① D: $(-\infty, \infty)$

②

③ no VA ④ no HA

Function #1: $f(x) = x^4 + 6x^3 + 12x^2 + 8x + 1$

⑤ $f'(x) = 4x^3 + 18x^2 + 24x + 8$

⑥
$$\begin{array}{r|rrrr} -2 & 4 & 18 & 24 & 8 \\ & & -8 & -20 & -8 \\ \hline & 4 & 10 & 4 & \boxed{0} \end{array}$$

$\boxed{x = -2, -\frac{1}{2}}$

$4x^2 + 10x + 4$
16

2, 8

$4x^2 + 2x + 8x + 4$

$2x(2x+1) + 4(2x+1)$

$(x+2)\ (2x+1)(2x+4) = 0$

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

⑦ -3 $f'(x)=0$ -1 $f'(x)=0$ 0

- - - -2 + - + $-\frac{1}{2}$ + + +

$f'(x)<0$ saddle pt $f'(x)<0$ min $f'(x)>0$

⑧ dec $(-\infty, -2)\ (-2, -\frac{1}{2})$
inc $(-\frac{1}{2}, \infty)$

⑨ ~~saddle point x = -2~~ $(-2, 1)$

$16 - 48 + 48 - 16 + 1$

minimum $x = -\frac{1}{2}$ $(-\frac{1}{2}, -\frac{11}{16})$

⑩ $f''(x) = 12x^2 + 36x + 24$
$= 12(x^2 + 3x + 2)$
$(x+2)(x+1)$

⑪ $\boxed{x = -2 \quad x = -1}$

⑫ -3 $f''(x)=0$ $-\frac{3}{2}$ $f''(x)=0$ 0

- - -2 + - -1 + +

$f''(x)>0$ ccu sp $f''(x)<0$ ccd $f''(x)>0$ ccu

⑬ concave up $(-\infty, -2)\ (-1, \infty)$
concave down $(-2, -1)$

⑭ ~~saddle point $(-2, 1)$~~ $(-2, 1)$
point of inflection $(-1, 0)$

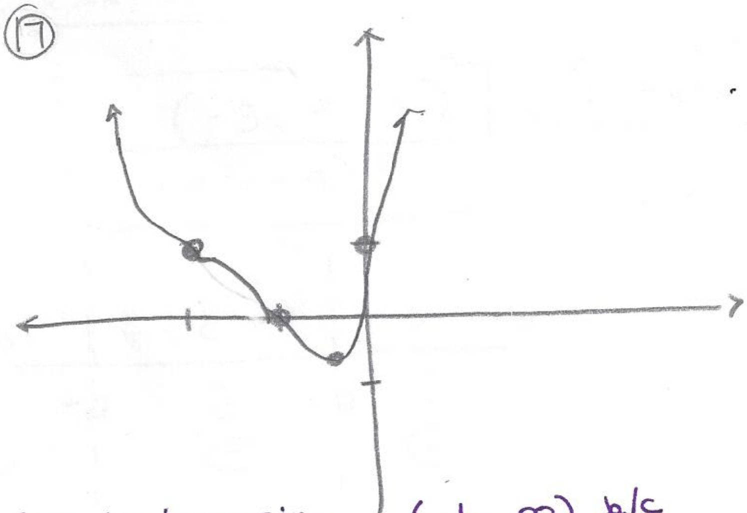
⑮ $x^4 + 6x^3 + 12x^2 + 8x + 1 = 0$

$$\begin{array}{r|rrrrr} -1 & 1 & 6 & 12 & 8 & 1 \\ & & -1 & -5 & -7 & -1 \\ \hline & 1 & 5 & 7 & 1 & \boxed{0} \end{array}$$

x-int
$x = -1$
$(-1, 0)$

⑯ y-int : $(0, 1)$

⑰



f(x) is increasing $(-\frac{1}{2}, \infty)$ b/c $f'(x) > 0$

f(x) is decreasing $(-\infty, -\frac{1}{2})$ b/c $f'(x) < 0$

f(x) has a relative minimum at $x = -\frac{1}{2}$ b/c f'(x) changes from negative to positive

f(x) is concave up $(-\infty, -2) \cup (-1, \infty)$ b/c $f''(x) > 0$

f(x) is concave down $(-2, -1)$ b/c $f''(x) < 0$

f(x) has a point of inflection at $x = -2$ and $x = -1$ b/c f''(x) changes from (+) to (−) to (+).

Function #1: $f(x) = \frac{2}{(x+2)^2} = 2(x+2)^{-2}$

(1) Domain: $x \neq -2$, $\mathbb{R}$
$(-\infty, -2) \cup (-2, \infty)$

(2) Range: $(0, \infty)$

(3) Vertical asy: $x = -2$

(4) Horiz. asy $y = 0$

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

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

$\frac{-4x-8}{(x+2)^4} = \frac{-4\cancel{(x+2)}}{(x+2)^{\cancel{4}\,3}}$

(6) Critical #'s
$x = -2$ (asy)

(7) $+$ f(x) und $-$
$-3 \quad -2 \quad -1$
$f'(x) > 0$ $\quad$ $f'(x) < 0$

(8) increasing $(-\infty, -2)$
decreasing $(-2, \infty)$

- f(x) is increasing $(-\infty, -2)$ b/c $f'(x) > 0$
- f(x) is decreasing $(-2, \infty)$ b/c $f'(x) < 0$

(9) ~~max @ x = -2~~
no relative maximum or minimum (asymptote)

(10) $f''(x) = 12(x+2)^{-4}$

$f''(x) = \frac{12}{(x+2)^4}$

$\frac{12x+24}{(x+2)^5} = \frac{12\cancel{(x+2)}}{(x+2)^{\cancel{5}\,4}}$

(11) critical #'s
$\boxed{x = -2}$ (asy)

(12) $+$ f''(x) und $+$
$-3 \quad -2 \quad -1$
$f''(x) > 0$ $\quad$ $f''(x) > 0$

(13) concave up
$(-\infty, -2) \cup (-2, \infty)$

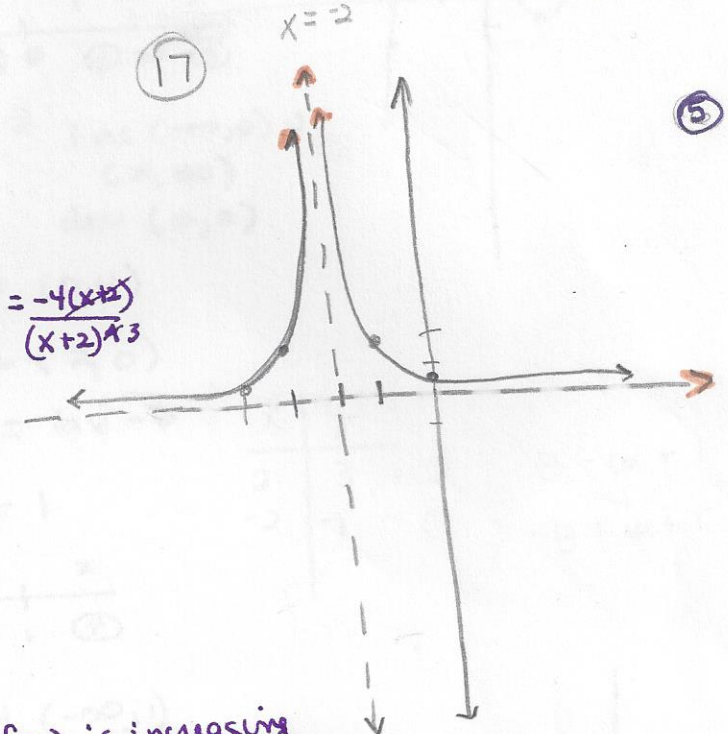
(14) no p of i

(15) x-int ~~(x, 0)~~
none

(16) y-int: $(0, \frac{1}{2})$

f(x) is concave up $(-\infty, -2) \cup (-2, \infty)$ b/c $f''(x) > 0$

(17)



x	y
-3	2
-4	$\frac{1}{2}$
-1	2

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$f(x) = \dfrac{\cos x}{1+\sin x}$

① D: $[0, \frac{3\pi}{2}) \cup (\frac{3\pi}{2}, 2\pi]$

② R: $(-\infty, \infty)$

③ VA: $1 + \sin x = 0$

$\sin x = -1$

$\boxed{x = \frac{3\pi}{2}}$

④ NO HA

⑤ $f'(x) = \dfrac{(1+\sin x)[-\sin x] - (\cos x\,[+\cos x])}{(1+\sin x)^2}$

$= \dfrac{-\sin x - \sin x^2 - \cos x^2}{(1+\sin x)^2} = \dfrac{-\sin x - 1\underbrace{(\sin^2 x + \cos^2 x)}_{1}}{(1+\sin x)^2}$

$= \dfrac{-1\cancel{(\sin x + 1)}}{(1+\sin x)^{\cancel{2}\,1}} = \boxed{\dfrac{-1}{1+\sin x}}$

⑥ $\dfrac{-1}{1+\sin x} \neq \dfrac{0}{1}$ critical # = any : $x = \frac{3\pi}{2}$

⑦ $f'(x)$

π	$\frac{3\pi}{2}$	2π
$\frac{-1}{1}$	$f'(x)$ = und	$\frac{-1}{1}$
$f'(x) < 0$		$f'(x) < 0$

⑧ $f(x)$ is decreasing $[0, \frac{3\pi}{2}) \cup (\frac{3\pi}{2}, 2\pi]$ b/c $f'(x) < 0$.

⑨ There is no relative maximum or minimum.

$f'(x) = \frac{-1}{(1+\sin x)} = -1(1+\sin x)^{-1}$

10) $f''(x) = 1 \cdot (1+\sin x)^{-2}[\cos x] = \frac{\cos x}{(1+\sin x)^2}$

11) $\frac{\cos x}{(1+\sin x)^2} = \frac{0}{1}$ $\quad \cos x = 0$

$x = \frac{\pi}{2}, \frac{3\pi}{2}$ (asy)

12) $f''(x)$

$f''(x)=0$ at $\frac{\pi}{2}$ $\quad$ $f''(x)$ und at $\frac{3\pi}{2}$

$0 \quad \frac{\pi}{2} \quad \pi \quad \frac{3\pi}{2} \quad 2\pi$

$\frac{1}{1} \qquad \frac{-1}{1} \qquad \frac{1}{1}$

$f''(x) > 0 \qquad f''(x) < 0 \qquad f''(x) > 0$

13) $f(x)$ is concave up $[0, \frac{\pi}{2}) \cup (\frac{3\pi}{2}, 2\pi)$ b/c $f''(x) > 0$.
$f(x)$ is concave dow $(\frac{\pi}{2}, \frac{3\pi}{2})$ b/c $f''(x) < 0$.

14) There is a point of inflection at $x = \frac{\pi}{2}$ because $f''(x)$ changes from positive to negative at $x = \frac{\pi}{2}$.

15) $\frac{0}{1} = \frac{\cos x}{1+\sin x}$

$\cos x = 0$

$x = \frac{\pi}{2}, \frac{3\pi}{2}$ (asy)

$(\frac{\pi}{2}, 0)$

x-int.

16) $\frac{\cos 0}{1+\sin 0} = y$

$\frac{1}{1+0} = 1 \quad y = 1$

$(0, 1)$ y int

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

① D: $(-\infty, 2) \cup (2, \infty)$

② R: $(-\infty, -2] \cup [6, \infty)$

③ VA: $x = 2$ ④ HA: none

④ SA:

$$\begin{array}{r|rrr} 2 & 1 & -2 & 4 \\ & & 2 & 0 \\ \hline & 1 & 0 & \boxed{4} \end{array}$$

$\boxed{y = x}$

⑤ $f'(x) = \dfrac{(x-2)[2x-2] - (x^2-2x+4\,[1])}{(x-2)^2}$

$= \dfrac{2x^2 - 6x + 4 - x^2 + 2x - 4}{(x-2)^2} = \dfrac{x^2 - 4x}{(x-2)^2}$

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

⑥ $\dfrac{x(x-4)}{(x-2)^2} = \dfrac{0}{1}$

$x(x-4) = 0$

$x = 0$ $x = 4$ and asy: $x = 2$

⑦ $f'(x)$

-1	0	1	2	3	4	5
	$f'(x) = 0$		$f'(x)$ und		$f'(x) = 0$	
$\frac{- -}{+}$		$\frac{+ -}{+}$		$\frac{+ -}{+}$		$\frac{+ +}{+}$
$f'(x) > 0$		$f'(x) < 0$		$f'(x) < 0$		$f'(x) > 0$

⑧ $f(x)$ is increasing $(-\infty, 0) \cup (4, \infty)$ b/c $f'(x) > 0$.
$f(x)$ is decreasing $(0, 2) \cup (2, 4)$ b/c $f'(x) < 0$.

⑨ $f(x)$ has a relative maximum at $x = 0$ b/c $f'(x)$ changes from positive to negative.

(9) $f(x)$ has a relative minimum at $x=4$
b/c $f'(x)$ changes from negative to positive.

(10) $$f''(x) = \frac{(x-2)^2\left[x[1] + (x-4)[1]\right] - \left((x^2-4x)\left[2(x-2)[1]\right]\right)}{(x-2)^4}$$

$$= \frac{\cancel{(x-2)}\left((x-2)(2x-4) - 2x^2 + 8x\right)}{(x-2)^{\cancel{4}\,3}}$$

$$= \frac{2x^2-8x+8-2x^2+8x}{(x-2)^3} = \boxed{\frac{8}{(x-2)^3}}$$

(11) $\dfrac{8}{(x-2)^3} \neq \dfrac{0}{1}$ asy: $\boxed{x=2}$

(12) $f''(x)$

1	2	3
$\frac{+}{-}$		$\frac{+}{+}$
$f''(x) < 0$		$f''(x) > 0$

(13) $f(x)$ is concave down $(-\infty, 2)$ b/c $f''(x)<0$.
$f(x)$ is concave up $(2, \infty)$ b/c $f''(x) > 0$.

(14) $f(x)$ does not have a point of inflection

15) $\frac{0}{1} = \frac{x^2 - 2x + 4}{x - 2}$

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

$x = \frac{2 \pm \sqrt{4 - 4(1)(4)}}{2}$

imaginary roots

no x-intercept

16) $y = \frac{0^2 - 2(0) + 4}{0 - 2} = \frac{4}{-2} = -2$

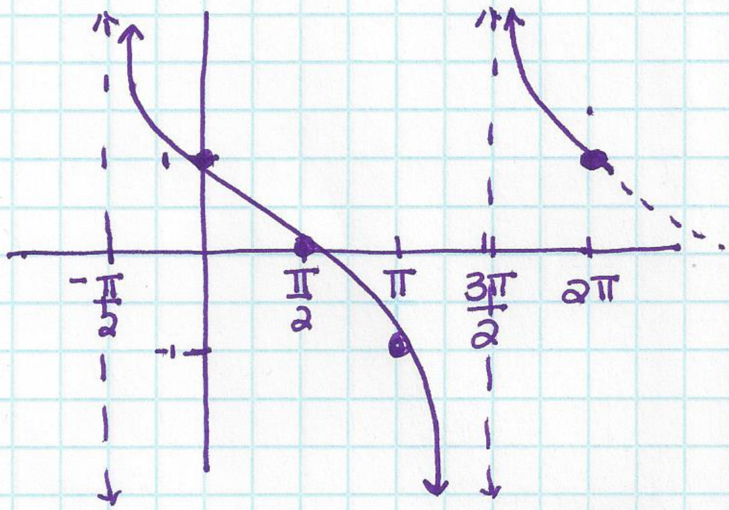
$\boxed{(0, -2)}$

17) $f(0) = -2$

$f(4) = \frac{16 - 8 + 4}{2} = \frac{12}{2} = 6$

x	y
-1	$-2\frac{1}{3}$
1	-3
3	7
5	$6\frac{1}{3}$

④



$$f(x) = \frac{\cos x}{1+\sin x}$$

③