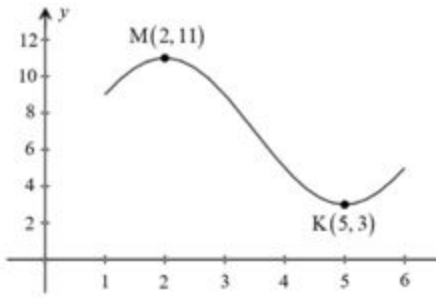
Math SL PROBLEM SET 62

1. **(A1.2 - R) (CA)** In the expansion of $\left(\frac{x}{2}+2a\right)^7$ one of the terms is $1120x^3$. Find the value(s) of a.

2. **(T3.4 - R) (CA)** The diagram shows part of the graph of $f(x) = a\cos(b(t+c)) + d$. There is a maximum point on the graph of $f(x)$ at M (2, 11) and a minimum point at K (5, 3).

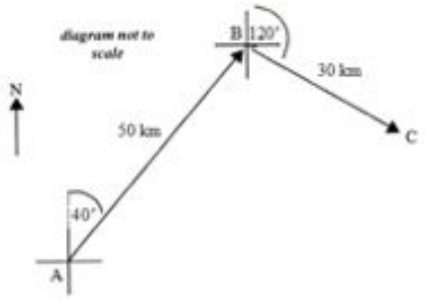


   a. For the equation $f(x) = a\cos(b(t+c)) + d$,
      i. Find the value of a.
      ii. Show that $b = \frac{\pi}{3}$.
      iii. Find the value of d.
      iv. Write down a value for c

   The transformation T is given by a vertical stretch by a factor of $\frac{1}{3}$, followed by a translation of $\begin{pmatrix}\frac{5}{-3}\end{pmatrix}$.

   b. Let M` be the image of M under $T$. Find the coordinates of M`.

3. **(T3.5 - R) (CA)** A ship leaves port A on a bearing of 040°. It sails a distance of 50 km to point B. At B, the ship changes direction to a bearing of 120°. It sails a distance of 30 km to reach point C. This information is shown in the diagram included.



   A second ship leaves port A and sails directly to C.

   a. Find the distance the second ship will travel.
   b. Find the bearing of the course taken by the second ship

4. **(SP5.8 - R) (CA)** The probability of obtaining heads on a biased coin is 0.70. The coin is tossed six times.
   a. Find the probability of obtaining no heads.
   b. Find the probability of obtaining exactly two heads.
   c. Find the probability of obtaining at least two heads

5. **(SP5.4 - R) (CA)** A company that manufactures car tires conducts an experiment to determine how a certain model of tire maintains its air pressure over time. A new tire is fitted to a wheel. The tire is then inflated to its recommended pressure of 39 psi (pounds per square inch) and the tire is placed in a temperature controlled room. At three month intervals, the air pressure of the tire is measured giving these results:

time (x months)	0	3	6	9	12	15	18	21	24
tire pressure (y psi)	39.0	37.2	35.6	34.7	33.5	32.2	30.6	29.2	28.1

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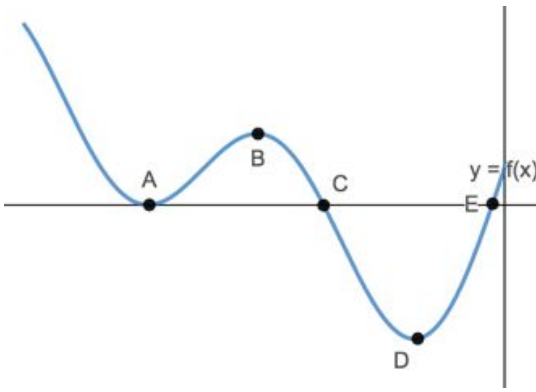
a. Write down the equation of a linear model for the association between time and tire pressure, i.e. an equation of the regression line of y (pressure) on x (time).
b. Use your linear regression model to interpret the meaning of the gradient.
c. Estimate the air pressure (psi) of the tire 20 months after being fitted to the wheel.
d. Do **not** give numerical answers for this question. Comment on the **appropriateness** of using your model to:
   i. estimate the tire pressure after three years;
   ii. estimate the number of months it would take for the tire pressure to decrease to 30 psi

6. **(CA6.3 - R) (CA)** The graph shows part of $y = f`(x)$. The x-intercepts are at the points A, C and E. There is a maximum at B and a maximum at D.



a. Write down the value of $f`(x)$ at A.
b. Does the graph of $f(x)$ have a maximum or minimum at $x = C$? Explain your reasoning.
c. What happens on the graph of f at the point $x = D$? Explain your reasoning.
d. Sketch a graph of f given your answers to the previous questions

7. **(F2.8, T3.4, CA6.1, CA6.2 - R) (CA)** Two functions, f and g, are defined on the domain $\left\{-\frac{\pi}{2} \le x \le \frac{\pi}{2}\right\}$. Let $f(x) = \sin(3x)$ and g is defined as $g(x) = 2 - e^{x^2}$. The two functions are shown in the diagram included.

a. Write down the period of $f(x)$.
b. Write down the value of $f\left(\frac{\pi}{3}\right)$.
c. Determine the equation of the derivative of $f(x)$.
d. Find the exact value of $g(1)$.
e. Determine the range of $g(x)$. Record your answer as BOTH exact and approximate answers.
f. The line L_1 is normal to $f(x)$ at the point where $x = \frac{\pi}{3}$. The line L_2 is normal to $g(x)$ at the point where $x = 1$. Determine the point at the lines L_1 and L_2 intersect.