MATHEMATICS

SEPTEMBER PREPARATORY 2018
MEMORANDUM

NATIONAL SENIOR CERTIFICATE

GRADE 12

MARKS: 150
TIME: 3 hours

This memorandum consists of 14 pages.
### QUESTION 1

<table>
<thead>
<tr>
<th>1.1.1</th>
<th>( x = 0 ) or ( x = 5 )</th>
<th>A✓ 0 A✓ 5</th>
<th>(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1.2</td>
<td>( 3x^2 + 4x - 2 = 0 )</td>
<td>A✓ formula</td>
<td></td>
</tr>
<tr>
<td></td>
<td>( x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} )</td>
<td>A✓ substitution in correct formula</td>
<td></td>
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<tr>
<td></td>
<td>( = \frac{-4 \pm \sqrt{(4)^2 - 4(3)(-2)}}{2(3)} )</td>
<td>CA✓✓answers</td>
<td></td>
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<tr>
<td></td>
<td>( = 0.39 ) or ( -1.72 )</td>
<td>(penalize 1 mark if rounding off is incorrect-once for whole paper)</td>
<td></td>
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<tr>
<td>1.1.3</td>
<td>( \sqrt{2x + 3} = x )</td>
<td>A✓ squaring both sides</td>
<td></td>
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<tr>
<td></td>
<td>( 2x + 3 = x^2 )</td>
<td>CA✓ standard form</td>
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<td></td>
<td>( x^2 - 2x - 3 = 0 )</td>
<td>CA✓ factors</td>
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<td></td>
<td>( (x + 1)(x - 3) = 0 )</td>
<td>CA✓ answers and rejecting</td>
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<td></td>
<td>( x = -1 ) or ( x = 3 )</td>
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<td>(4)</td>
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<td>( n/a )</td>
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<tr>
<td>1.1.4</td>
<td>( 9^x = 4.3^x )</td>
<td>A✓ writing ( 9^x ) as prime base 3</td>
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<td>( 3^x - 4.3^x = 0 )</td>
<td>CA✓ factors</td>
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<td></td>
<td>( 3^x(3^x - 4) = 0 )</td>
<td>CA✓ ( 3^x = 0 ) and ( 3^x = 4 )</td>
<td></td>
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<td></td>
<td>( 3^x = 0 ) or ( 3^x = 4 )</td>
<td>A✓ use of logs</td>
<td></td>
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<tr>
<td></td>
<td>( n/s ) ( x = \log_3 4 = 1.26 )</td>
<td>CA✓1,26 or ( \log_3 4 )</td>
<td>(5)</td>
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<tr>
<td>OR</td>
<td>( 9^x = 4.3^x )</td>
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<tr>
<td></td>
<td>( 3^{2x} - 4.3^x = 0 )</td>
<td>A✓ writing ( 9^x ) as prime base 3</td>
<td></td>
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<tr>
<td></td>
<td>( 3^x(3^x - 4) = 0 )</td>
<td>A✓ dividing by ( 3^x : 3^x \neq 0 )</td>
<td></td>
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<tr>
<td></td>
<td>( 3^x = 4 )</td>
<td>CA✓ and ( 3^x = 4 )</td>
<td></td>
</tr>
<tr>
<td>OR</td>
<td>( x = \log_3 4 = 1.26 )</td>
<td>A✓ use of logs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CA✓1,26 or ( \log_3 4 )</td>
<td></td>
<td>(5)</td>
</tr>
</tbody>
</table>
1.2 \[ x = 2y \quad \text{and} \quad \frac{-4 + y}{2} = \frac{1}{2} \]

\[-4 + \frac{y}{2} = \frac{3}{2} \]

\[-4 + y^2 = 3y \]

\[y^2 - 3y - 4 = 0 \]

\[(y - 4)(y + 1) = 0 \]

\[y = 4 \quad \text{or} \quad y = -1 \]

\[x = 8 \quad \text{or} \quad x = -2 \]

A\checkmark substitution

CA\checkmark simplification

CA\checkmark standard form

CA\checkmark factors

CA\checkmark both y – values

CA\checkmark both x – values

1.3 \[2^{-x}(x + 4) \leq 0 \]

\[2^{-x} > 0 \quad \text{for all} \quad x \in R \]

\[\therefore x + 4 \leq 0 \]

\[x \leq -4 \]

AA\checkmark 2^{-x} > 0

CA\checkmark x + 4 \leq 0

CA\checkmark answer

OR

If graphical Solution is used:

2 Marks for sketches (AA)

2 Marks for solution (CACA)

QUESTION 2

2.1 73 ; 99

AA\checkmark answers

2.2

\[\begin{array}{cccc}
9 & 19 & 33 & 51 \\
1D & 10 & 14 & 18 \\
2D & 4 & 4 \\
\end{array} \]

\[2a = 4 \quad a = 2 \]

\[3a + b = 10 \quad b = 4 \]

\[a + b + c = 9 \quad c = 3 \]

\[T_n = 2n^2 + 4n + 3 \]

A\checkmark a value

CA\checkmark b value

CA\checkmark c value

CA\checkmark answer

[25]
$$T_n = T_1 + (n-1)d_1 + \frac{(n-1)(n-2)}{2}d_2$$

$$= 9 + (n-1)(10) + \frac{(n-1)(n-2)}{2}(4)$$

$$= 9 + 10n - 10 + 2n^2 - 6n + 4$$

$$= 2n^2 + 4n + 3$$

For the first difference

$$T_n = 2n^2 + 4n + 3$$

$$= 2(n^2 + 2n + 1) + 1$$

2($n^2 + 2n + 1$) is even for all $n \in N$

$$\therefore 2(n^2 + 2n + 1) + 1 \text{ is odd for all } n \in N$$

For the first difference

$$T_n = 4n + 6 = 2(2n + 3)$$

An even number of the first difference is always added to first term of the quadratic sequence to get an odd number. This process continues to produce all odd numbers of the sequence.

NB. If a candidate presents the following argument: The first term (9) is odd. To get next term, an even number is always added. This will give an odd number all the time.

Award 1/3
### QUESTION 3

#### 3.1

\[ 3 - t ; - t ; \sqrt{9 - 2t} \]
\[ - t - (3 - t) = \sqrt{9 - 2t} - (-t) \]
\[ - t + 3 + t = \sqrt{9 - 2t} + t \]
\[ 3 - t = \sqrt{9 - 2t} \]
\[ 9 + 6t + t^2 = 9 - 2t \]
\[ t^2 + 8t = 0 \]
\[ t(t + 8) = 0 \]
\[ t = 0 \quad \text{or} \quad t = -8 \]
\[ n / a \]

- A ✓ equating differences
- CA ✓ standard form of equation
- CA ✓ factors
- CA ✓ answers with rejection

#### 3.2

Pattern is 11; 8; 5; 2; −1; ...

- 4 terms are positive.

**OR**

11; 8; 5

\[ T_n = -3n + 14 > 0 \]

\[ n < \frac{14}{-3} \]

\[ i.e. \ n < 4 \frac{2}{3} \]

4 terms are positive.

- AA ✓ all 5 terms listed
- CA ✓ answer

[7]

### QUESTION 4

#### 4.1.1

\[ r = (x - 3) \]

- A ✓ answer

#### 4.1.2

\[ -1 < r < 1 \]

- A ✓ condition
- CA ✓ substitution of common ratio
- CA ✓ answer
4.2  \[3; 3 + p; 3 + 2p; \ldots \quad \text{and} \quad 3; 3p; 3p^2; \ldots\]

\[T_{10} = 3 + 9p\]

\[S_n = \frac{3}{1 - p}\]

\[T_{10} = 3 + 9p = \frac{3}{1 - p}\]

\[(3 + 9p)(1 - p) = 3\]

\[3 + 6p - 9p^2 = 3\]

\[9p^2 - 6p = 0\]

\[3p(3p - 2) = 0\]

\[p = 0 \quad \text{or} \quad p = \frac{2}{3}\]

\[n/a\]

\[\text{A}\times 3 + 9p\]

\[\text{A}\times \frac{3}{1 - p}\]

\[\text{CA}\times \text{equating}\]

\[\text{CA}\times \text{standard form}\]

\[\text{CA}\times p - \text{values and rejecting}\]

\[\text{QUESTION 5}\]

5.1  \[f(x) = \frac{x + 2}{x + 2} - \frac{5}{x + 2}\]

\[= 1 - \frac{5}{x + 2}\]

\[\text{A}\times \text{writing numerator as } x + 2 - 5\]

\[\text{(1)}\]

5.2  \[x = -2 \quad \text{and} \quad y = 1\]

\[\text{A}\times x = -2 \quad \text{A}\times y = 1\]

\[\text{(2)}\]

5.3  \[y - \text{intercept}: \left(0; -\frac{3}{2}\right)\]

\[x - \text{intercept}: (3; 0)\]

\[\text{A}\times y - \text{intercept}\]

\[\text{A}\times x - \text{intercept}\]

\[\text{(2)}\]

\[\text{(co-ordinate form not needed)}\]

5.4  \[y = x + c\]

\[1 = -2 + c \quad \therefore c = 3\]

\[\text{OR}\]

\[f(x) = \frac{x - 3}{x + 2} = \frac{x + 2 - 5}{x + 2} = \frac{-5}{x + 2} + 1\]

\[y = x + 2 + 1 = x + 3\]

\[c = 3\]

\[\text{CA}\times \text{substitution of the point } (-2; 1)\]

\[\text{CA}\times \text{answer}\]

\[\text{OR}\]

\[\text{CA}\times y = x + 3 \text{ (m must be 1)}\]

\[\text{CA}\times \text{answer}\]

\[\text{(2)}\]
QUESTION 6

6.1 \[ f(x) = \log_p x \]

\[ -1 = \log_p 2 \]

\[ p^{-1} = 2 \]

\[ p = \frac{1}{2} \]

A ✓ substitution of the point (2 ; -1) (2)

A ✓ answer (1)

6.2 B(1 ; 0)

A ✓ answer (1)

6.3 At A the \( x \) – co-ordinate is the same as the axis of symmetry value of the graph of \( g \).

\[ x = \frac{1}{2} \]

\[ \therefore y = \log_2 \frac{1}{2} \]

\[ = 1 \]

\[ A\left(\frac{1}{2}; 1\right) \]

CA ✓ \( x \) – value (3)

CA ✓ substitution (3)

CA ✓ answer (3)

6.4 \[ y = a(x - 0)(x - 1) \]

\[ 1 = a\left(\frac{1}{2} - 0\right)\left(\frac{1}{2} - 1\right) \]

\[ 1 = -\frac{1}{4}a \quad \therefore a = -4 \]

\[ y = -4x(x - 1) \]

\[ y = -4x^2 + 4x \]

\[ b = 4 \]

OR

CA ✓ substitution of \( x \) intercepts and TP (4)

CA ✓ \( a \) – value \( (a < 0) \) (4)

CA ✓ substitution into equation (4)

CA ✓ \( b \) – value (4)

OR
\[
y = a(x + p)^2 + q
\]
\[
y = a\left(x - \frac{1}{2}\right)^2 + 1
\]
\[B(1; 0):\]
\[0 = a\left(-\frac{1}{2}\right)^2 + 1
\]
\[-1 = \frac{1}{4}a
\]
\[a = -4
\]
\[y = -4\left(x - \frac{1}{2}\right)^2 + 1
\]
\[= -4\left(x^2 - x + \frac{1}{4}\right) + 1
\]
\[= -4x^2 + 4x - 1 + 1
\]
\[= -4x^2 + 4x
\]
\[\therefore b = 4
\]

**OR**
\[B(1; 0): 0 = a + b \rightarrow (1)
\]
\[A\left(\frac{1}{2}; 1\right): 1 = \frac{1}{4}a + \frac{1}{2}b \rightarrow (2)
\]
\[2 : 4 = a + 2b \rightarrow (3)
\]
Substituting \(a = -b\) into (3)
\[4 = -b + 2b
\]
\[\therefore b = 4
\]
\[a = -4
\]

6.5
\[y = \left(\frac{1}{2}\right)^x \quad \text{or} \quad y = 2^{-x}
\]
AA✓✓ answer

6.6
\[(0 ; 2 )
\]
AA✓✓ answer (penalize 1 for incorrect notation)

6.7
\[\frac{1}{2} \leq x \leq 1
\]
CA CA✓✓ answer (penalize 1 for incorrect notation)

[16]
## QUESTION 7

### 7.1

<p>| | | | |</p>
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<thead>
<tr>
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<tbody>
<tr>
<td>1</td>
<td>( y = -2x^3 + 3x^2 + 32x + 15 )</td>
<td>( \frac{dy}{dx} = -6x^2 + 6x + 32 )</td>
<td>A✓ derivative</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>CA✓ substitution of ( x = -2 ) into derivative and equating to gradient</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>CA✓ substituting ( m = -4 ) and given point</td>
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<td></td>
<td>CA✓ ( c ) – value</td>
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<td></td>
<td></td>
<td>CA✓ answer</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>( m = -6(-2)^2 + 6(-2) + 32 = -4 )</td>
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<td></td>
<td>( y = mc + c )</td>
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<td></td>
<td>( -21 = -4(-2) + c )</td>
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<td>( c = -29 )</td>
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<td></td>
<td>( y = -4x - 29 )</td>
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</tbody>
</table>

### 7.2

<p>| | | | |</p>
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</thead>
<tbody>
<tr>
<td>2</td>
<td>( -2x^3 + 3x^2 + 32x + 15 = -4x - 29 )</td>
<td>( -2x^3 + 3x^2 + 36x + 44 = 0 )</td>
<td>CA✓ equating</td>
</tr>
<tr>
<td></td>
<td>( 2x^2 - 3x^2 - 36x - 44 = 0 )</td>
<td>( (x + 2)(x + 2)(2x - 11) = 0 )</td>
<td>CA✓ standard form</td>
</tr>
<tr>
<td></td>
<td>( x = -2 ) or ( x = \frac{11}{2} = 5.5 = 5 \frac{1}{2} )</td>
<td>CA✓ factors</td>
<td></td>
</tr>
<tr>
<td></td>
<td>( x = \frac{11}{2} = 5.5 = 5 \frac{1}{2} )</td>
<td>CA✓ ( x ) – values</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>CA✓ choosing answer</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>( x = -2 )</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>( x = \frac{11}{2} = 5.5 = 5 \frac{1}{2} )</td>
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</table>

[10]
### QUESTION 8

#### 8.1

\[ A = P(1 - i)^n \]

\[
\begin{align*}
65000 &= 180000(1 - i)^8 \\
\frac{65000}{180000} &= (1 - i)^8 \\
1 - i &= \frac{65000}{\sqrt[8]{180000}} \\
i &= 0.1195491715 \\
\end{align*}
\]

Therefore the interest rate is 11.95% p.a.

#### 8.2.1

\[ P_v = \frac{x[1 - (1 + i)^{-n}]}{i} \]

\[
\begin{align*}
x &= \frac{850000}{\frac{0.1425}{12}} \\
x &= R10724.61 \\
\end{align*}
\]

#### 8.2.2

120% of \( \frac{10724.61}{1} = R12869.53 \)

\[
\begin{align*}
P_v &= \frac{x[1 - (1 + i)^{-n}]}{i} \\
&= \frac{12869.53}{\frac{0.1425}{12}} \\
&= 0.2156861983 \\
\end{align*}
\]

\[-n = \log_{1 + \frac{0.1425}{12}} 0.2156861983 \\
\]

\[-n = -129,938569 \\
\]

\[
\therefore n = 129,938569 \\
n = 130 \text{ payments} \\
\]

- \( n \) value
- \( i \) and \( n \) values
- \( i \) – value
- Correct substitution into correct formula
- Correct substitution of \( P \) value
- Correct substitution of \( i \) and \( n \) values
- Use of logs
- Answer
- Use of logs
- Answer

(3) (4)
8.2.3 Balance on loan

\[ P_v = \frac{12869.53 \left[ 1 - \left( 1 + \frac{0.1425}{12} \right)^{-0.938569} \right]}{0.1425} = R11941.51 \]

Final Instalment = 11941.51 \( \left( 1 + \frac{0.1425}{12} \right) = 12083.32 \)

OR

Balance on loan = A - F

\[ = 85000 \left( 1 + \frac{0.1425}{12} \right)^{129} - \frac{12869.53 \left[ 1 - \left( 1 + \frac{0.1425}{12} \right)^{129} - 1 \right]}{0.1425} = R11941.51 \]

Final Instalment = 11941.51 \( \left( 1 + \frac{0.1425}{12} \right) = 12083.32 \)

QUESTION 9 (penalize 1 mark once for incorrect notation in this question)

9.1

\[ f'(x) = \lim_{{h \to 0}} \frac{f(x+h) - f(x)}{h} = \lim_{{h \to 0}} \frac{-5(x+h)^2 + 3(x+h) - (-5x^2 + 3x)}{h} = \lim_{{h \to 0}} \frac{-5x^2 - 10xh - 5h^2 + 3x + 3h + 5x^2 - 3x}{h} = \lim_{{h \to 0}} \frac{h(-10x - 5h + 3)}{h} = -10x + 3 \]
### 9.2

\[ g(x) = \frac{1}{2\sqrt{x}} = \frac{1}{2} x^{-\frac{1}{2}} \]

\[ g'(x) = -\frac{1}{4} x^{-\frac{3}{2}} \]

\[ g'(4) = -\frac{1}{4} \left(4\right)^{-\frac{3}{2}} = -\frac{1}{4} \left(2^2\right)^{-\frac{3}{2}} \]

\[ = -\frac{1}{4} \cdot \frac{1}{8} = -\frac{1}{32} \]

**A ✓ rewriting in exponential form**

CA ✓ derivative

CA ✓ substituting 4 into derivative

CA ✓ answer

\[(4)\]

### 9.3

\[ D \left(2x - 3\right)^3 \]

\[ = D \left(8x^3 - 36x^2 + 54x - 27\right) \]

\[ = 24x^2 - 72x + 54 \]

**A ✓ cubing the binomial**

CACACA ✓✓✓ each answer

\[(4)\]

### QUESTION 10

#### 10.1

\[ h(x) = x^3 - \frac{3}{2} x^2 + cx + d \]

\[ h'(x) = 3x^2 - 3x + c \]

\[ h'(3) = 3(3)^2 - 3(3) + c = 0 \]

\[ 27 - 9 + c = 0 \]

\[ c = -18 \]

\[ h(x) = x^3 - \frac{3}{2} x^2 - 18x + d \]

\[ h(4) = (4)^3 - \frac{3}{2} (4)^2 - 18(4) + d = 0 \]

\[ 64 - 24 - 72 + d = 0 \]

\[ d = 32 \]

**OR**

\[ h'(x) = 3x^2 - 3x + c \]

\[ h'(x) = 3(x + 2)(x - 3) = 3x^2 - 3x - 18 \]

\[ c = -18 \]

\[ h(x) = x^3 - \frac{3}{2} x^2 - 18x + d \]

\[ h(4) = 64 - 24 - 72 + d = 0 \]

\[ d = 32 \]

**A ✓ derivative**

A ✓ subst. 3 or –2 into derivative and equating to 0

A ✓ simplifying

\[ h'(-2) = 3(-2)^2 - 3(-2) + c = 12 + 6 + c = 0 \]

\[ c = -18 \]

A ✓ subst. 4 into \( h \) and equating to 0

A ✓ simplifying

\[(5)\]

**OR**

A ✓ derivative

A ✓ derivative using stationary values

A ✓ simplifying

A ✓ equating coefficients of polynomials to get \( c – value \)

A ✓ substituting \( x = 4 \) onto equation to get \( d – value \)

\[(5)\]
| 10.2 | \( h(x) = x^3 - \frac{3}{2}x^2 - 18x + 32 \)  
    | \( h(-2) = (-2)^3 - \frac{3}{2}(-2)^2 - 18(-2) + 32 = 54 \)  
    | \( A(-2; 54) \) | A\( \checkmark \) subst. \( x = -2 \) into \( h \)  
    | | A\( \checkmark \) \( y \) – value | (2) |
| 10.3 | \( x = \frac{-2 + 3}{2} \)  
    | \( x = \frac{1}{2} \) | A\( \checkmark \) \( x = \frac{-2 + 3}{2} \)  
    | | CA\( \checkmark \) answer | (2) |

**OR**  
\( h(x) = x^3 - \frac{3}{2}x^2 - 18x + 32 \)  
\( h'(x) = 3x^2 - 3x - 18 \)  
\( h''(x) = 6x - 3 = 0 \)  
\( x = \frac{1}{2} \)  
A\( \checkmark \) second derivative equal to 0  
CA\( \checkmark \) \( x \) – value | (2) |
| 10.4 | \( x > \frac{1}{2} \) | CA\( \checkmark \) answer | (1) |
| 10.5 | \( (2; 54) \) | A x=2 CA y=54\( \checkmark \)\( \checkmark \) answer | (2) |
| 10.6 | \( 32 < k < 54 \) | CA\( \checkmark \)\( \checkmark \) answer | (2) |
### QUESTION 11

11.1 \[ D \left[ 28 - \frac{1}{9} t^2 - \frac{1}{27} t^3 \right]. \]

\[ D(2) = 28 - \frac{1}{9} (2)^2 - \frac{1}{27} (2)^3 = \frac{736}{27} = 27 \frac{7}{27} = 27,26 \]

Average Rate of change = \[ \frac{27,26 - 28}{2 - 0} = -\frac{10}{27} = -0,37 \]

A✓ subst. \( t = 2 \)
A✓ 27,26
CA✓ subst. into average rate of change
CA✓ answer

11.2 \[ D = 28 - \frac{1}{9} t^2 - \frac{1}{27} t^3. \]

\[ D'(t) = -\frac{2}{9} t - \frac{1}{9} t^2 \]

\[ D'(16) = -\frac{2}{9} (16) - \frac{1}{9} (16)^2 \]

\[ = -32 \text{ m/h} \]

The water level is decreasing at 32 m/h.

A✓ A✓ derivative
CA✓ subst. \( t = 16 \)
CA✓ −32 m/h

(4) [8]
**QUESTION 12**

| 12.1 | \( a = 120 \); \( b = 60 \); \( c = 140 \); \( d = 210 \) | A✓ \( a \) – value and A✓ \( b \) – value  
A✓ \( c \) – value and A✓ \( d \) – value (4) |
| 12.2 | \[
\begin{align*}
P(\text{Male}) &= \frac{140}{350} \\
P(\text{liking sport}) &= \frac{200}{350} \\
P(\text{Male and liking sport}) &= \frac{80}{350} = \frac{8}{35} \\
P(\text{Male}) \times P(\text{liking sport}) \\
&= \frac{140}{350} \times \frac{200}{350} = \frac{8}{35} \\
P(\text{Male liking sport}) &= P(\text{Male}) \times P(\text{liking sport}) \\
\therefore \text{The events are independent.}
\end{align*}
\] | \[
\begin{align*}
\text{CA✓} P(\text{Male}) &= \frac{140}{350} \\
\text{CA✓} P(\text{Male and liking sport}) &= \frac{8}{35} \\
P(\text{Male}) \times P(\text{liking sport}) \\
&= \frac{140}{350} \times \frac{200}{350} = \frac{8}{35} \\
\text{CA✓} \text{conclusion} \\
\text{OR}
\end{align*}
\] |
| \[
\begin{align*}
P(\text{Female}) &= \frac{210}{350} \\
P(\text{liking sport}) &= \frac{200}{350} \\
P(\text{Female and liking sport}) &= \frac{120}{350} = \frac{12}{35} \\
P(\text{Female}) \times P(\text{liking sport}) \\
&= \frac{210}{350} \times \frac{200}{350} = \frac{12}{35} \\
P(\text{Female liking sport}) &= P(\text{Female}) \times P(\text{liking sport}) \\
\therefore \text{The events are independent.}
\end{align*}
\] | \[
\begin{align*}
\text{CA✓} P(\text{Female}) &= \frac{140}{350} \\
\text{CA✓} P(\text{Female and liking sport}) &= \frac{12}{35} \\
P(\text{Female}) \times P(\text{liking sport}) \\
&= \frac{140}{350} \times \frac{200}{350} = \frac{12}{35} \\
\text{CA✓} \text{conclusion} \\
\text{OR}
\end{align*}
\] |

[8]
### QUESTION 13

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
<th>Calculation</th>
<th>Mark</th>
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</thead>
</table>
| 13.1 | There are 9 letters: 3 Es, 2Ds and 2Ns. The number of different words are | \[
\frac{9!}{3! \times 2! \times 2!} = 15120
\] | 3 |
| 13.2 | If we take one of the letters for the first letter, there are seven letters remaining, of which there are 3Es and 2 Ds. Hence the number of words | \[
\frac{1 \times 8!}{3! \times 2!} = 3360
\] | 3 |
| 13.3 | If both Ns are used for the first and last, there are 7 letters remaining of which there are 3Es and 2Ds. Hence the number of word | \[
\frac{1 \times 7!}{3! \times 2!} = 420
\] | 3 |

Total Marks: 150