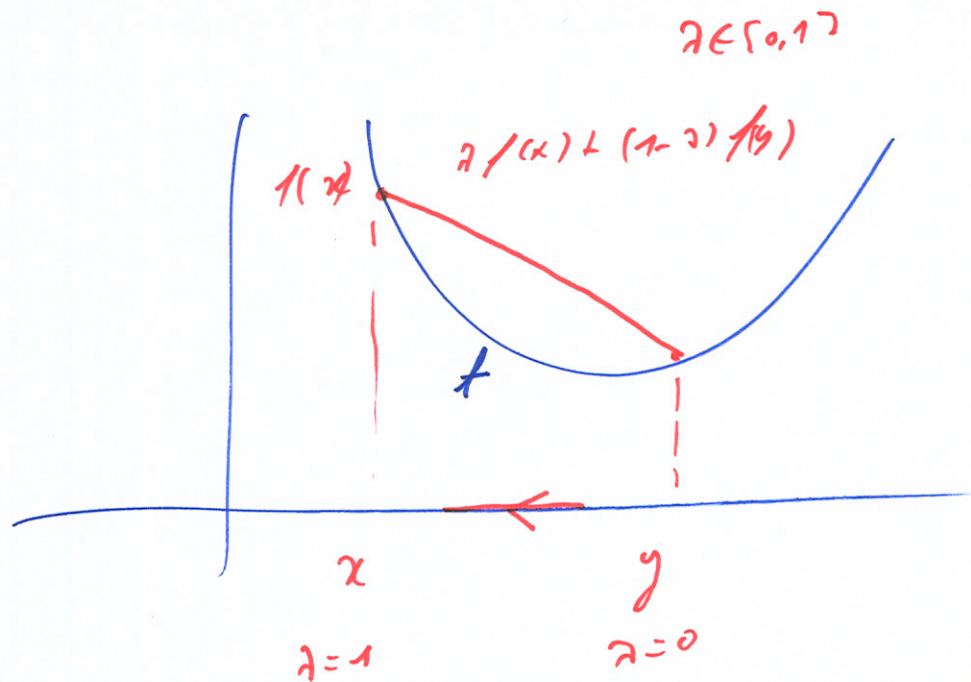
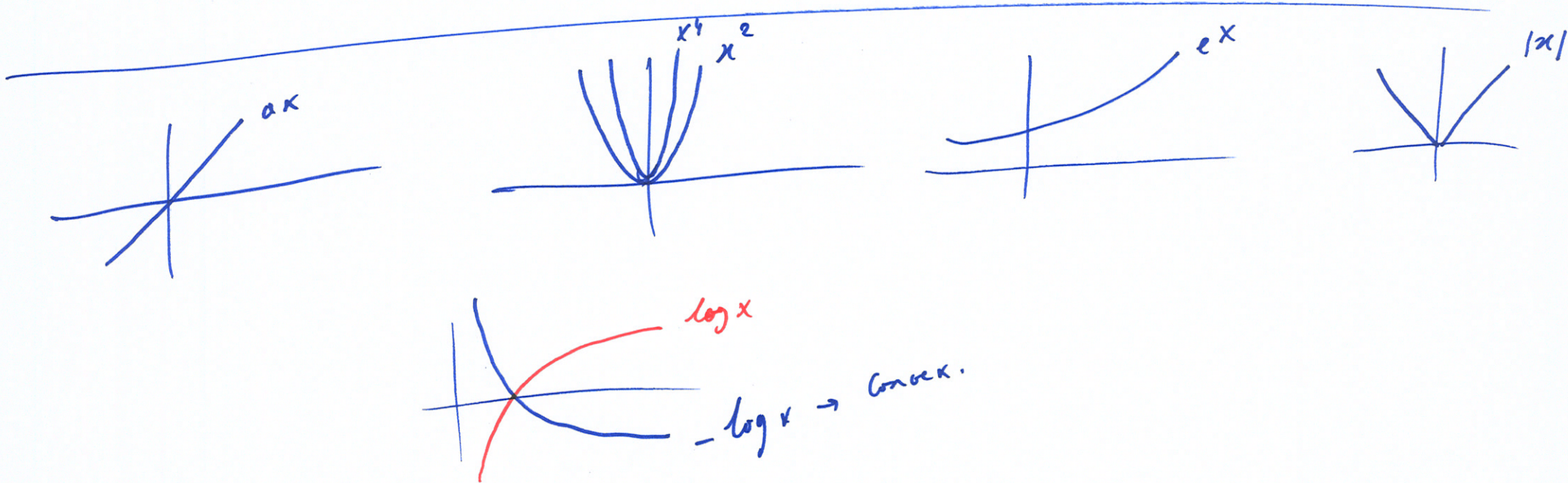


②



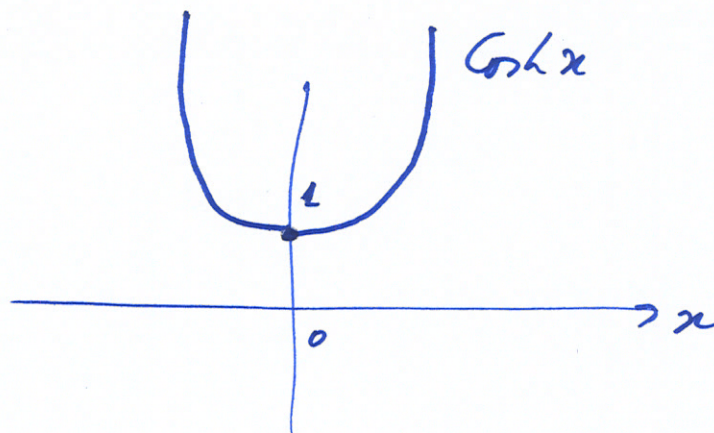
$(1-\lambda)f(x) + \lambda f(y)$

$\lambda \in [0, 1]$

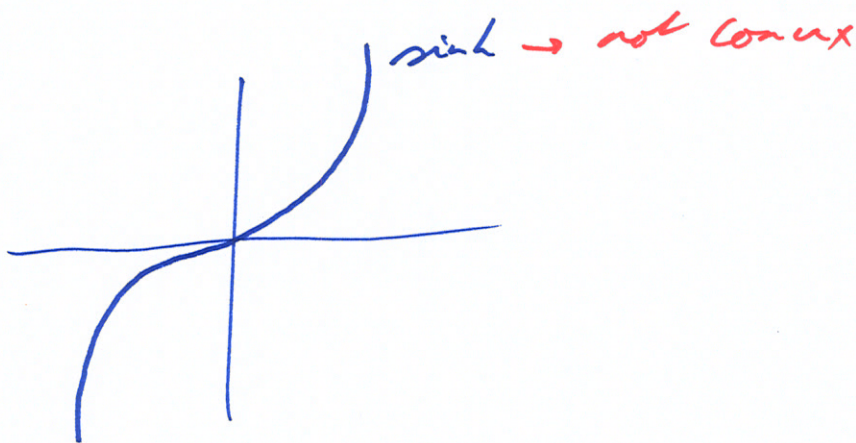


⑧

$$\cosh x = \frac{e^x + e^{-x}}{2}$$



$$\sinh x = \frac{e^x - e^{-x}}{2}$$



$$f'' > 0 \rightarrow f \text{ convex.}$$

$$H_f > 0 \rightarrow f \text{ convex}$$

e^x is convex

$$\downarrow$$
$$2x + 3y + 4z - 9$$

is convex

$$x^2 \text{ is convex} \rightarrow (x + y - 3z + 5)^2 \text{ is convex}$$

9

$$\| \lambda x + (1-\lambda)y \| \stackrel{?}{\leq} \lambda \|x\| + (1-\lambda) \|y\|$$

$$f(x) = \|x\|$$

$$\leq \| \lambda x \| + \| (1-\lambda)y \|$$

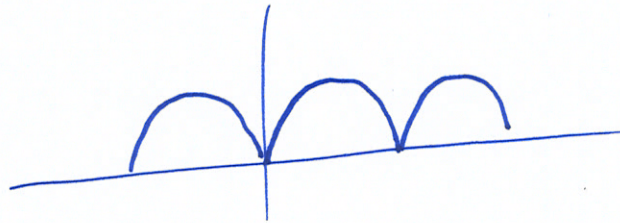
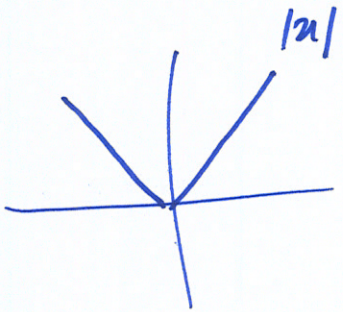
$$\leq |\lambda| \|x\| + |1-\lambda| \|y\|$$

$$\leq \lambda \|x\| + (1-\lambda) \|y\|$$

$$\lambda \in [0, 1]$$

$\rightarrow \|x\|$ is convex in x

$|\sin x| \rightarrow$ not convex



10

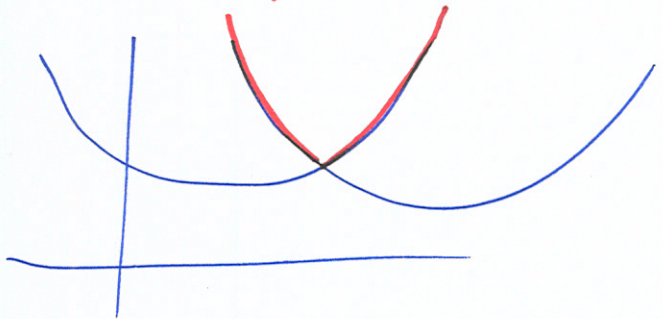
x^2 is convex
 e^x is convex



$6e^x + 7x^2$ is convex
↑ ↑

→ $\text{max}(e^x, x^2)$ is convex.

max(x², e^x) is convex



$h = e^x$

$g = x^2 + 3x + 5$

$x^2 + 3x + 5$
 e
↓
Convex

h, g convex
 $h \uparrow$



(11)

$$\min_x f(x)$$

$$g(x) \leq 0$$

$$h(x) = 0$$

f, g convex.

? condition on h ?