10A

1(d) $y = x^3 + 3x^2 - 2x + 4 \quad (2, 20)$

$\frac{dy}{dx} = 3x^2 + 6x - 2$

$\frac{dy}{dx}(2) = 3(2)^2 + 6(2) - 2$

$\frac{dy}{dx}(2) = 22$

$\underline{m = 22}$ at $(2, 20)$

$y - b = m(x - a)$

$y - 20 = 22(x - 2)$

$y - 20 = 22x - 44$

$\underline{y = 22x - 24}$

2(c) $y = 4\sin x \quad \left(\frac{\pi}{4}, 2\sqrt{2}\right)$

$\frac{dy}{dx} = 4\cos x$

$\frac{dy}{dx}\left(\frac{\pi}{4}\right) = 4\cos\left(\frac{\pi}{4}\right)$

$= 4 \cdot \frac{1}{\sqrt{2}}$

$= \frac{4}{\sqrt{2}} \cdot \frac{\sqrt{2}}{\sqrt{2}} = \frac{4\sqrt{2}}{2} = 2\sqrt{2}$

$m = 2\sqrt{2}$ at $\left(\frac{\pi}{4}, 2\sqrt{2}\right)$

$y - b = m(x - a)$

$y - 2\sqrt{2} = 2\sqrt{2}\left(x - \frac{\pi}{4}\right)$

10A

2(c) continued

common factor of $2\sqrt{2}$.

$$y = 2\sqrt{2}x - 2\sqrt{2}\cdot\frac{\pi}{4} + 2\sqrt{2}$$

$$y = 2\sqrt{2}x + 2\sqrt{2}\left(1 - \frac{\pi}{4}\right)$$

3(e) $y = 8 - x^3$

$$\frac{dy}{dx} = -3x^2$$

$$\frac{dy}{dx}(-3) = -3(-3)^2$$

$$= \underline{-27}$$

$$y(-3) = 8 - (-3)^3$$

$$= \underline{35}$$

$m = -27$ at $(-3, 35)$

$$y - b = m(x - a)$$

$$y - 35 = -27(x - -3)$$

$$y - 35 = -27x - 81$$

$$\underline{y = -27x - 46}$$

10A

4(d) $y = 6\sin\left(x - \frac{\pi}{4}\right)$ at $x = \pi/4$

$$y\left(\tfrac{\pi}{4}\right) = 6\sin\left(\tfrac{\pi}{4} - \tfrac{\pi}{4}\right)$$
$$= 6\sin 0$$
$$= \underline{\underline{0}} \qquad \left(\tfrac{\pi}{4}, 0\right)$$

$$\frac{dy}{dx} = 6\cos\left(x - \pi/4\right) \times \cancel{\frac{d}{dx}\left(x - \pi/4\right)'}$$

$$\frac{dy}{dx} = 6\cos\left(x - \pi/4\right)$$

$$\frac{dy}{dx}\left(\tfrac{\pi}{4}\right) = 6\cos\left(\tfrac{\pi}{4} - \pi/4\right)$$
$$= 6\cancel{\cos(0)}'$$
$$= \underline{\underline{6}} \qquad m = 6 \quad \text{at } \left(\tfrac{\pi}{4}, 0\right)$$

$$y - 0 = 6\left(x - \tfrac{\pi}{4}\right)$$
$$y = 6x - \frac{6\pi}{4}$$
$$y = 6x - \frac{3\pi}{2}$$

10A

(7) $y = f(x)$

$$y = 8 - 2(x-4)^2$$

at A and B $y = 0$

$$0 = 8 - 2(x-4)^2$$

$$2(x-4)^2 = 8$$

$$(x-4)^2 = \frac{8}{2} = 4$$

$$x - 4 = \pm\sqrt{4}$$

$$x - 4 = \pm 2$$

$x - 4 = 2$ $\quad$ $x - 4 = -2$

$x_B = 6$ $\quad$ $x_A = 2$ $\quad$ at B $(6, 0)$

$$\frac{dy}{dx} = -4(x-4)^1 \times \frac{d}{dx}\cancel{(x-4)}^1$$

$$= -4(x-4)$$

$$= -4x + 16$$

$$\frac{dy}{dx}(6) = -4(6) + 16$$

$$= -8$$

$m = -8$

$$y - 0 = -8(x-6)$$

$$y = -8x + 48$$

10A

(11) $f(x) = 2\cos\left(2x + \frac{\pi}{2}\right)$

$f'(x) = -2\sin\left(2x + \frac{\pi}{2}\right) \times \frac{d}{dx}\overset{2}{\left(2x + \frac{\pi}{2}\right)}$

$f'(x) = -4\sin\left(2x + \frac{\pi}{2}\right)$

$m = 2 \quad \Rightarrow \quad -4\sin\left(2x + \frac{\pi}{2}\right) = 2$

$\sin\left(2x + \frac{\pi}{2}\right) = -\frac{1}{2} \qquad \sin^{-1}\left(\frac{1}{2}\right) = \frac{\pi}{6}$

$2x + \frac{\pi}{2} = \pi + \frac{\pi}{6},\ 2\pi - \frac{\pi}{6}$

$2x + \frac{\pi}{2} = \frac{7\pi}{6},\ \frac{11\pi}{6}$

$2x = \frac{4\pi}{6},\ \frac{8\pi}{6} \qquad \left(\frac{\pi}{2} = \frac{3\pi}{6}\right)$

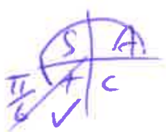
$x = \frac{4\pi}{12},\ \frac{8\pi}{12}$

$x = \frac{\pi}{3},\ \frac{2\pi}{3}$ Assume point P has $x = \frac{\pi}{3}$

$x = \frac{\pi}{3}$ find y coordinate

$y\left(\frac{\pi}{3}\right) = 2\cos\left(\frac{2\pi}{3} + \frac{\pi}{2}\right)$

$= 2\cos\left(\frac{7\pi}{6}\right)$



$= -2\cos\left(\frac{\pi}{6}\right)$

$= -2 \cdot \frac{\sqrt{3}}{2}$

$= -\sqrt{3}$

$\left(\frac{\pi}{3}, -\sqrt{3}\right)$

10A

(11) continued

$m = 2$ at $\left(\frac{\pi}{3}, -\sqrt{3}\right)$

$y - -\sqrt{3} = 2\left(x - \frac{\pi}{3}\right)$

$y + \sqrt{3} = 2x - \frac{2\pi}{3}$

$y = 2x - \frac{2\pi}{3} - \sqrt{3}$

10A

15 $\quad y = (3x+2)^5$

$$\frac{dy}{dx} = 5(3x+2)^4 \times \overset{3}{\cancel{\frac{d}{dx}(3x+2)}}$$

$$= 15(3x+2)^4$$

$$\frac{dy}{dx}(-1) = 15(3(-1)+2)^4$$

$$= 15(-1)^4$$

$$= \underline{\underline{15}}$$

$$m = 15$$

at $x=-1$ $\quad y$ coordinate

$$y(-1) = (3(-1)+2)^5$$

$$= (-1)^5$$

$$= \underline{-1}$$

$$m = 15 \text{ at } (-1,-1)$$

$$(y - -1) = 15(x - -1)$$

$$y + 1 = 15(x+1)$$

$$y + 1 = 15x + 15$$

$$\underline{\underline{y = 15x + 14}}$$

10A

19 $y = (\sin x)^3$

$$y\left(\frac{7\pi}{6}\right) = \left(\sin \frac{7\pi}{6}\right)^3$$

$$= \left(-\sin \pi/6\right)^3$$

$$= \left(-\frac{1}{2}\right)^3$$

$$= -\frac{1}{8}$$

point $\left(\frac{7\pi}{6}, -\frac{1}{8}\right)$

$$\frac{dy}{dx} = 3(\sin x)^2 \times \frac{d}{dx} \sin x$$

$$= 3 \sin^2 x \cos x$$

$$\frac{dy}{dx}\left(\frac{7\pi}{6}\right) = 3 \sin^2\left(\frac{7\pi}{6}\right) \cos\left(\frac{7\pi}{6}\right)$$

$$= 3\left(-\sin^2\left(\pi/6\right)\right)\left(\cos\left(-\pi/6\right)\right)$$

$$= 3 \cdot \frac{1}{4} \cdot -\frac{\sqrt{3}}{2}$$

$$= -\frac{3\sqrt{3}}{8}$$

contined over.

10A

(19) continued

$$y - b = m(x - a)$$

$$y - -\frac{1}{8} = -\frac{3\sqrt{3}}{8}\left(x - \frac{7\pi}{6}\right)$$

$$y + \frac{1}{8} = -\frac{3\sqrt{3}}{8}\left(x - \frac{7\pi}{6}\right)$$

$$y + \frac{1}{8} = -\frac{3\sqrt{3}}{8}x + \frac{21\sqrt{3}\pi}{48} \cancel{-\frac{1}{8}}$$

$$y = -\frac{3\sqrt{3}}{8}x + \frac{7\sqrt{3}\pi}{16} \cancel{+} - \frac{1}{8}$$

10B

1 (c) $h(x) = x^4 - 2x^3 - 2x^2 - 3$

$h'(x) = 4x^3 - 6x^2 - 4x$

$h'(-1) = 4(-1)^3 - 6(-1)^2 - 4(-1)$

$= \underline{\underline{-6}}$

$h'(-1) < 0 \quad \therefore \quad h(x)$ decreasing at $x = -1$

1 (d) $p(x) = 6x - x^4$

$p'(x) = 6 - 4x^3$

$p'(-2) = 6 - 4(-2)^3$

$p'(-2) = 38$

$p'(-2) > 0 \quad \therefore \quad p(x)$ increasing at $x = -2$

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

$f'(x) = x^2 - 2x - 3$

when increasing $f'(x) > 0$

$x^2 - 2x - 3 > 0$

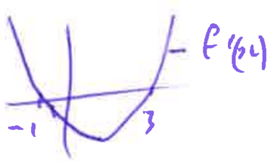
solve $x^2 - 2x - 3 = 0$

$(x-3)(x+1) = 0$

$x - 3 = 0 \quad x + 1 = 0$

$x = 3 \quad x = -1$

sketch



$f'(x) > 0 \quad \underline{\underline{x < -1}}$ and $\underline{\underline{x > 3}}$

(i.e. $f(x)$ increasing)

10B

2 (d) $h(x) = x^4 + 32x$

$h'(x) = 4x^3 + 32$

If decreasing $4x^3 + 32 < 0$

$4x^3 < -32$

$x^3 < -8$

$\underline{\underline{x < -2}}$

5 (a) $h(x) = (3x-1)^4$

$h'(x) = 4(3x-1)^3 \times \frac{d}{dx}(3x-1)$

$h'(\frac{1}{2}) = 4(3(\frac{1}{2})-1)^3 \times 3$

$= 12 (\frac{1}{2})^3$

$= 12 \cdot \frac{1}{8}$

$= \frac{3}{2}$

$h'(\frac{1}{2}) > 0 \quad \therefore \quad h(x)$ increasing at $x = \frac{1}{2}$

(b) when decreasing $h'(x) < 0$

$12(3x-1)^3 < 0$

$(\div 12) \qquad (3x-1)^3 < 0 \qquad (\div 12)$

$(\sqrt[3]{\ }) \qquad \qquad (\sqrt[3]{\ })$

$3x - 1 < 0$

$3x < 1$

$\underline{\underline{x < \frac{1}{3}}}$

10B

(8) $h(x) = 4\sin x + 3\cos\left(x + \frac{\pi}{6}\right)$

$h'(x) = 4\cos x - 3\sin\left(x + \frac{\pi}{6}\right) \times \cancel{\frac{d}{dx}\left(x + \frac{\pi}{6}\right)}$ 1

$h'(x) = 4\cos x - 3\sin\left(x + \frac{\pi}{6}\right)$

$h'\left(\frac{\pi}{6}\right) = 4\cos\left(\frac{\pi}{6}\right) - 3\sin\left(\frac{\pi}{6} + \frac{\pi}{6}\right)$

$= 4\cos\frac{\pi}{6} - 3\sin\left(\frac{\pi}{3}\right)$

$= 4 \cdot \frac{\sqrt{3}}{2} - 3 \cdot \frac{\sqrt{3}}{2}$

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

$h'\left(\frac{\pi}{6}\right) > 0 \quad \therefore \; h(x)$ increasing at $x = \frac{\pi}{6}$

(11) $f(x) = \frac{1}{3}x^3 - 3x^2 + 10x - 5$

$f'(x) = x^2 - 6x + 10$

$f'(x) = x^2 - 6x + 9 + 1$

$f'(x) = (x-3)^2 + 1$

$(x-3)^2 + 1 > 0$ for all x

$\therefore f(x)$ is always increasing

10B

(12) $h(x) = \frac{2}{3}x^3 + 2x^2 + 2x - 3$

$$h'(x) = 2x^2 + 4x + 2$$
$$= 2(x^2 + 2x + 1)$$
$$= 2(x+1)^2$$

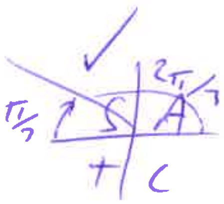
$2(x+1)^2 \geq 0$ for all x $\therefore$ $h(x)$ is never decreasing.

(15) $y = 2\sin^3 x$

$$y = 2(\sin x)^3$$

$$\frac{dy}{dx} = 2 \times 3(\sin x)^2 \times \frac{d}{dx}\sin x$$
$$= 6\sin^2 x \cos x$$

$$\frac{dy}{dx} = 6\sin^2\frac{2\pi}{3}\cos\frac{2\pi}{3}$$
$$= 6\left(\sin^2\frac{\pi}{3}\right)\left(-\cos\frac{\pi}{3}\right)$$
$$= 6\left(\frac{\sqrt{3}}{2}\right)^2\left(\frac{-1}{2}\right)$$
$$= 6 \times \frac{3}{4} \times \left(\frac{-1}{2}\right)$$
$$= \frac{-18}{8} = \frac{-9}{4}$$



$\sin\frac{2\pi}{3} = \sin\frac{\pi}{3}$

$\cos\frac{2\pi}{3} = -\cos\frac{\pi}{3}$

$\frac{dy}{dx} < 0$ at $x = \frac{2\pi}{3}$ $\therefore$ y is decreasing.

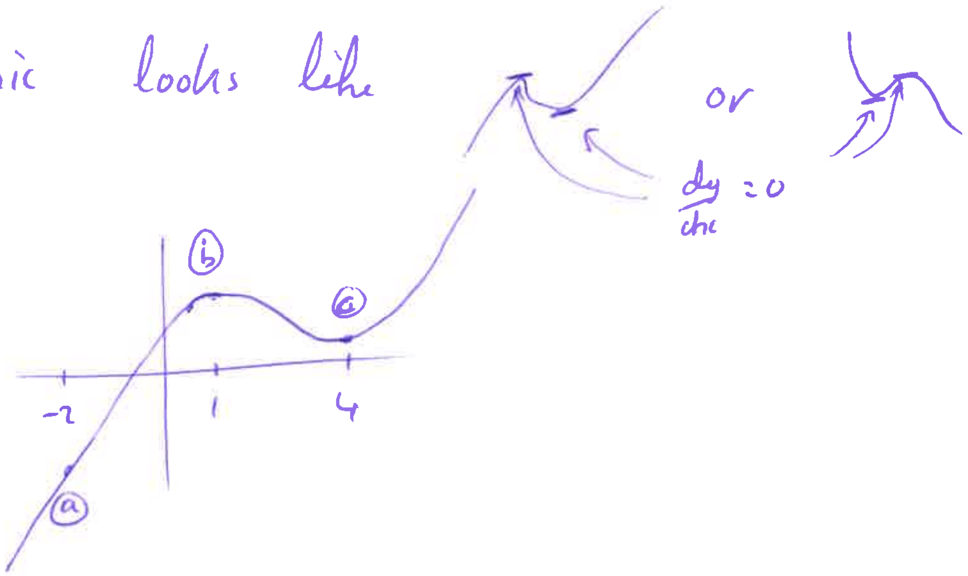
10B

(18) (a) $f'(-2) > 0$ at $x = -2$ the curve is increasing

(b) at $x = 1$ the gradient is 0

(c) at $x = 4$ the gradient is 0

cubic looks like



A correct

B incorrect

C incorrect

D incorrect (curve's gradient gets steeper & steeper after $x = 4$)

E correct.

10C

positive cubic

1 (d) $y = x^3 - 2x^2 - 4x + 1$

$$\frac{dy}{dx} = 3x^2 - 4x - 4$$

at stationary points $\frac{dy}{dx} = 0$

$$3x^2 - 4x - 4 = 0$$

$$(3x+2)(x-2) = 0$$

$3x + 2 = 0$ $\qquad$ $x - 2 = 0$

$3x = -2$ $\qquad$ $\underline{\underline{x = 2}}$

$\underline{\underline{x = -\tfrac{2}{3}}}$

$$y\left(-\tfrac{2}{3}\right) = \left(-\tfrac{2}{3}\right)^3 - 2\left(-\tfrac{2}{3}\right)^2 - 4\left(-\tfrac{2}{3}\right) + 1$$

$$= \frac{67}{27}$$

$$y(2) = (2)^3 - 2(2)^2 - 4(2) + 1$$

$$= -7$$

stationary points $\left(-\tfrac{2}{3}, \tfrac{67}{27}\right), (2, -7)$

Nature table

x	$\rightarrow$	$-\tfrac{2}{3}$	$\rightarrow$	2	$\rightarrow$
$\frac{dy}{dx} = (3x+2)(x-2)$	+	0	−	0	+
slope	/	—	\	—	/
		$\left(-\tfrac{2}{3}, \tfrac{67}{27}\right)$ maximum		$(2, -7)$ minimum	

10C

negative cubic

(2)(d) $y = x^2(2-x)$

$y = 2x^2 - x^3$

$\frac{dy}{dx} = 4x - 3x^2$

$\frac{dy}{dx} = 0$ for stationary point

$4x - 3x^2 = 0$

$x(4-3x) = 0$

$\underline{x = 0}$, $\quad 4 - 3x = 0$

$4 = 3x$

$\frac{4}{3} = x$

$\underline{x = \frac{4}{3}}$

$y(0) = (0)^2(2-0)$

$= 0$

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

$= \frac{32}{27}$

stationary points at $(0,0)$ and $\left(\frac{4}{3}, \frac{32}{27}\right)$

Nature table

x	$\rightarrow$	0	$\rightarrow$	$\frac{4}{3}$	$\rightarrow$
$\frac{dy}{dx} = x(4-3x)$	$-$	0	$+$	$\rightarrow$	$-$
slope	\	—	/	—	\

$(0,0)$ minimum

$\left(\frac{4}{3}, \frac{32}{27}\right)$ maximum

10C

3d $\quad y = \frac{1}{2}x^2(2 - x^2)$

$$= x^2 - \frac{1}{2}x^4$$

$$\frac{dy}{dx} = 2x - 2x^3$$

$\frac{dy}{dx} = 0$ for stationary point

$$2x - 2x^3 = 0$$

$$2x(1 - x^2) = 0$$

$$2x(1-x)(1+x) = 0$$

$2x = 0 \qquad 1 - x = 0 \qquad 1 + x = 0$

$x = 0 \qquad x = 1 \qquad x = -1$

$y(-1) = \frac{1}{2}(1)^2(2 - 1^2)$
$= \frac{1}{2}$
$(-1, \frac{1}{2})$

$y(0) = \frac{1}{2}(0)^2(2 - (0)^2)$
$= 0$
$(0, \frac{1}{2})$

$y(1) = \frac{1}{2}(1)^2(2 - (1)^2)$
$= \frac{1}{2}$
$(1, \frac{1}{2})$

Nature table

x	→	-1	→	0	→	1	→
$\frac{dy}{dx} = 2x(1-x)(1+x)$	+	0	~~+~~ −	0	+	0	−
slope	/	—	\	_	/	—	\

$(-1, \frac{1}{2})$ maximum $\qquad (0, 0)$ minimum $\qquad (1, \frac{1}{2})$ maximum

10C

(4) (a) $f(x) = (4x-1)^5$

$$f'(x) = 5(4x-1)^4 \times \cancel{\frac{d}{dx}(4x-1)}^{\,4}$$

$$= \underline{20(4x-1)^4}$$

$f'(x) = 0$ for stationary point

$$20(4x-1)^4 = 0$$

$$(4x-1)^4 = 0$$

$$4x - 1 = 0$$

$$4x = 1$$

$$\underline{\underline{x = 1/4}}$$

$$f(\tfrac{1}{4}) = (4(\tfrac{1}{4}) - 1)^5$$

$$= (0)^5$$

$$= 0$$

stationary point $(\frac{1}{4}, 0)$

(b)

x	$\rightarrow$	$\frac{1}{4}$	$\rightarrow$
$\frac{dy}{dx} = 20(4x-1)^4$	+	0	+
slope	/	—	/

$(\frac{1}{4}, 0)$ point of inflexion

LOD

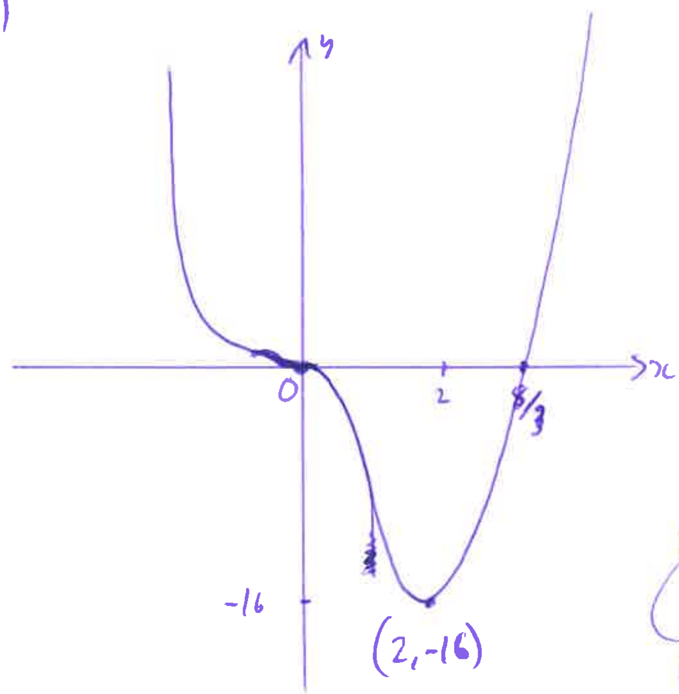
1g (ii) continued

x	$\to$	0	$\to$	2	$\to$
$\frac{dy}{dx} = 12x^2(x-2)$	$-$	0	$-$	0	$+$
slope	$\backslash$	$-$	$\backslash$	$-$	$/$

$(0,0)$ falling point of inflexion

$(2,-16)$ minimum

1g (iii)



Note: Annotate points or you will drop marks.

100

1(g) (i) $y = 3x^4 - 8x^3$

y-int : $y(0) = 3(0)^4 - 8(0)^3$

$y(0) = 0$

$(0,0)$

x-int : $0 = 3x^4 - 8x^3$
(y=0)

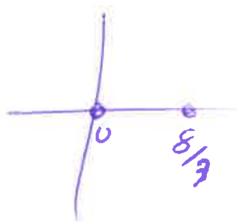
$0 = x^3(3x-8)$

$x^3 = 0$ $\quad$ $3x - 8 = 0$

$x = 0$ $\quad$ $3x = 8$

$x = 8/3$

$(0,0)$ $\quad$ $(8/3, 0)$



info so far gives this

(ii) $\frac{dy}{dx} = 12x^3 - 24x^2$

$\frac{dy}{dx} = 0$ for stationary point

$12x^3 - 24x^2 = 0$

$12x^2(x-2) = 0$

$12x^2 = 0$ $\quad$ $x - 2 = 0$

$x^2 = 0$ $\quad$ $x = 2$

$x = 0$

$y(0) = 3(0)^4 - 8(0)^3$
$= 0$

$(0,0)$

$y(2) = 3(2)^4 - 8(2)^3$
$= -16$

$(2,-16)$

continued over

10D

2 (a)(i)

1	1	3	0	−4
		1	4	4
	1	4	4	0

$r = 0$ $\therefore$ $x = 1$ is a root and $(x-1)$ is a factor of $f(x)$.

(ii) $f(x) = (x-1)(x^2+4x+4)$

$f(x) = \underline{(x-1)(x+2)(x+2)}$

(b) $f'(x) = 3x^2 + 6x$

$f'(x) = 0$ for stationary point

$3x^2 + 6x = 0$

$3x(x+2) = 0$

$3x = 0 \quad (x+2) = 0$

$x = 0 \quad x = -2$

$f(0) = (0)^3 + 3(0)^2 - 4$

$= -4$

$\underline{(0, -4)}$

$f(-2) = (-2)^3 + 3(-2)^2 - 4$

$= 0$

$\underline{(-2, 0)}$

Nature

x	$\rightarrow$	-2	$\rightarrow$	0	$\rightarrow$
$\frac{dy}{dx} = 3x(x+2)$	+	0	−	0	+
Slope	/	—	\	—	/

<u>Maximum at $(-2, 0)$</u> <u>Minimum at $(0, -4)$</u>

10D

2(c) y-int : $f(0) = (0)^3 + 3(0)^2 - 4$

$= -4$

$(0, -4)$

x-int $f(x) = 0$

From part (a)

$(x-1)(x+2)(x+2) = 0$

$x - 1 = 0 \quad x + 2 = 0 \quad x + 2 = 0$

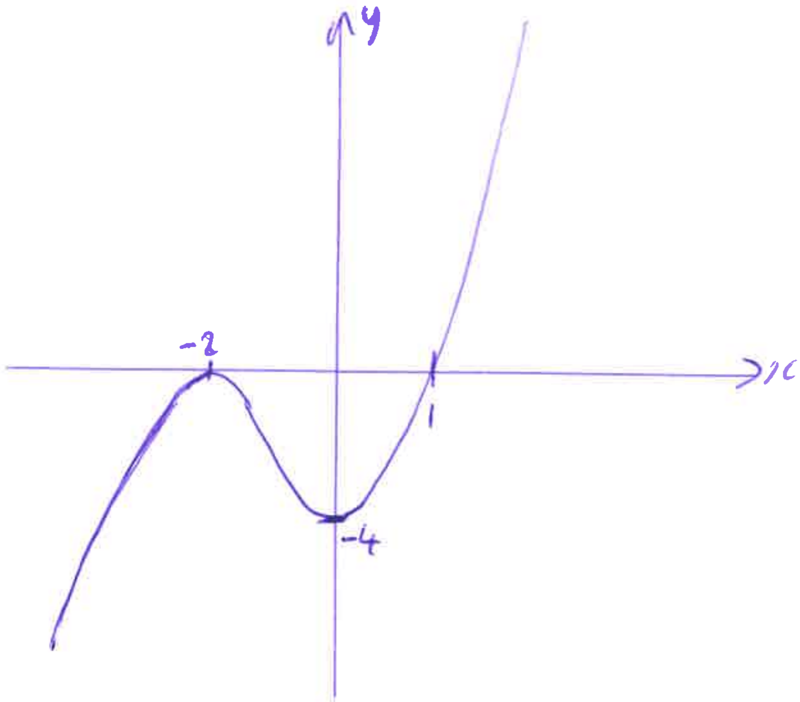
$x = 1 \quad x = -2 \quad x = -2$

Note: $x = -2$ is a repeated root so curve ~~line~~ will touch but not cross.

$\cancel{f(1) = (1)^3 + 3(1)^2 - 4 = 0}$

$\underline{\underline{(1, 0)}} \quad \underline{\underline{(-2, 0)}}$

2(d)



10D

5(a)

$$\begin{array}{r|rrrr} -2 & 1 & -1 & -1 & 10 \\ & & -2 & 6 & -10 \\ \hline & 1 & -3 & 5 & \underline{0} \end{array}$$

$r=0$ ∴ $x=-2$ is a root and $(x+2)$ is a factor of $f(x)$.

$f(x) = \underline{\underline{(x+2)(x^2-3x+5)}}$ ← b^2-4ac

$= (-3)^2 - 4(1)(5)$

$= -11 < 0$ ∴ no real roots

i.e. cannot be factorised further.

(b) $y = x^3 - x^2 - x + 10$

$\frac{dy}{dx} = 3x^2 - 2x - 1$

$\frac{dy}{dx} = 0$ for stationary point

$3x^2 - 2x - 1 = 0$

$(3x+1)(x-1) = 0$

$3x+1=0$ $\quad$ $x-1=0$

$3x = -1$ $\quad$ $\underline{\underline{x=1}}$

$\underline{\underline{x = -1/3}}$

$y(-\tfrac{1}{3}) = (-\tfrac{1}{3})^3 - (-\tfrac{1}{3})^2 - (-\tfrac{1}{3}) + 10$

$= 10\tfrac{5}{27}$

$\underline{(-\tfrac{1}{3}, 10\tfrac{5}{27})}$ $\underline{\underline{\text{maximum}}}$

$y(1) = (1)^3 - (1)^2 - (1) + 10$

$= 9$

$\underline{\underline{(1,9)\text{ minimum}}}$

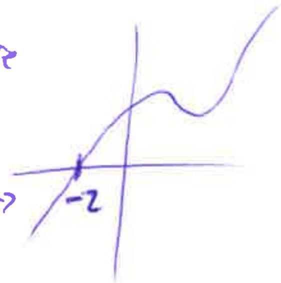
Nature

x	→	$-\tfrac{1}{3}$	→	1	→
$dy/dx = (3x+1)(x-1)$	+	0	−	0	+
slope	/	—	\	—	/

10D

~~10~~ (E)

5(c) $f(x)$ is a positive cubic and there is only one root $(x+2=0)$ at $x=-2$, stationary points occur after $x=-2$ so y coordinates must be positive



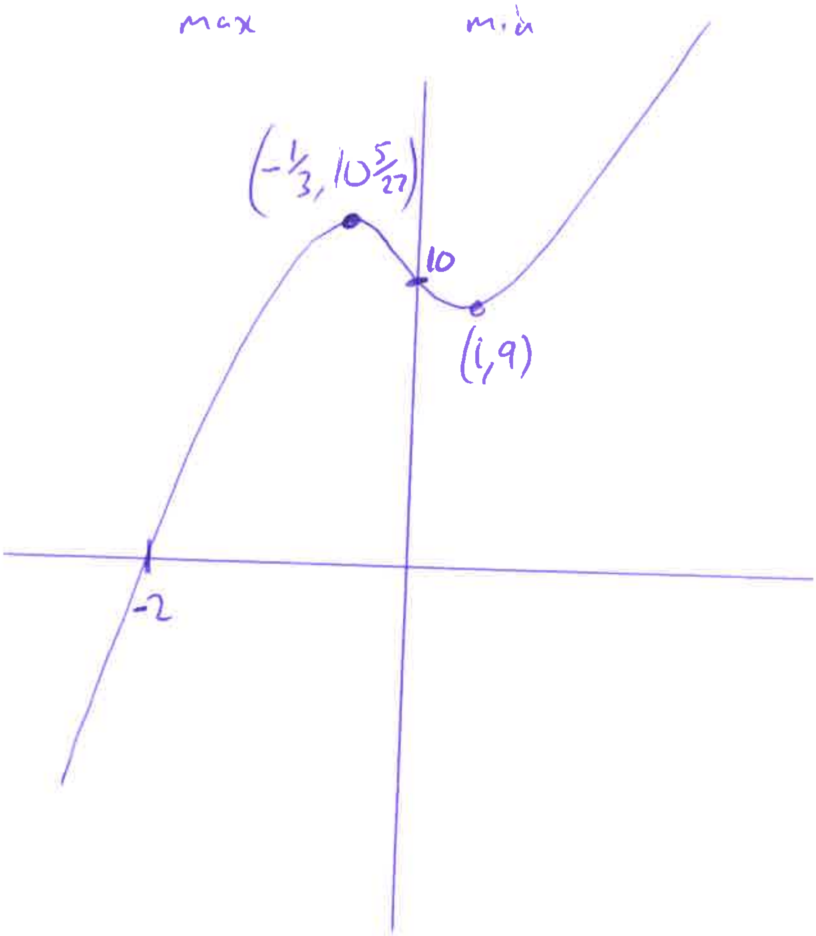
only root →
so graph does not drop below x-axis again.

5(d) x int : $x=-2$

y int $(x=0)$ $y=10$

S.P. $\left(-\frac{1}{3}, 10\frac{5}{27}\right)$ and $(1,9)$

max min



(Not to scale)

10D

7(a)

$$\begin{array}{r|rrrr} -2 & 1 & K & K+1 & 18 \\ & & -2 & -2K+4 & +2K-10 \\ \hline & 1 & K-2 & -K+5 & \boxed{8+2K=0} \end{array}$$

as $x=-2$ is a root.

$8+2K=0$

~~$8=2K$~~ ~~$K=$~~ $\hookrightarrow$ $2K=-8$

$\underline{\underline{K=-4}}$

$f(x) = (x+2)(x^2+(K-2)x+(-K+5))$

$= (x+2)(x^2-6x+9)$ (as $K=-4$)

$= \underline{\underline{(x+2)(x-3)^2}}$

(b) Repeated root at $x=3$ $\therefore$ $x=3$ is a stationary point $(m=0)$ and the x-axis will be a tangent to the curve.

(c) $f(x) = x^3-4x^2-3x+18$ (as $K=-4$)

$f'(x) = 3x^2-8x-3$

$f'(x)=0$ for stationary point

$3x^2-8x-3=0$

$(3x+1)(x-3)=0$

$3x+1=0 \qquad x-3=0$

$3x=-1 \qquad \underline{x=+3}$

$\underline{\underline{x=-\frac{1}{3}}}$

10 1)

7(c) continued

$f(-\frac{1}{3}) = (-\frac{1}{3})^3 - 4(-\frac{1}{3})^2 - 3(-\frac{1}{3}) + 18$

$= 18\frac{14}{27}$

$f(3) = (3)^3 - 4(3)^2 - 3(3) + 18$

$= 0$

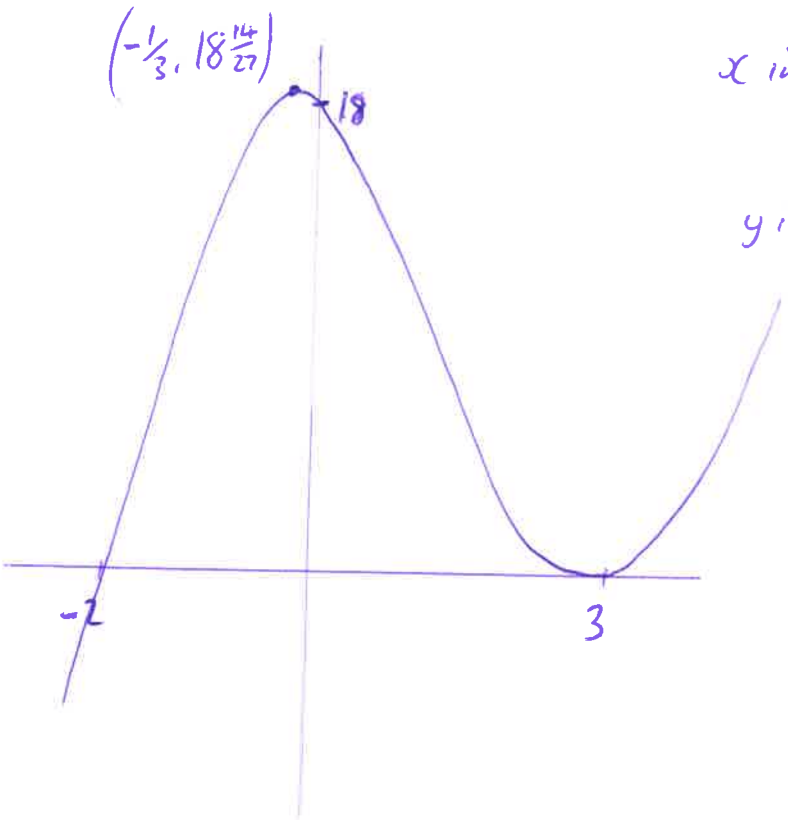
$(-\frac{1}{3}, 18\frac{14}{27})$ $(3, 0)$

Nature:

x	$\rightarrow$	$-\frac{1}{3}$	$\rightarrow$	3	$\rightarrow$
$\frac{dy}{dx} = (3x+1)(x-3)$	$+$	0	$-$	0	$+$
slope	/	—	\	—	/

$(-\frac{1}{3}, 18\frac{14}{27})$ maximum $(3, 0)$ minimum

(d)



x int: $(x+2)(x-3)^2 = 0$

$\underline{x = -2}$, $\underline{x = 3}$

y int: $y(0) = 18$