

# ćwiczenia 1

October 29, 2021

1. (a)  $7 + 4i + 3(5 - 9i) = 7 + 4i + 15 - 27i = 22 - 23i$   
 (b)  $Im(3 + 2i)(4 - 2i) - Re(5 + 3i)(1 - 4i) = 2(4 + 2i) - 5(1 - 4i) = 8 - 4i - 5 - 20 = 3 + 16i$   
 (c)  $(3 - 2i)(3 + 4i) = 9 + 12i - 6i - 8i^2 = 17 + 6i$   
 (d)  $(4 - 5i)(4 + 5i) = 4^2 - (5i)^2 = 16 + 25 = 41$   
 (e)  $\frac{-11+7i}{2+6i} = \frac{(-11+7i)(2-6i)}{(2+6i)(2-6i)} = \frac{-22+66i+14i-42i^2}{4+36} = \frac{20+80i}{40} = \frac{1}{2} + 2i$   
 (f)  $\frac{-1+2i}{5-3i} = \frac{(-1+2i)(5+3i)}{(5-3i)(5+3i)} = \frac{-5-3i+10i+6i^2}{25+9} = \frac{-11+7i}{34} = -\frac{11}{34} + \frac{7i}{34}$   
 (g)  $\frac{3+i}{2-5i} = \frac{(3+i)(2+5i)}{(2-5i)(2+5i)} = \frac{6+15i+2i+5i^2}{4+25} = \frac{1+17i}{29} = \frac{1}{29} + \frac{17i}{29}$   
 (h)  $\frac{5+3i}{8-2i} = \frac{(5+3i)(8+2i)}{(8-2i)(8+2i)} = \frac{40+10i+24i+6i^2}{64+4} = \frac{34+34i}{68} = \frac{1}{2} + \frac{1}{2}i$   
 (i)  $\frac{3+2i}{-1+3i} = \frac{(3+2i)(-1-3i)}{(-1+3i)(-1-3i)} = \frac{-3-9i-2i-6i^2}{1+9} = \frac{3-11i}{10} = \frac{3}{10} - \frac{11i}{10}$

2. (a)

$$\begin{array}{lll}
 2z + (3 - i)\bar{z} = 5 + 4i & 5a - b = 5 & 5a - (-4 - a) = 5 \\
 2(a + bi) + (3 - i)(a - bi) = 5 + 4i & -b - a = 4 & 5a + 4 + a = 5 \\
 2a + 2bi + 3a - 3bi - ai + bi^2 = 5 + 4i & a + b = -4 & 6a = 1 \\
 5a - bi - ai - b = 5 + 4i & b = -4 - a & b = -\frac{25}{6} \\
 5a - b + i(-b - a) = 5 + 4i & & a = \frac{1}{6} \\
 \\ 
 z = \frac{1}{6} - \frac{25}{6}i & & 
 \end{array}$$

- (b)

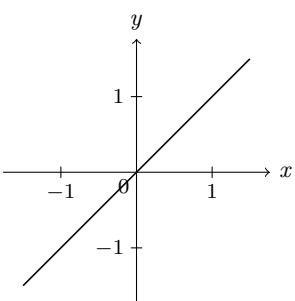
$$\begin{array}{lll}
 2z + (1 + i)\bar{z} = 1 - 3i & 3a + b = 1 & 3a - 3 - a = 1 \\
 2(a + bi) + (1 + i)(a - bi) = 1 - 3i & a + b = -3 & 2a = 4 \\
 2a + 2bi + a - bi + ai - bi^2 = 1 - 3i & b = -3 - a & a = 2 \\
 3a + b + bi + ai = 1 - 3i & & b = -5 \\
 3a + b + (a + b)i = 1 - 3i & & \\
 \\ 
 z = 2 - 5i & & 
 \end{array}$$

- (c)

$$\begin{array}{lll}
 \bar{z} + i = 8 + 3\operatorname{Im}z & a - 3b = 8 & a + 3 = 8 \\
 (a - bi) + i = 8 + 3b & -b - 1 = 0 & a = 5 \\
 a - 3b - (b + 1)i = 8 + 0i & b = -1 & \\
 \\ 
 z = 5 - i & & 
 \end{array}$$

3. tego gówna jeszcze nie rozumiem

(a)  $\frac{9}{z} = \bar{z}$



4. (a)

$$\begin{aligned} z &= 6 & \cos \varphi &= \frac{6}{6} = 1 & \varphi &= 0 \\ |z| &= \sqrt{6^2} = 6 & \sin \varphi &= 0 & & \end{aligned}$$

$$z = 6(\cos 0 + i \sin 0)$$

$$z = 6e^0$$

(b)

$$\begin{aligned} z &= 7 + 7i & \cos \varphi &= \frac{7}{7\sqrt{2}} = \frac{7\sqrt{2}}{7 \times 2} = \frac{\sqrt{2}}{2} & \varphi &= \frac{\pi}{4} \\ |z| &= \sqrt{7^2 + 7^2} = \sqrt{98} = 7\sqrt{2} & \sin \varphi &= \frac{7}{7\sqrt{2}} = \frac{\sqrt{2}}{2} & & \\ z &= 7\sqrt{2} \left( \cos \frac{\pi}{4} + i \sin \frac{\pi}{4} \right) & & & & \\ z &= 7\sqrt{2} e^{\frac{\pi}{4}} & & & & \end{aligned}$$

(c)

$$\begin{aligned} z &= -1 + i\sqrt{3} & \cos \varphi &= \frac{-1}{2} = -\frac{1}{2} & \varphi &= \frac{2\pi}{3} \\ |z| &= \sqrt{1 + (\sqrt{3})^2} = \sqrt{4} = 2 & \sin \varphi &= \frac{\sqrt{3}}{2} & & \\ z &= 2 \left( \cos \frac{2\pi}{3} + i \sin \frac{2\pi}{3} \right) & & & & \\ z &= 2e^{\frac{2\pi}{3}} & & & & \end{aligned}$$

(d)

$$\begin{aligned} z &= 5\sqrt{3} - 5i & \cos \varphi &= \frac{5\sqrt{3}}{10} = \frac{\sqrt{3}}{2} & \varphi &= \frac{11\pi}{6} \\ |z| &= \sqrt{(5\sqrt{3})^2 + (-5)^2} = \sqrt{25 \cdot 3 + 25} & \sin \varphi &= \frac{-5}{10} = -\frac{1}{2} & & \\ &= \sqrt{100} = 10 & & & & \\ z &= 10 \left( \cos \frac{11\pi}{6} + i \sin \frac{11\pi}{6} \right) & & & & \\ z &= 10e^{\frac{11\pi}{6}} & & & & \end{aligned}$$