

# Math SL PROBLEM SET 44

## Section A (Skills/Concepts Consolidation)

1. **(CA6.1 - N) (CI)** Find the equations of derivatives of the following functions:

**(Cirrito 19.1, p608)**

a. i.  $g(x) = 4x^3 - 2x^2 + 12x + 10$       ii.  $f(x) = \frac{x^3 + 3x - 1}{x}$   
b. i.  $k(x) = 2\sqrt{x} - \sqrt[3]{x^2}$       ii.  $m(x) = \frac{2}{x^2} + \frac{3}{x^3} + 2$

2. **(CA6.1 - N) (CI)** Determine the equations of the lines that are (i) tangent to and (ii) normal to the following functions at the specified points:

**(Cirrito 20.1, p646)**

a.  $y = x(x - 3)^2$  at the point where  $x = 1$ .  
b.  $y = x^3 + x^2$  at the point where  $x = -\frac{2}{3}$ .  
c.  $y = 2x + \frac{1}{x}$  at the point where  $x = \frac{1}{2}$ .

3. **(CA6.1 - N) (CI)** The function  $y = ax^3 - 2x^2 - x + 7$  has a slope of 3 at the point where  $x = 2$ . Find the value of  $a$ .

**(Cirrito 20.1, p646)**

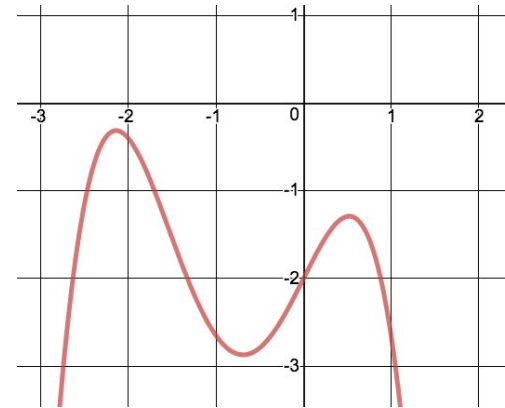
4. **(CA6.3 - N) (CI)** Here is a graph of a function. Draw graphs of the first and second derivatives of this function.

**(Cirrito 19.2, p609)**

5. **(CA6.3 - N) (CI)** For  $f(x) = 2x^3 + 3x^2 - 72x + 5$  determine:

**(Cirrito 20.2, p649)**

- a. the equation of the derivative of  $f(x)$ .  
b. the zeroes of  $f'$ .  
c. Hence or otherwise, find the coordinates of the **stationary points** of  $f$ .  
d. Hence or otherwise, find the **intervals of increase and decrease** of  $f$ .  
e. Sketch a graph of  $f$ . Then use your calculator and graph  $f$  and compare.



6. **(CA6.3 - N) (CI)** For the function  $f(x) = 3x^4 - 4x^3 - 12x^2 + 5$  determine:

**(Cirrito 20.2, p649)**

- a. the equation of the second derivative of  $f(x)$ ,  
b. the zeroes of  $f''$ .  
c. Hence or otherwise, find the coordinates of the **inflection points** of  $f$ .  
d. Hence or otherwise, find the **intervals of concavity** of  $f$ .  
e. Sketch a graph of  $f$ . Then use your calculator and graph  $f$  and then compare.

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## Section B (Skills/Concepts Practice)

7. **(V4.2 - N) (CA)** Two vectors:  $r_1 = \begin{pmatrix} 0 \\ 6 \\ -1 \end{pmatrix} + \lambda \begin{pmatrix} 7 \\ 3 \\ 1 \end{pmatrix}$  and  $r_2 = \begin{pmatrix} 3 \\ 1 \\ 2 \end{pmatrix} + t \begin{pmatrix} 2 \\ 4 \\ -1 \end{pmatrix}$  intersect at the point P. **(Cirrito 12.6.1, p432)**
- Find the coordinates of point P.
  - Find the acute angle between the two lines.

8. **(SP5.7 - N) (CA)** The random variable,  $X$ , has a probability distribution as shown on the table:  
*(NOTE: Again, we do not KNOW what the variable actually is, so if you need to - make up a variable/event ... say like the time to complete this question)* **(Cirrito 16.1, p527)**

$X = x$	5	10	15	20	25
$P(X = x)$	$\frac{3}{20}$	$\frac{7}{30}$	$k$	0.3	$\frac{13}{60}$

- Find the value of  $k$ .
  - Find  $P(x > 10)$
  - Find  $P(5 < x \leq 20)$
  - Find the mean (now called **expected value**) and the standard deviation and the variance.
9. **(V4.3 - N) (CA)**. Submarine X23 is located at (2,4). It fires a torpedo with a velocity vector of  $\mathbf{i} - 3\mathbf{j}$  at exactly 2:17 pm. Submarine Y18 is located at (11,3) and it fires a torpedo with a velocity vector of  $-\mathbf{i} + a\mathbf{j}$  at 2:19pm to intercept the torpedo from X23. **(Cirrito 12.7.2, p452)**
- Find  $x_1(t)$  and  $y_1(t)$  for the torpedo fired from X23.
  - Find  $x_1(t)$  and  $y_1(t)$  for the torpedo fired from Y18.
  - At what time does the interception occur?
  - What is the speed and direction of the interception torpedo?