar's total distance first exceed Mohamed's?

4. **(A1.3 - N)** **(CI)** Use the binomial theorem to determine: *(Cirrito 4.1, p95)*

   a. The coefficient of the term containing x^3 in the expansion of $(2x - 5)^5$.
   b. The coefficient of the term independent of x in $(4x^3 - \frac{2}{x^2})^5$.

5. (**SP5.6 - R**) (**CA**) Drug tests may be used by companies to screen potential employees. A given test for Mathitis is determined to be 98.2% accurate in the sense that it identifies a person as a user or non-user 98.2% of the time. Each job applicant takes this test twice. The tests are done at separate times and are designed to be independent of each other. What is the probability that: *(Oxford 3.5, p89)*

   a. A non-user fails both tests?
   b. A drug user is detected (i.e. s/he fails at least one test)
   c. A drug user passes both tests

6. (T3.5 - R) (CA) The depth, *d* meters, of water in a harbour varies with the tides each day. The first high tide occurs at 05:00 am with a depth of 5.8 m. The first low tide occurs at 10:30 am with a depth of 2.6 meters. *(Cirrito 10.5, p361)*

   a. Find a trigonometric function that models, *d*, the depth of the water *t* hours after midnight.
   b. Find the depth of the water at 12 noon.
   c. A large boat needs at least 3.5 m of water to dock in the harbour. During what times after 12 noon can the boat dock safely?

Section B (Extended Response/Investigation)

7. (**A1.1, F2.3, F2.6 - R**) (**CI**) Given the function $f(x) = \ln(x - 3)$, determine   *(Cirrito 5.3.4, p138)*

   a. the domain and range of *f*.
   b. the equation(s) of the asymptote(s) and intercept(s)
   c. a sketch of *f*.
   d. *h(x)* represents a transformation of *f*. The equation for *h(x)* is $h(x) = -2f(\frac{1}{2}x) + 5$. Determine the:

      i.   transformations applied to *f*.
      ii. the intercept(s) and asymptote(s) of *h*.
      iii. the equation for the inverse function of *h*.

8. (**T3.2, T3.3 - E**) (**CI**) Given $\sin(A) = \frac{5}{8}$ and $\frac{\pi}{2} < A < \pi$ and $\cos(B) = -\frac{3}{4}$ and $\pi \leq B \leq \frac{3\pi}{2}$,
(Cirrito 10.1.2, p316; Cirrito 10.2, p327)

    a. Show that $\cos(A) = \frac{-\sqrt{39}}{8}$.

    b. Determine the value of $\sin(B)$.

    c. Show that the value of $\sin^2(A) + \cos^2(A)$ is 1.

    d. Show that the value of $\frac{sin(B)}{cos(B)}$ is the same as $\tan(B)$

    e. Use the formula $\sin(2A) = 2\sin(A)\cos(A)$ to find the value of (i) $\sin(2A)$ and (ii) hence $\cos(2A)$