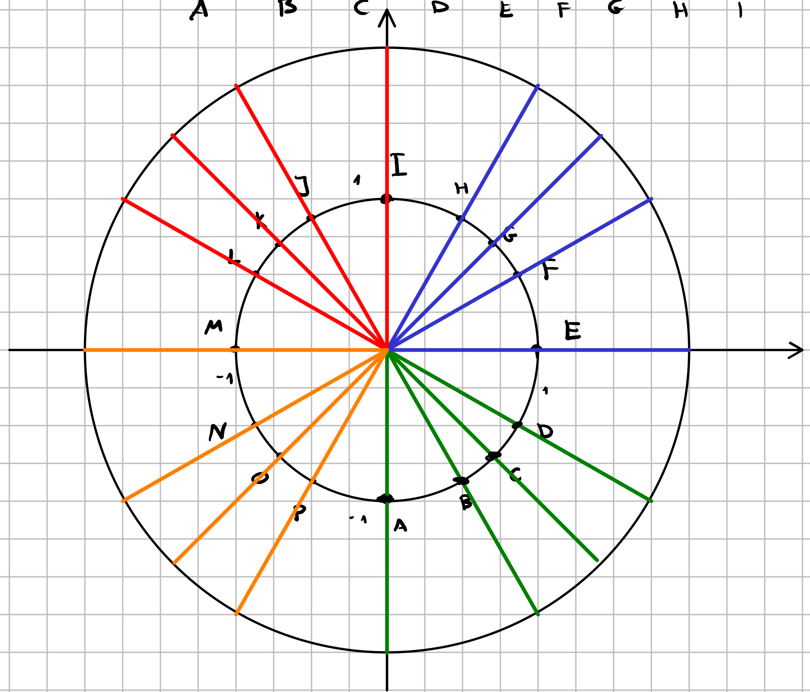
1.

α	$-\frac{\pi}{2}$	$-\frac{\pi}{3}$	$-\frac{\pi}{4}$	$-\frac{\pi}{6}$	0	$\frac{\pi}{6}$	$\frac{\pi}{4}$	$\frac{\pi}{3}$	$\frac{\pi}{2}$
$\cos\alpha$	$\frac{\sqrt{0}}{2}$	$\frac{\sqrt{1}}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{4}}{2}$	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{1}}{2}$	$\frac{\sqrt{0}}{2}$
$\sin\alpha$	$-\frac{\sqrt{4}}{2}$	$-\frac{\sqrt{3}}{2}$	$-\frac{\sqrt{2}}{2}$	$-\frac{\sqrt{1}}{2}$	$\frac{\sqrt{0}}{2}$	$\frac{\sqrt{1}}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{4}}{2}$
	A	B	C	D	E	F	G	H	I



	przecięcie z okr. $r=\sqrt{2}$	przecięcie z okr $r = 2$
A	$(0, -\sqrt{2})$	$(0, -2)$
B	$(\frac{\sqrt{2}}{2}, -\frac{\sqrt{6}}{2})$	$(1, -\sqrt{3})$
C	$(1, -1)$	$(\sqrt{2}, -\sqrt{2})$
D	$(\frac{\sqrt{6}}{2}, -\frac{\sqrt{2}}{2})$	$(\sqrt{3}, -1)$
E	$(\sqrt{2}, 0)$	$(2, 0)$
F	$(\frac{\sqrt{6}}{2}, \frac{\sqrt{2}}{2})$	$(\sqrt{3}, 1)$
G	$(1, 1)$	$(\sqrt{2}, \sqrt{2})$
H	$(\frac{\sqrt{2}}{2}, \frac{\sqrt{6}}{2})$	$(1, \sqrt{3})$
I	$(0, \sqrt{2})$	$(0, 2)$

	J	K	L	M	N	O	P
α	$\frac{2\pi}{3}$	$\frac{3\pi}{4}$	$\frac{5\pi}{6}$	π	$-\frac{5\pi}{6}$	$-\frac{3\pi}{4}$	$-\frac{2\pi}{3}$
$\cos(\alpha)$	$-\frac{1}{2}$	$-\frac{\sqrt{2}}{2}$	$-\frac{\sqrt{3}}{2}$	-1	$-\frac{\sqrt{3}}{2}$	$-\frac{\sqrt{2}}{2}$	$-\frac{1}{2}$
$\sin(\alpha)$	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{1}{2}$	0	$-\frac{1}{2}$	$-\frac{\sqrt{2}}{2}$	$-\frac{\sqrt{3}}{2}$

2. $\alpha \in (-\pi, \pi]$

a) $\cos(\alpha) = -\frac{\sqrt{3}}{2}$ $\quad \sin(\alpha) = \frac{1}{2}$ $\quad \alpha = \frac{5\pi}{6}$

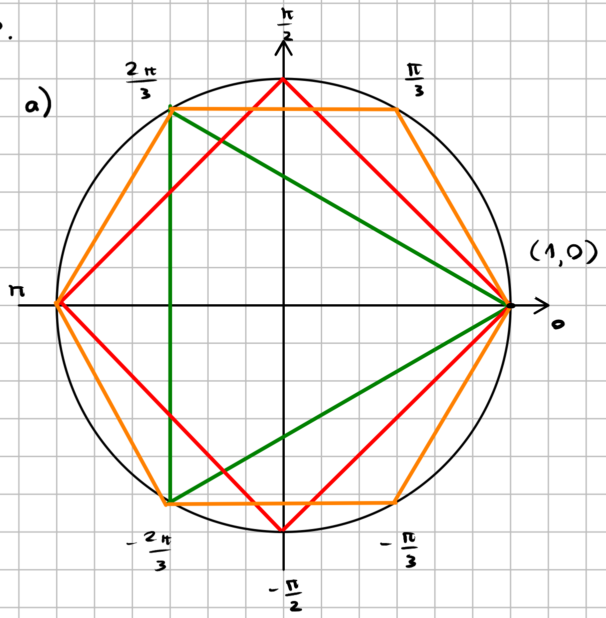
b) $\cos(\alpha) = -\frac{\sqrt{2}}{2}$ $\quad \sin(\alpha) = -\frac{\sqrt{2}}{2}$ $\quad \alpha = -\frac{3\pi}{4}$

c) $2\cos(\alpha) = 1$ $\quad 2\sin(\alpha) = -\sqrt{3}$ $\quad \alpha = -\frac{\pi}{3}$

d) $\sqrt{2}\cos(\alpha) = -1$ $\quad \sqrt{2}\sin(\alpha) = 1$ $\quad \alpha = \frac{3\pi}{4}$

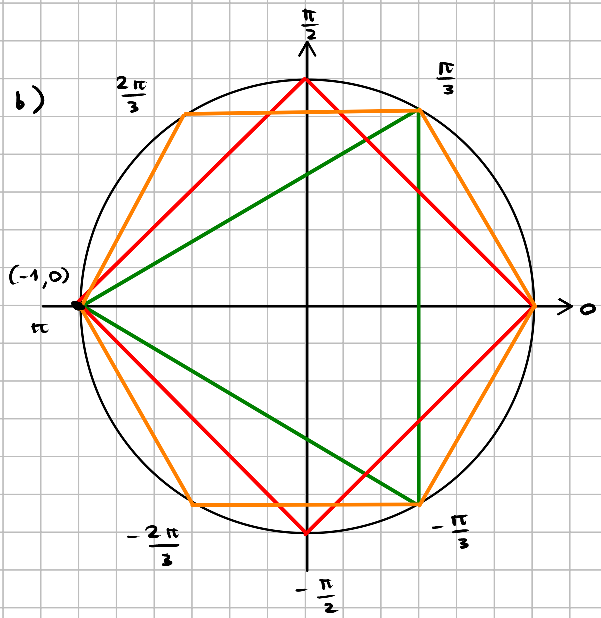
3.

a)



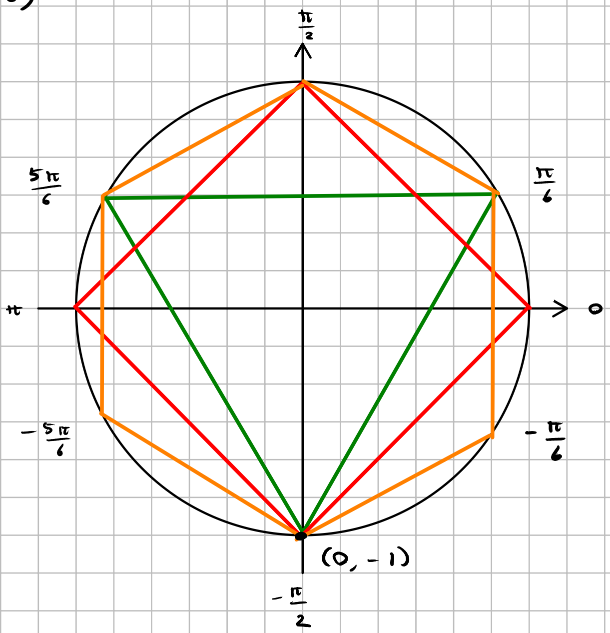
$\frac{\pi}{2}$
$\frac{2\pi}{3}$
$\frac{\pi}{3}$
$(1,0)$
π
0
$-\frac{2\pi}{3}$
$-\frac{\pi}{3}$
$-\frac{\pi}{2}$

b)



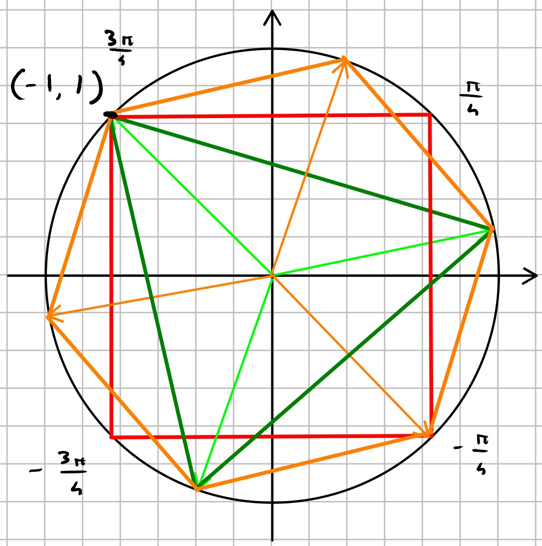
$\frac{\pi}{2}$
$\frac{2\pi}{3}$
$\frac{\pi}{3}$
$(-1,0)$
π
0
$-\frac{2\pi}{3}$
$-\frac{\pi}{3}$
$-\frac{\pi}{2}$

c)



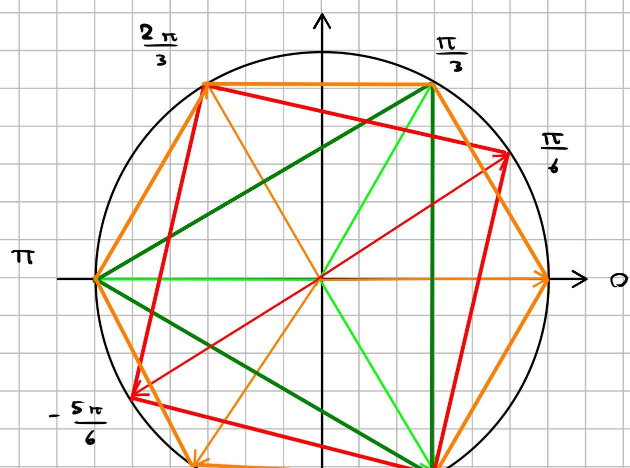
$\frac{\pi}{2}$
$\frac{5\pi}{6}$
$\frac{\pi}{6}$
π
0
$-\frac{5\pi}{6}$
$-\frac{\pi}{6}$
$(0,-1)$
$-\frac{\pi}{2}$

d)



$\frac{3\pi}{4}$
$(-1,1)$
$\frac{\pi}{4}$
$-\frac{3\pi}{4}$
$-\frac{\pi}{4}$

e)



$\frac{2\pi}{3}$
$\frac{\pi}{3}$
$\frac{\pi}{6}$
π
0
$-\frac{5\pi}{6}$
$-\frac{2\pi}{3}$
$(1,-\sqrt{3})$
$-\frac{\pi}{3}$

4.

a) $x \circ y := x - y$ w $\mathbb{Z}$

$a - (b - c) \neq (a - b) - c$ nie jest łączne

$a - b \neq b - a$ nie jest przemienne

nie istnieje element neutralny

b) $x * y := x + y + xy$ w $\mathbb{R}$

$a + b + ab = b + a + ba$

$a * (b * c) = a + (b * c) + a(b * c) = a + b + c + bc + a(b + c + bc)$
$= a + b + c + bc + ab + ac + abc$

$(a * b) * c = (a * b) + c + (a * b) c = a + b + ab + c + ac + bc + abc$

$a * 0 = a + 0 + 0 = a$

jest łączne

jest przemienne

$e = 0$

c) $x \sqcap y := \max\{x, y\}$ w $\mathbb{N} = \{1, 2, 3, \ldots\}$

$a \sqcap b = \max\{a, b\} = \max\{b, a\} = b \sqcap a$ jest przemienne

$a \sqcap (b \sqcap c) = (a \sqcap b) \sqcap c = \max\{a, b, c\}$ jest łączne

$a \sqcap 1 = a = 1 \sqcap a$ $e = 1$

d) $(x_1, y_1) \oplus (x_2, y_2) := (x_1 + x_2, y_1 + y_2)$ w $\mathbb{R} \times \mathbb{R}$

$(a, b) \oplus (c, d) = (a + c, b + d) = (c + a, d + b) = (c, d) \oplus (a, b)$

$(a, b) \oplus [(c, d) \oplus (e, f)] = (a, b) \oplus (c + e, d + f) = (a + c + e, b + d + f)$

$[(a, b) \oplus (c, d)] \oplus (e, f) = (a + c, b + d) \oplus (e, f) = (a + c + e, b + d + f)$

$(a, b) \oplus (0, 0) = (a + 0, b + 0) = (a, b)$

jest łączne

jest przemienne

$e = (0, 0)$

e) $(x_1, y_1) \odot (x_2, y_2) := (x_1 x_2 - y_1 y_2, x_1 y_2 + x_2 y_1)$

$(a, b) \odot (c, d) = (ac - bd, ad + bc)$
$(c, d) \odot (a, b) = (ac - bd, bc + ad)$

$(a, b) \odot [(c, d) \odot (e, f)] = (a, b) \odot (ce - df, cf + de)$
$= (ace - adf - bcf - bde, acf + ade + bce - bdf)$

$[(a, b) \odot (c, d)] \odot (e, f) = (ac - bd, ad + bc) \odot (e, f)$
$= (ace - bde - adf - bcf, acf - bdf + ade + bce)$

jest łączne

jest przemienne

$e = (1, 0)$

$(1, 0) \odot (a, b) = (a, b)$

5.

a) $(c,0) \oplus (x,0) = (c+x, 0)$

b) $(c,0) \odot (x,0) = (cx, 0)$

c) $(c,0) \odot (x,y) = (cx, cy)$

d) $(-1,0) \odot (x,y) = (-x, -y)$

e) $(0,1) \odot (x,y) = (-y, x)$

f) $(0,1) \odot (0,1) = (-1, 0)$