2026 DBE NSC Maths P1 Suggested Memo for TAS-AMESA Exam Review

1.1.1

$$x^2 + x - 6 = 0$$
$$(x+3)(x-2) = 0$$
$$\therefore x = -3 \text{ or } x = 2$$

(3)

1.1.2

$$2x + 10 = 3x^2$$
$$\therefore 3x^2 - 2x - 10 = 0$$
$$a = 3, \quad b = -2, \quad c = -10$$
$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$
$$= \frac{-(-2) \pm \sqrt{(-2)^2 - 4(3)(-10)}}{2(3)}$$
$$= \frac{1 \pm \sqrt{31}}{3}$$
$$\therefore x \approx -1{,}52 \text{ or } x \approx 2{,}19$$

$$2x + 10 = 3x^2$$
$$\therefore 3x^2 - 2x = 10$$
$$\therefore x^2 - \frac{2}{3}x = \frac{10}{3}$$
$$\therefore \left(x - \frac{1}{3}\right)^2 = \frac{1}{9} + \frac{30}{9}$$
$$\therefore \left(x - \frac{1}{3}\right)^2 = \frac{31}{9}$$
$$\therefore x - \frac{1}{3} = \pm\frac{\sqrt{31}}{3}$$
$$\therefore x = \frac{1 \pm \sqrt{31}}{3}$$
$$\therefore x \approx -1{,}52 \text{ or } x \approx 2{,}19$$

(4)

1.1.3

$$81.2^{x-4} - 3^x = 0$$
$$\therefore 3^4.2^{x-4} - 3^x = 0$$
$$\therefore 3^4.2^{x-4} = 3^x$$
$$\therefore \frac{3^4.2^{x-4}}{3^4} = \frac{3^x}{3^4}$$
$$\therefore 2^{x-4} = 3^{x-4}$$
$$\therefore x - 4 = 0$$
$$\therefore x = 4$$

$$81.2^{x-4} - 3^x = 0$$
$$\therefore 81.2^{x-4} = 3^x$$
$$\therefore 81.2^x.2^{-4} = 3^x$$
$$\therefore \frac{81}{16} = \frac{3^x}{2^x}$$
$$\therefore \left(\frac{3}{2}\right)^4 = \left(\frac{3}{2}\right)^x$$
$$\therefore x = 4$$

$$81.2^{x-4} - 3^x = 0$$
$$\therefore 3^4.2^{x-4} = 3^x$$
$$2^{x-4} = 3^{x-4}$$
$$\therefore \frac{2^{x-4}}{3^{x-4}} = \frac{3^{x-4}}{3^{x-4}}$$
$$\therefore \left(\frac{2}{3}\right)^{x-4} = 1$$
$$\therefore x - 4 = 0$$
$$\therefore x = 4$$

(3)

1.1.4

$$\sqrt{x+6}.\sqrt{10-x} = 4\sqrt{3}$$
$$\therefore \left(\sqrt{x+6}.\sqrt{10-x}\right)^2 = \left(4\sqrt{3}\right)^2$$
$$\therefore (x+6)(10-x) = 16(3)$$
$$\therefore 10x - x^2 + 60 - 6x = 48$$
$$\therefore -x^2 + 4x + 60 - 48 = 0$$
$$\therefore x^2 - 4x - 12 = 0$$
$$\therefore (x-6)(x+2) = 0$$
$$\therefore x = 6 \text{ or } x = -2$$

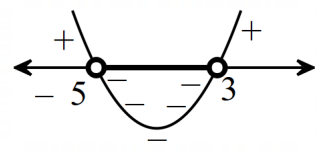
Both solutions are valid.

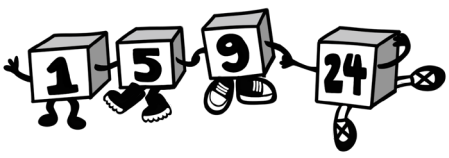


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1.2	$y-2x-2=0$ and $y^2+3x^2-4=0$ ② $\therefore y=2x+2$ ① Substitute ① into ② $(2x+2)^2+3x^2-4=0$ $\therefore 4x^2+8x+4+3x^2-4=0$ $\therefore 7x^2+8x=0$ $\therefore x(7x+8)=0$ $\therefore x=0$ or $x=-\frac{8}{7}$ $\therefore y=2$ or $x=-\frac{2}{7}$ $(0;2)$ or $\left(-\frac{8}{7};-\frac{2}{7}\right)$	(5)
1.3	Let the first number be x. $\therefore$ the second number is $x+2$ $\therefore x(x+2)<15$ $\therefore x^2+2x-15<0$ $\therefore (x+5)(x-3)<0$ $\therefore -5<x<3$ $\therefore$ the first number lies between – 5 and 3. 	(5)
		[24]



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2.1.1	$-1;-\frac{2}{3};-\frac{1}{3};\ldots;27$ $d=T_2-T_1=-\frac{2}{3}-(-1)=\frac{1}{3}$		(1)
2.1.2	$a+(n-1)d=T_n$ $\therefore -1+(n-1)\left(\frac{1}{3}\right)=27$ $\therefore -3+(n-1)=81$ $\therefore n=85$	$T_n=a+(n-1)d$ $\therefore 27=-1+(n-1)\left(\frac{1}{3}\right)$ $\therefore 28=(n-1)\left(\frac{1}{3}\right)$ $\therefore 84=n-1$ $\therefore n=85$	(2)
2.1.3	Add the last 65 terms in the sequence. $T_n=-1+(n-1)\left(\frac{1}{3}\right)=\frac{n-4}{3}$ $\sum_{n=21}^{85}\left[\frac{n-4}{3}\right]$ or $\sum_{n=21}^{85}\left[-1+(n-1)\left(\frac{1}{3}\right)\right]$ Check $=\frac{65}{2}\left[\left(\frac{17}{3}\right)+\left(\frac{81}{3}\right)\right]\quad(65=85-21+1)$ $=\frac{3185}{3}$	Calculate T_{21} and use $a=T_{21}$ $T_{21}=-1+20\left(\frac{1}{3}\right)=\frac{17}{3}$ $T_n=\frac{17}{3}+(n-1)\left(\frac{1}{3}\right)=\frac{n+16}{3}$ $\sum_{n=1}^{65}\left[\frac{n+16}{3}\right]$ or $\sum_{n=1}^{65}\left[\frac{17}{3}+(n-1)\left(\frac{1}{3}\right)\right]$ Check $=\frac{65}{2}\left[\frac{17}{3}+\left(\frac{81}{3}\right)\right]$ $=\frac{3185}{3}$	
	Reversed sequence: $27;\ldots;-\frac{1}{3};-\frac{2}{3};-1$ with $a=27$ and $d=-\frac{1}{3}$ $T_n=27+(n-1)\left(-\frac{1}{3}\right)=\frac{82-n}{3}$ $\sum_{n=1}^{65}\left[\frac{82-n}{3}\right]$ or $\sum_{n=1}^{65}\left[27+(n-1)\left(-\frac{1}{3}\right)\right]$ Check $\frac{65}{2}\left[\left(\frac{81}{3}\right)+\left(\frac{17}{3}\right)\right]$ $=\frac{3185}{3}$		(3)

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2.2.1 $T_1 = 4^{-1+5} = 4^4 = 256$ and $T_2 = 4^{-2+5} = 4^3 = 64$ (2)

2.2.2 $a = 256; \quad r = \frac{1}{4}; \quad T_n = \frac{1}{1\,024}$

Exponents, using base 2

$$256\left(\frac{1}{4}\right)^{n-1} = \frac{1}{1\,024}$$
$$\therefore 2^8.2^{-2n+2} = 2^{-10}$$
$$\therefore 2^{10-2n} = 2^{-10}$$
$$\therefore 10-2n = -10$$
$$\therefore 2n = 20$$
$$\therefore n = 10$$

Exponents using base $\frac{1}{4}$

$$256\left(\frac{1}{4}\right)^{n-1} = \frac{1}{1\,024}$$
$$\left(\frac{1}{4}\right)^{n-1} = \frac{1}{262\,400}$$
$$\therefore \left(\frac{1}{4}\right)^{n-1} = \left(\frac{1}{4}\right)^{9}$$
$$\therefore n-1 = 9$$
$$\therefore n = 10$$

Logs with base 2

$$256\left(\frac{1}{4}\right)^{n-1} = \frac{1}{1\,024}$$
$$\therefore (2^{-2})^{n-1} = \frac{1}{262\,144}$$
$$\therefore 2^{-2n+2} = \frac{1}{262\,144}$$
$$\therefore -2n+2 = \log_2 \frac{1}{262\,144}$$
$$\therefore -2n+2 = -18$$
$$\therefore -2n = -20$$
$$\therefore n = 10$$

Logs with base $\frac{1}{4}$

$$256\left(\frac{1}{4}\right)^{n-1} = \frac{1}{1\,024}$$
$$\therefore \left(\frac{1}{4}\right)^{n-1} = \frac{1}{262\,144}$$
$$\therefore n-1 = \log_{\frac{1}{4}} \frac{1}{262\,144}$$
$$\therefore n-1 = 9$$
$$\therefore n = 10$$

(3)

2.2.3
$$S_\infty = \frac{a}{1-r}$$
$$= \frac{256}{1-\frac{1}{4}}$$
$$= \frac{1\,024}{3}$$
$$= 341,\dot{3} \quad (\text{or rounded off: } 341,33)$$



(3)

[14]

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<table>
<tr>
<td>3.1</td>
<td>Using TP of parabola
$\left(y=a(x-p)^2+q\right)$
$T_n=an^2+bn+c$
$2a=-2$
$\therefore a=-1$
$T_n=-1(n-8)^2+44$
$=-(n^2-16n+64)+44$
$=-n^2+16n-20$</td>
<td>Using axis of symmetry
$T_n=an^2+bn+c$
$2a=-2$
$\therefore a=-1$
$-\frac{b}{2a}=8$
$\therefore \frac{b}{2(-1)}=-8$
$\therefore b=16$
$\therefore 44=-(8)^2+16(8)+c$
$\therefore c=-20$
$\therefore T_n=-n^2+16n-20$</td>
<td>Using Calculus
$T_n=an^2+bn+c$
$2a=-2$
$\therefore a=-1$
At max $D_x[T_n]=0$
$\therefore D_x[-n^2+bn+c]=0$
$\therefore -2n+b=0$
$\therefore -2(8)+b=0$
$\therefore b=16$
$\therefore 44=-(8)^2+16(8)+c$
$\therefore c=44+64-128=-20$
$T_n=-n^2+16n-20$</td>
<td>(4)</td>
</tr>
<tr>
<td>3.2</td>
<td colspan="3">Option 1 uses $S_{36}=\frac{1}{2}S_{54}$
Let x be the no. of litres of water that passed through the hole in the first minute.
$x;\ x+2;\ x+4;\ldots$ is the amount of water passing through the whole each minute
We know that $S_{36}=\frac{1}{2}S_{54}$
$\therefore \frac{36}{2}[(x)+(x+35\times 2)]=\frac{1}{2}\times\frac{54}{2}[(x)+(x+53\times 2)]$
$\therefore 18(2x+70)=\frac{27}{2}(2x+106)$
$\therefore 36(2x+70)=27(2x+106)$
$\therefore 4(2x+70)=3(2x+106)$
$\therefore 8x+280=6x+318$
$\therefore\ 2x=38$
$\therefore x=19$
$\therefore$ 19 litres of water passed through the hole in the first minute.</td>
<td></td>
</tr>
</table>



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3.2

Option 2 use $S_{36} = T_{37} + T_{38} + T_{39} + \ldots T_{54}$

Let x be the no. of litres of water that passed through the hole in the first minute.

$x;\ x+2;\ x+4;\ldots$ is the amount of water passing through the whole each minute

We know that $S_{36} = T_{37} + T_{38} + T_{39} + \ldots T_{54}$

$$x+(x+2)+(x+2\times 2)+\ldots+(x+35\times 2)=(x+36\times 2)+(x+37\times 2)+..,+(x+53\times 2)$$

$$\therefore \frac{36}{2}[(x)+(x+70)]=\frac{18}{2}[(x+72)+(x+106)]$$

$$\therefore 18(2x+70)=9(2x+178)$$

$$\therefore 2(2x+70)=2x+178$$

$$\therefore 2x+70=x+89$$

$$\therefore x=19$$

$\therefore$ 19 litres of water passed through the hole in the first minute.

Option 3 uses sum of the first 36 terms = half the sum of all the terms

Let the tank hold x litres of water.

Let the no. of litres of water lost in the first minute be p.

$$\therefore p+(p+2)+(p+4)+\ldots+(p+35\times 2)=\frac{1}{2}x$$

$$\therefore 36p+2+4+6++\ldots+70=\frac{1}{2}x$$

$$\therefore 36p+\frac{35}{2}(2+70)=\frac{1}{2}x$$

$$\therefore 36p+1\,260=\frac{1}{2}x \qquad ①$$

$$p+(p+2)+(p+4)+\ldots+(p+53\times 2)=x$$

$$\therefore 54p+2+4+6+\ldots+106=x$$

$$\therefore 54p+\frac{53}{2}(2+106)=x$$

$$\therefore 54p+2862=x \qquad ②$$

$$\therefore 2(36p+1\,260)=54p+2862$$

$$\therefore 72p+2\,520=54p+2862$$

$$\therefore 18p=342$$

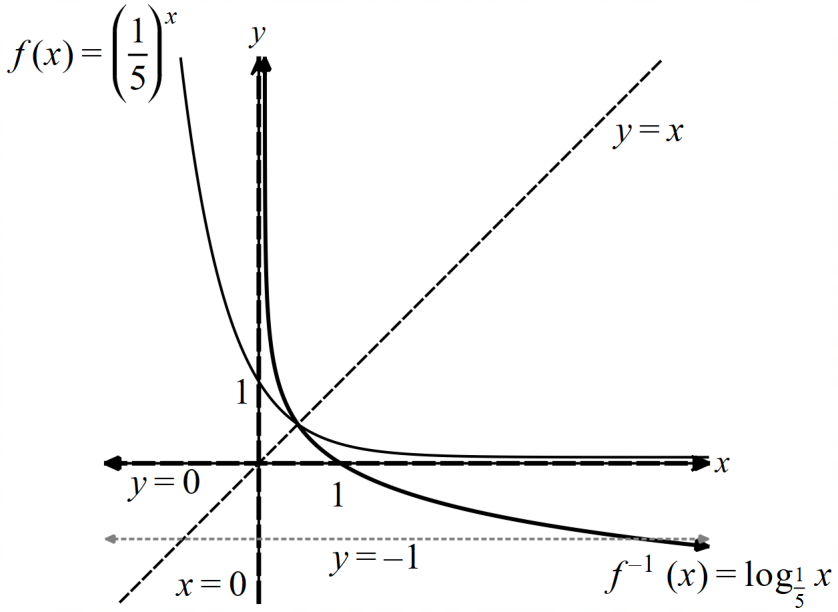
$$\therefore p=19$$

$\therefore$ 19 litres of water passed through the hole in the first minute. (5)

[9]

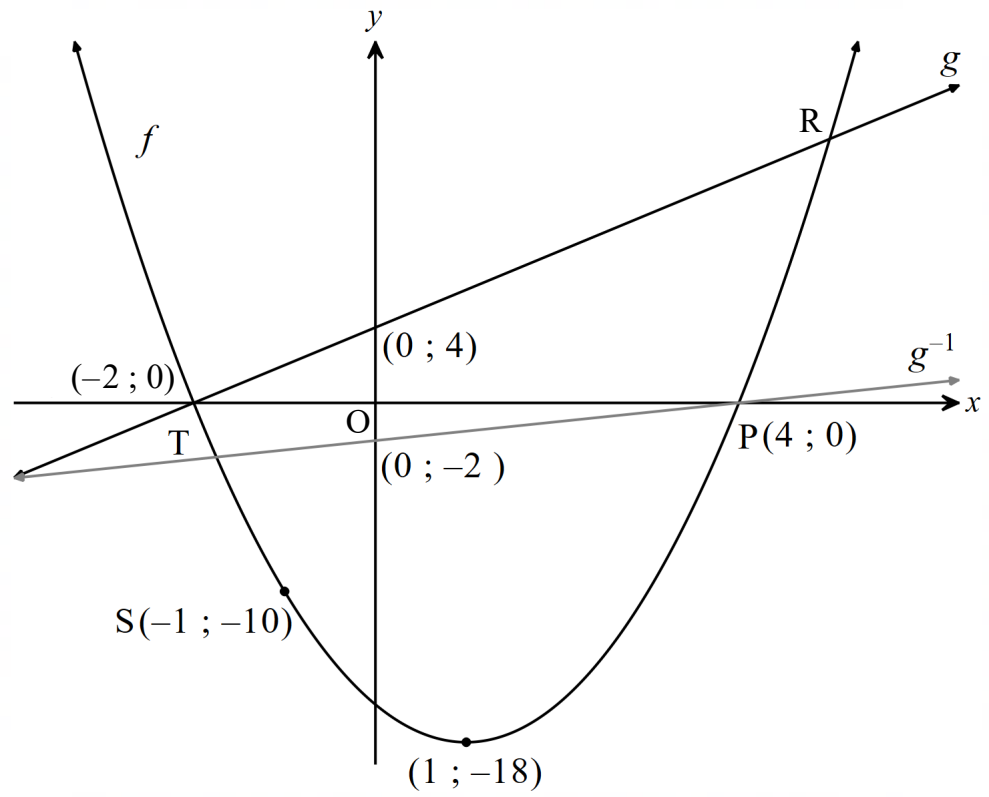
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4.1	$\left(\frac{1}{5}\right)^1 = \frac{1}{5}; \left(\frac{1}{5}\right)^2 = \frac{1}{25}; \left(\frac{1}{5}\right)^3 = \frac{1}{125}\ldots$ $\therefore \left(\frac{1}{5}\right)^x$ decreases as x increases. or $f(x) = \left(\frac{1}{5}\right)^x$ Since the base < 1 the function will decrease as x increases.	(1)
4.2	**Uses base 5** $f(x) = y = \left(\frac{1}{5}\right)^x = 5^{-x}$ $\therefore x = 5^{-y}$ $\therefore -y = \log_5 x$ $\therefore y = -\log_5 x$ **Uses base $\frac{1}{5}$** $f(x) = y = \left(\frac{1}{5}\right)^x$ $\therefore x = \left(\frac{1}{5}\right)^y$ $\therefore y = \log_{\frac{1}{5}} x$	(2)
4.3		(4)
4.4	Use given y-coordinate in f $f(-1) = \left(\frac{1}{5}\right)^{-1} = 5$ $\therefore f^{-1}(5) = -1$ $\therefore\ 0 < x \leq 5$ $-\log_5 x = -1$ $\therefore \log_5 x = 1$ $\therefore x = 5$ $\therefore 0 < x \leq 5$ $\log_{\frac{1}{5}} x = -1$ $\therefore x = \left(\frac{1}{5}\right)^{-1} = 5$ $\therefore 0 < x \leq 5$	(2)
		[9]

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5.		
5.1	T(–2 ; 0) (y = 2x + 4 = 0 when x = –2)	(1)
5.2	P(4 ; 0) (TP = 6 units) $f(x) = a(x+2)(x-4)$ $f(-1) = a(-1+2)(-1+4) = -10$ $\therefore a(1)(-5) = -10$ $\therefore a = 2$ $\therefore f(x) = 2(x+2)(x-4)$ $= 2(x^2 - 2x - 8)$ $= 2x^2 - 4x - 16$ $\therefore a = 2;\ b = -4;\ c = -16$	P(4 ; 0) (TP = 6 units) $y = a(x+2)(x-4)$ $y = ax^2 - 2ax - 8a$ $\therefore -10 = a(-1)^2 - 2a(-1) - 8a$ $\therefore -10 = a + 2a - 5a$ $\therefore 5a = 10$ $\therefore a = 2$ $\therefore y = 2x^2 - 4x - 16$ $\therefore a = 2;\ b = -4;\ c = -16$



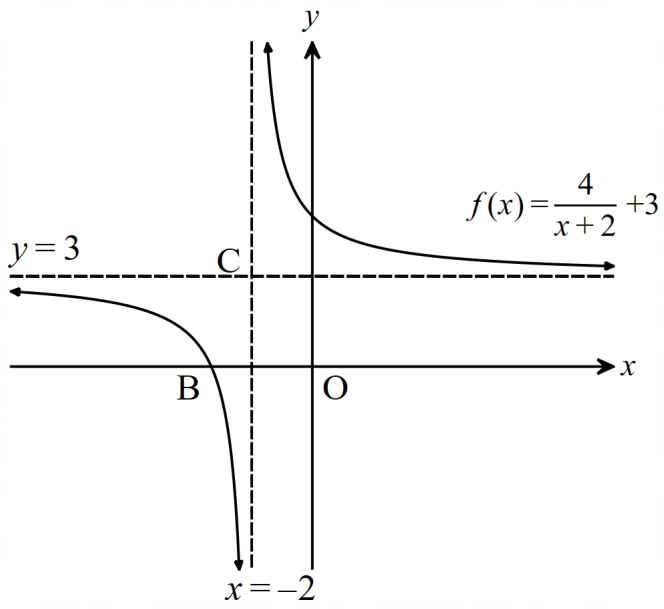
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5.3.1	**Uses Calculus** $f(x)=2x^2-4x-16$ $f'(x)=4x-4=0$ at minimum $\therefore x=1$ and $f(1)=-18$ $\therefore$ T.P. $(1;-18)$ $\therefore f(x)+18\geq 0$ for $x\in\mathbb{R}$ $\therefore f(x)+18>0$ for $x\in\mathbb{R}, x\neq 1$	**Uses axis of symmetry** $f(x)=2x^2-4x-16$ T.P. $x=-\frac{(-4)}{2(2)}=1$ $\therefore f(1)=2(1)^2-4(1)-16=-18$ $\therefore f(x)+18\geq 0$ for $x\in\mathbb{R}$ $\therefore f(x)+18>0$ for $x\in\mathbb{R}, x\neq 1$	(3)
	Uses completing the square $f(x)=2x^2-4x-16$ $=2(x^2-2x-8)$ $=2[(x-1)^2-1-8]$ $=2(x-1)^2-18$ $\therefore$ T.P. $(1;-18)$ $\therefore f(x)+18\geq 0$ for $x\in\mathbb{R}$ $\therefore f(x)+18>0$ for $x\in\mathbb{R}, x\neq 1$		
5.3.2	$g(x).g^{-1}(x)=0$ when $g(x)=0$ or $g^{-1}(x)=0$ $g(-2)=0$ and $g^{-1}(4)=0$ $(g(0)=4)$ $\therefore x=-2$ or $x=4$		(3)
			[11]

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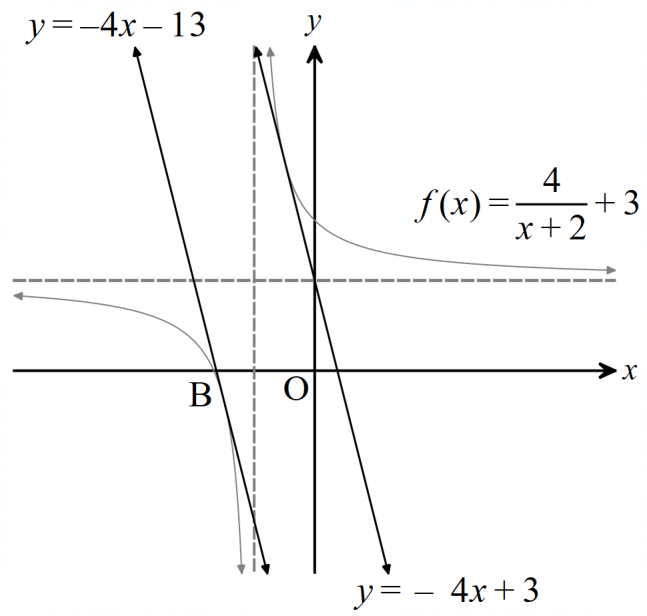
6.		
6.1	$x=-2$	(1)
6.2	$y\in\mathbb{R},\ y\neq 3$	(1)
6.3	Let $y=0$ $\therefore \frac{4}{x+2}+3=0$ $\therefore 4+3(x+2)=0$ $\therefore 4+3x+6=0$ $\therefore 3x=-10$ $\therefore x=-\frac{10}{3}$ $\therefore \mathrm{B}\left(-\frac{10}{3};0\right)$	(3)



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6.4



6.4

Using nature of roots

$$\frac{4}{x+2} + 3 = -4x + k$$

$$\therefore 4 + 3(x+2) + 4x(x+2) - k(x+2) = 0$$

$$\therefore 4 + 3x + 6 + 4x^2 + 8x - kx - 2k = 0$$

$$\therefore 4x^2 + 11x - kx + 10 - 2k = 0$$

$$\therefore 4x^2 + (11-k)x + (10-2k) = 0$$

$b^2 - 4ac = 0$ for equal roots

$$\therefore (11-k)^2 - 4(4)(10-2k) = 0$$

$$\therefore 121 - 22k + k^2 - 160 + 32k = 0$$

$$\therefore k^2 + 10k - 39 = 0$$

$$\therefore (k+13)(k-3) = 0$$

$$\therefore k = -13 \text{ or } k = 3$$

Using Calculus covered in FS Maths

$$f(x) = \frac{4}{x+2} + 3 = 4(x+2)^{-1} + 3$$

$$\therefore f'(x) = -4(x+2)^{-2} = -4$$

$$\therefore (x+2)^{-2} = 1$$

$$\therefore \frac{1}{(x+2)^2} = 1$$

$$\therefore x + 2 = \pm 1$$

$$\therefore x = -1 \text{ or } x = -3$$

$$\therefore y = 7 \text{ or } y = -1$$

Points of contact:

$(-1\ ;\ 7)$ and $(-3\ ;\ -1)$

Substitute into $y = -4x + k$

$$\therefore 7 = -4(-1) + k \Rightarrow$$

$$\therefore k = 3$$

or

$$-1 = -4(-3) + k$$

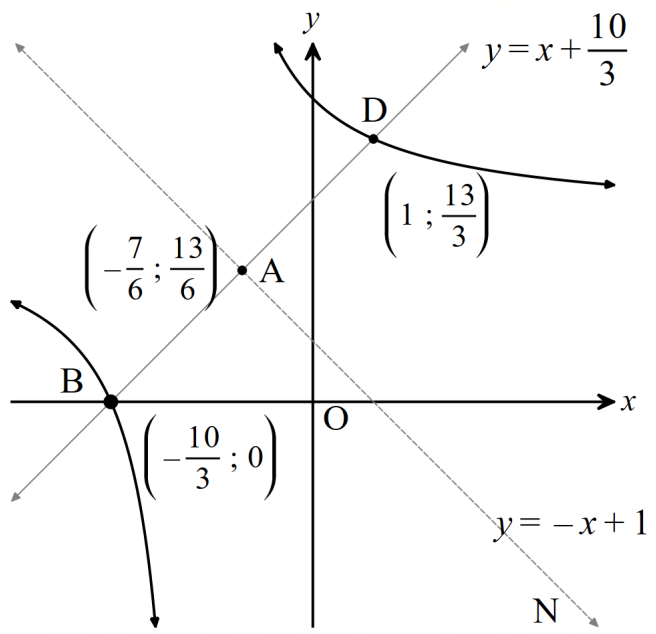
$$\therefore k = -13$$

(6)

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6.5 D is the reflection of B in symmetry line with gradient $m = -1$.



Find A, the mipoint of BD and then D

BD ⊥ AN (N lies on $y = -x + 1$)

Equation of AN

$$y - y_1 = m(x - x_1)$$

$$\therefore y - 0 = 1\left(x - \left(-\frac{10}{3}\right)\right)$$

$$\therefore y = x + \frac{10}{3}$$

BA = AD (B is reflected to D)

$$-x + 1 = x + \frac{10}{3} \text{ at A}$$

$$\therefore -3x + 3 = 3x + 10$$

$$\therefore 6x = -7$$

$$\therefore x = -\frac{7}{6}$$

$$y = -\left(-\frac{7}{6}\right) + 1 = \frac{13}{6}$$

$$\therefore \text{D}\left(1; \frac{13}{3}\right) \text{ (A is the midpoint of BD)}$$

$$\therefore \text{BD} = \sqrt{\left(1 - \left(-\frac{10}{3}\right)\right)^2 + \left(\frac{13}{3} - 0\right)^2}$$

$$= \frac{13\sqrt{2}}{3}$$

$$\approx 6{,}13$$

Equate line through BD and graph f

BD ⊥ AN

Equation of AN

$$y - y_1 = m(x - x_1)$$

$$\therefore y - 0 = 1\left(x - \left(-\frac{10}{3}\right)\right)$$

$$\therefore y = x + \frac{10}{3}$$

$$x + \frac{10}{3} = \frac{4}{x + 2} + 3$$

$$\therefore 3x(x + 2) + 10(x + 2) = 4(3) + 3(3)(x + 2)$$

$$\therefore 3x^2 + 6x + 10x + 20 = 12 + 9x + 18$$

$$\therefore 3x^2 + 7x - 10 = 0$$

$$\therefore (3x + 10)(x - 1) = 0$$

$$\therefore x = -\frac{10}{3} \text{ or } x = 1$$

$$\therefore \text{D}\left(1; \frac{13}{3}\right)$$

$$\therefore \text{BD} = \sqrt{\left(1 - \left(-\frac{10}{3}\right)\right)^2 + \left(\frac{13}{3} - 0\right)^2}$$

$$= \frac{13\sqrt{2}}{3}$$

$$\approx 6{,}13$$

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6.5 Find A, the mipoint of BD, then the length of BA and then double this result.

$BD \perp AN$

Equation of AN

$$y - y_1 = m(x - x_1)$$

$$\therefore y - 0 = 1\left(x - \left(-\frac{10}{3}\right)\right)$$

$$\therefore y = x + \frac{10}{3}$$

BA = AD (B is reflected to D)

$$-x + 1 = x + \frac{10}{3} \text{ at A}$$

$$\therefore -3x + 3 = 3x + 10$$

$$\therefore 6x = -7$$

$$\therefore x = -\frac{7}{6}$$

$$y = -\left(-\frac{7}{6}\right) + 1 = \frac{13}{6}$$

$$\therefore \text{A}\left(-\frac{7}{6}; \frac{13}{6}\right)$$

$$\therefore \text{BA} = \sqrt{\left(\left(-\frac{7}{6}\right) - \left(-\frac{10}{3}\right)\right)^2 + \left(\frac{13}{6} - 0\right)^2}$$

$$= \frac{13\sqrt{2}}{6}$$

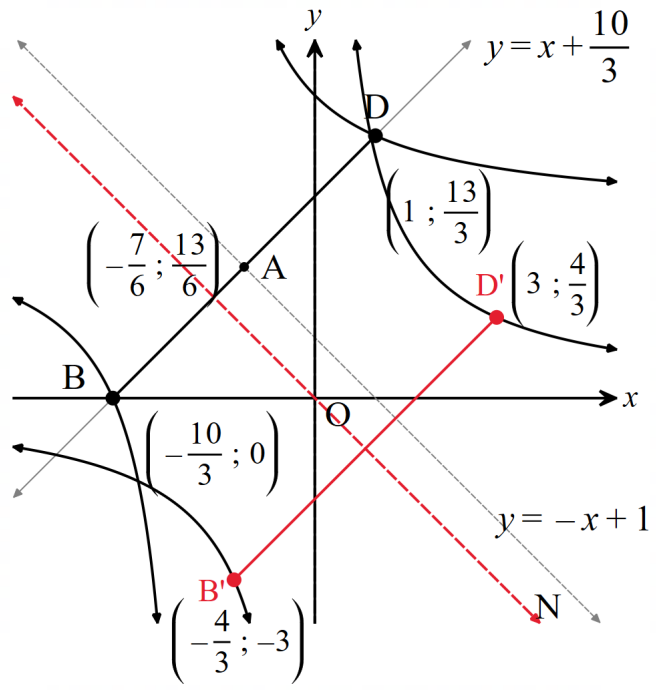
$$\therefore \text{BD} = 2\left(\frac{13\sqrt{2}}{6}\right) \approx 6{,}13$$



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6.5 GREAT alternative using shifting



Shift f 2 units to the right and 3 units down to form $y = \frac{4}{x}$.

This shift moves $B\left(-\frac{10}{3}; 0\right) \rightarrow B'\left(-\frac{4}{3}; -3\right)$

Reflecting $B'\left(-\frac{4}{3}; -3\right)$ in the line $y = -x$ gives us $D'\left(3; \frac{4}{3}\right)$.

$$BD = B'D'$$

$$= \sqrt{\left(3 - \left(-\frac{4}{3}\right)\right)^2 + \left(\frac{4}{3} - (-3)\right)^2}$$

$$= \sqrt{\left(\frac{13}{3}\right)^2 + \left(\frac{13}{3}\right)^2}$$

$$= \sqrt{2\left(\frac{13}{3}\right)^2}$$

$$= \frac{13}{3}\sqrt{2}$$

$$\approx 6{,}13$$

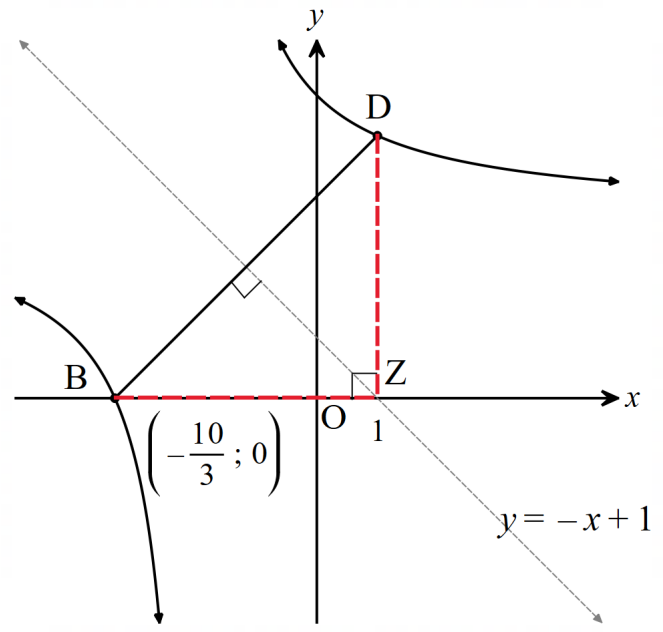


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Alternative using Pythagoras and isosceles triangles.



BD is bisected perpendicularly by $y = -x + 1$.

(We know this because D is the reflection of B in the line $y = -x + 1$)

The line through D, perpendicular to the x-axis, intersects the horizontal line through B on the line $y = -x + 1$ at Z, which also lies on the x-axis.

$B\hat{Z}D = 90°$

$\tan D\hat{B}Z = 1$

$\therefore D\hat{B}Z = 45°$

$\therefore B\hat{D}Z = 45°$ ($\angle$ sum in Δ)

$\therefore DZ = BZ$ (sides opp $= \angle$s)



$Z(1;0)$

$$\therefore BZ = 1-\left(-\frac{10}{3}\right) = \frac{13}{3}$$

$$\therefore BD = \sqrt{\left(\frac{13}{3}\right)^2+\left(\frac{13}{3}\right)^2}$$

$$= \sqrt{2\left(\frac{13}{3}\right)^2}$$

$$= \frac{13}{3}\sqrt{2}$$

$$\approx 6{,}13$$

[16]

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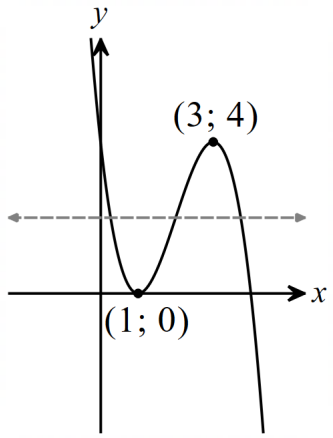
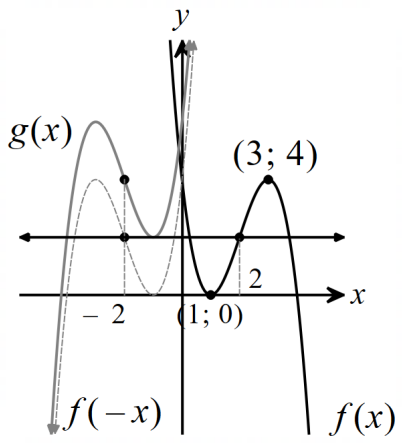
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7.1	$A = 197\ 700 \qquad P = 465\ 000 \qquad i = \frac{11,5}{100} = 0,115$ $A = P(1-i)^n$ $\therefore 197\ 700 = 465\ 000(1-0,115)^n$ $\therefore (0,885)^n = \frac{197\ 700}{465\ 000}$ $\therefore n = \log_{0,885} \frac{659}{1\ 550}$ $= 7 \text{ years}$	(3)
7.2	$P = 10\ 000$ $i = \frac{0,065}{2}$ for the first three years , with $n = 6$ $i = \frac{0,07}{4}$ for the next two years, with $n = 8$ $A = 20\ 000\left(1+\frac{0,065}{2}\right)^6\left(1+\frac{0,007}{4}\right)^8$ $= 13\ 919,245...$ $= R13\ 919,25$	(4)
7.3.1	$n = 12 \times 44 = 528 \qquad i = \frac{0,075}{12} \qquad x = 800$ $F = \frac{800\left[\left(1+\frac{0,075}{12}\right)^{528} - 1\right]}{\frac{0,075}{12}}$ $= 3\ 306\ 959,906$ $\approx R3\ 306\ 959,91$	(4)
7.3.2	$i = \frac{0,06}{12} \qquad n = 12 \times 20 = 240 \qquad P = 3\ 306\ 959,91$ $3\ 306\ 959,91 = \frac{x\left[1-\left(1+\frac{0,06}{12}\right)^{-240}\right]}{\frac{0,06}{12}}$ $= 23\ 692,08789$ $= R23\ 692,09$	(3)
		[14]

8.1	$f'(x)=\lim\limits_{h\to 0}\dfrac{f(x+h)-f(x)}{h}$ $=\lim\limits_{h\to 0}\dfrac{\left[-(x+h)^2+(x+h)\right]-\left[x^2+x\right]}{h}$ $=\lim\limits_{h\to 0}\dfrac{\left[-x^2-2xh-h^2+x+h\right]-\left[x^2+x\right]}{h}$ $=\lim\limits_{h\to 0}\dfrac{-2xh-h^2+h}{h}$ $=\lim\limits_{h\to 0}\dfrac{h(-2x-h+1)}{h}$ $=-2x+1$	(5)
8.2.1	$g(x)=3\sqrt[3]{x}-3x^2$ $=3x^{\frac{1}{3}}-3x^2$ $\therefore g'(x)=x^{-\frac{2}{3}}-6x$ $=\dfrac{1}{x^{\frac{2}{3}}}-6x$ $=\dfrac{1}{\sqrt[3]{x^2}}-6x$	(3)
8.2.2	$y=\dfrac{4x^3-x}{2x-1}$ $=\dfrac{x(4x^2-1)}{2x-1}$ $=\dfrac{x(2x-1)(2x+1)}{2x-1}$ $=x(2x+1)$ $=2x^2+x$ $\therefore \dfrac{dy}{dx}=4x+1$	(3)
		[11]

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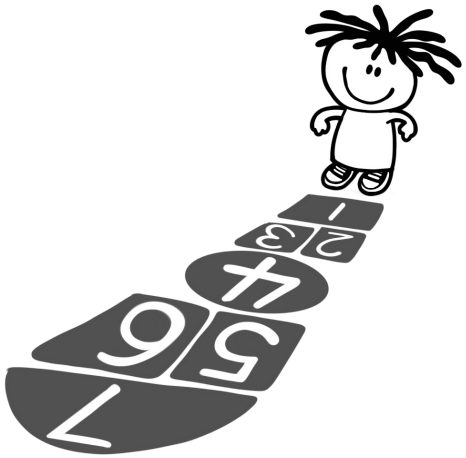
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9.1.1	$f(1)=-(1)^3+6(1)^2-9(1)+4$ $=-1+6-9+4$ $=0$ $\therefore x-1$ is a factor of $f(x)$	$f(x)=-(x-1)(x^2-5x+4)$ or $f(x)=(x-1)(-x^2+5x-4)$	(1)
9.1.2	$x^3-6x^2+9x-4=0$ $\therefore (x-1)(x^2-5x+4)=0$ $\therefore (x-1)(x-1)(x-4)=0$ $\therefore x=1$ or $x=4$ $\therefore (1;0)$ or $(4;0)$	$-x^3+6x^2-9x+4=0$ $\therefore (x-1)(-x^2+5x-4)=0$ $\therefore (x-1)(-x+1)(x-4)=0$ $\therefore x=1$ or $x=4$ $\therefore (1;0)$ or $(4;0)$	(3)
9.1.3	$f(x)=-x^3+6x^2-9x+4$ $f'(x)=-3x^2+12x-9=0$ $\therefore x^2-4x+3=0$ $\therefore (x-1)(x-3)=0$ $\therefore x=1$ or $x=3$ $f(1)=0$ $f(3)=-27+54-27+4=4$ $\therefore$ the turning points are (1 ; 0) and (3 ; 4) $\therefore 0<k<4$		(5)
9.1.4	$g(x)$ is a reflection of f in the y-axis and then a translation 2 units up. The vertical shift will not affect the concavity for any given x-value. $g(x)=f(-x)+2$ will be concave up when $x>-2$.		(2)

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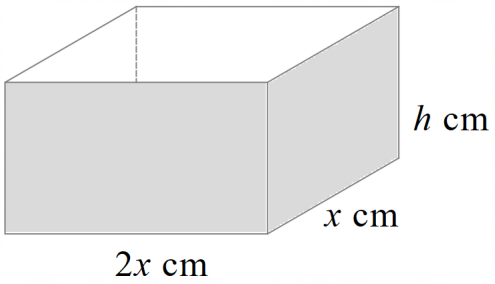
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9.2	$f(x)=3x^3+ax^2+bx+c$ $f(2)=24+4a+2b+c=3$ $\therefore 21+4a+2b+c=0$ ①	$f'(x)=9x^2+2ax+b$ $\therefore 9(2)^2+2a(2)+b=0$ $\therefore 36+4a+b=0$ ②	$f''(x)=18x+2a=0$ $f''(2)=18(2)+2a=0$ $\therefore 2a=-36$ $\therefore a=-18$	
	Substitute $a=-18$ into ② $\therefore 36+4(-18)+b=0$ $\therefore b=36$ Substitute $b=36$ into ① $\therefore 21+4(-18)+2(36)+c=0$ $\therefore c=-21$			(6)
				[17]



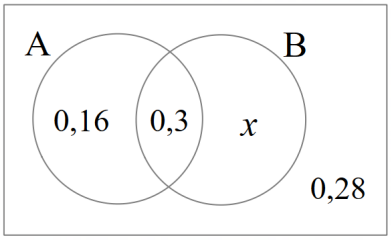
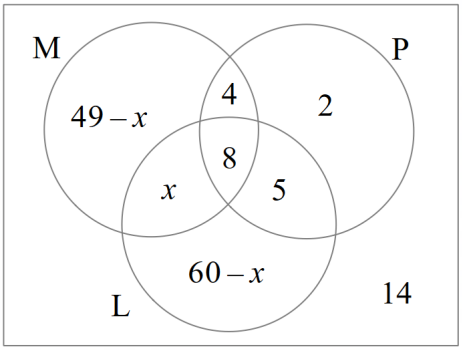
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10.1	The box has no lid. Its length = $2x$. T.S.A. of box = 300 cm^2 $\therefore 2x^2 + 2(xh + 2xh) = 300$ $\therefore x^2 + 3xh = 150$ $\therefore h = \dfrac{150 - x^2}{3x}$ $= \dfrac{50}{x} - \dfrac{x}{3}$ Note : $\dfrac{300 - 2x^2}{6x} = \dfrac{150 - x^2}{3x} = \dfrac{50}{x} - \dfrac{x}{3}$  	(2)
10.2	$\text{Volume} = (2x)(x)\left(\dfrac{50}{x} - \dfrac{x}{3}\right)$ $= 100x - \dfrac{2}{3}x^3$	(2)
10.3	The volume is a maximum when $D_x\left[100x - \dfrac{2}{3}x^3\right] = 0$. $100 - 2x^2 = 0$ $\therefore x^2 = 50$ $\therefore x = \sqrt{50} \quad (x > 0)$ $\therefore$ maximum volume $= 100\left(\sqrt{50}\right) - \dfrac{2}{3}\left(\sqrt{50}\right)^3$ $= 471,4045...$ $\approx 471,40$ In surd form the answer is: $100\left(\sqrt{50}\right) - \dfrac{2}{3}\left(\sqrt{50}\right)^3$ $= 500\sqrt{2} - \dfrac{500\sqrt{2}}{3}$ $= \dfrac{1\,000\sqrt{2}}{3}$	(4)
		[8]

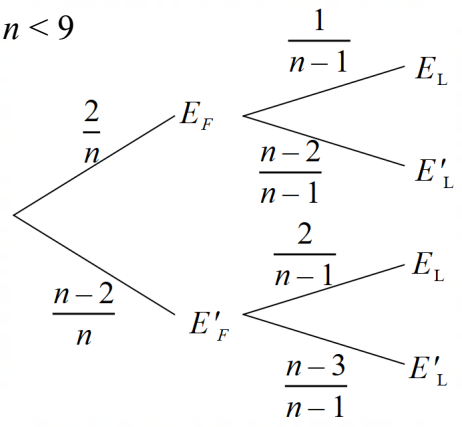
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11.1.1	No, they are not mutually exclusive because P(A and B) ≠ 0.	(2)
11.1.2	P(A or B) = 1 – P(not (A or B)) = 0,72 P(A or B) = P(A) + P(B) – P(A and B) = [P(A only) + P(A and B)] + P(B) – P(A and B) = P(A only) + P(B) ∴ 0,72 = 0,16 + P(B) ∴ P(B) = 0,56 or Let P(B only) = x. x = 1 – (0,16 + 0,3 + 0,28) = 1 – 0,74 = 0,26 P(B) = 0,3 + 0,26 = 0,56 	(3)
11.2.1	$n = 100$  (49 – x) + (60 – x) + 2 + 4 + x + 5 + 8 + 14 = 100 ∴ 142 – x = 100 ∴ x = 42	(1)
11.2.2	P(M) = 0,61 (49 – 42 + 4 + 8 + 42 = 61) P(L) = 0,73 (42 + 8 + 5 + 60 – 42 = 73) P(M)×P(L) = 0,61× 0,73 = 0,4453 P(M and L) = 0,5 (42 + 8 = 50) ∴ P(M)×P(L) ≠ P(M and L) No, taking Mathematics is NOT independent of taking Life Sciences.	(5)

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11.3.1	9 unique bottles are selected. These bottles can be arranged in 9! = 362 880 different ways on the shelf.	(1)
11.3.2	**Option 1: Using a tree diagram** where: • E_F shows probability of choosing an energy drink first • E_L shows probability of choosing an energy drink last • n gives the number of unbroken bottles, $0 < n < 9$ $\therefore \frac{2}{n} \times \frac{1}{n-1} = \frac{1}{21}$ $\therefore n(n-1) = 42$ $\therefore n^2 - n - 42 = 0$ $\therefore (n-7)(n+6) = 0$ $\therefore n = 7$ or $n = -6$ $\therefore n = 7$ only $(0 < n < 9)$  $\therefore$ 7 bottles were left on the shelf. $\therefore$ 2 bottles were broken.	
	Option 2: Let the number of bottles left on the shelf be *x*. There are TWO ways to choose the first bottle & ONE way to choose the last one. $\therefore \frac{2}{x} \times \frac{1}{x-1} = \frac{1}{21}$ $\therefore x(x-1) = 42$ $\therefore x^2 - x - 42 = 0$ $\therefore (x-7)(x+6) = 0$ $\therefore x = 7$ or $x = -6$ $\therefore x = 7$ only $(0 < x < 9)$ $\therefore \frac{2 \times (x-2)! \times 1}{x!} = \frac{1}{21}$ $\therefore \frac{2}{x(x-1)} = \frac{1}{21}$ $\therefore x^2 - x = 42$ $\therefore x^2 - x - 42 = 0$ $\therefore (x-7)(x+6) = 0$ $\therefore x = 7$ or $x = -6$ $\therefore x = 7$ only $(0 < x < 9)$ $\therefore$ 7 bottles were left on the shelf. $\therefore$ 2 bottles were broken.	

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11.3.2

Option 3: Let the number of broken juice bottles be *x*.

There are TWO ways to choose the first bottle & ONE way to choose the last one.

$$\therefore \frac{2}{9-x}\times\frac{1}{8-x}=\frac{1}{21}$$
$$\therefore (9-x)(8-x)=42$$
$$\therefore 72-9x-8x+x^2-42=0$$
$$\therefore x^2-17x+30=0$$
$$\therefore (x-2)(x-15)=0$$
$$\therefore x=2 \text{ or } x=15$$
$$\therefore x=2 \text{ only } (0<x<4)$$

(If 4 is included, then all are broken)

$$\therefore \frac{2\times(7-x)!\times 1}{(9-x)!}=\frac{1}{21}$$
$$\therefore \frac{2}{(9-x)(8-x)}=\frac{1}{21}$$
$$\therefore 72-9x-8x+x^2=42$$
$$\therefore x^2-17x+30=0$$
$$\therefore (x-2)(x-15)=0$$
$$\therefore x=2 \text{ or } x=15$$
$$\therefore x=2 \text{ only } (0<x<4)$$

(If 4 is included, then all are broken)

$\therefore$ 2 bottles were broken.



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11.3.2 **Option 4: Let the number of juice bottles be *n*.**

We have 3 cold drinks and 2 energy drinks.

The unbroken bottles can be arranged in $(n + 5)!$ ways.

Number of ways drinks can be arranged with an energy drink on each end

$= 2(n + 3)!$

We know that the probability of the energy drinks being on the ends is $\frac{1}{21}$

$$\therefore \frac{2(n+3)!}{(n+5)!} = \frac{1}{21}$$

$$\therefore \frac{2}{(n+5)(n+4)} = \frac{1}{21}$$

$$\therefore (n+5)(n+4) = 42$$

$$\therefore n^2 + 9n + 20 = 42$$

$$\therefore n^2 + 9n - 22 = 0$$

$$\therefore (n+11)(n-2) = 0$$

$$\therefore n = -11 \text{ or } n = 2$$

$$\therefore n = 2 \quad (0 < n < 4, \text{ if 4 is included, than all are broken})$$



$\therefore$ 2 bottles were broken.

It is possible to solve this by inspection:

$$\therefore \frac{2(n+3)!}{(n+5)!} = \frac{1}{21}$$

$$\therefore \frac{(n+3)!}{(n+5)!} = \frac{1}{42} = \frac{1}{7 \times 6}$$

$$\therefore \frac{1}{(\mathbf{2}+5)(\mathbf{2}+4)} = \frac{1}{21}$$

$$\therefore n = 2 \quad (0 < n < 4, \text{ if 4 is included, then all are broken})$$

$\therefore$ 2 bottles were broken.

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	By inspection **Some** of the juice bottles were broken. The number of broken bottles can only be 1, 2 or 3. If 1 bottle was broken, then $\frac{2}{8}\times\frac{1}{7}=\frac{1}{28}$ ✗ (8 bottles left) If 2 bottles were broken, then $\frac{2}{7}\times\frac{1}{6}=\frac{1}{21}$ ✓ (7 bottles left) If 3 bottles were broken, then $\frac{2}{6}\times\frac{1}{5}=\frac{1}{15}$ ✗ (6 bottles left) $\therefore$ 2 bottles of juice were broken.	
		[17]

TOTAL: 150

