第 7 章　複素数の基本

演習問題 7.1

1.　①　$\dot{z}=10-j8$

　②　$z=\sqrt{10^2+8^2}\fallingdotseq 12.8$

$$\theta=\tan^{-1}\frac{-8}{10}=-38.7^\circ$$

　よって，$\dot{z}=12.8\{\cos(-38.7^\circ)+j\sin(-38.7^\circ)\}=12.8(\cos 38.7^\circ-j\sin 38.7^\circ)$

　③　$\dot{z}=12.8\varepsilon^{-j38.7^\circ}$

　④　$\dot{z}=12.8\angle-38.7^\circ$

2.　①　$z=\sqrt{6^2+15^2}\fallingdotseq 16.2$

$$\theta=\tan^{-1}\frac{15}{6}\fallingdotseq 1.19\ \mathrm{rad}$$

　よって $\dot{z}=16.2(\cos 1.19+j\sin 1.19)$

　②　$z=\sqrt{2^2+3^2}\fallingdotseq 3.6$

$$\theta=\tan^{-1}\frac{3}{2}\fallingdotseq 0.98\ \mathrm{rad}$$

　ただし，$\dot{z}$ は第 3 象限にあるため，$0.98+3.14=4.12\ \mathrm{rad}$

　よって，$\dot{z}=3.6(\cos 4.12-j\sin 4.12)$

3.　①　$z=\sqrt{12^2+9^2}=15$

$$\theta=\tan^{-1}\frac{9}{-12}\fallingdotseq -0.64\ \mathrm{rad}$$

　ただし，$\dot{z}$ は第 2 象限にあるため，$-0.64+3.14=2.5\ \mathrm{rad}$

　よって，$\dot{z}=15\angle 2.5\ \mathrm{rad}$

　②　$z=\sqrt{5^2+20^2}\fallingdotseq 20.62$

$$\theta=\tan^{-1}\frac{-20}{5}\fallingdotseq -1.33\ \mathrm{rad}$$

　よって，$\dot{z}=20.62\angle-1.33\ \mathrm{rad}$

演習問題 7.2

1.　$\dot{z}_1+\dot{z}_2=(-6+j7)+(5-j2)=-1+j5$

　$\dot{z}_1-\dot{z}_2=(-6+j7)-(5-j2)=-11+j9$

2.　$\dot{z}_1\times\dot{z}_2=(4-j)(2+j7)=8+j28-j2-j^2 7=15+j26$

3.　$\dot{z}_1\times\dot{z}_2=(4\varepsilon^{j\frac{\pi}{3}})\times(0.5\varepsilon^{j\frac{\pi}{4}})=4\times 0.5\varepsilon^{j(\frac{\pi}{3}+\frac{\pi}{4})}=2\varepsilon^{j\frac{7\pi}{12}}$

　$\dot{z}_1\div\dot{z}_2=(4\varepsilon^{j\frac{\pi}{3}})\div(0.5\varepsilon^{j\frac{\pi}{4}})=\dfrac{4}{0.5}\varepsilon^{j(\frac{\pi}{3}-\frac{\pi}{4})}=8\varepsilon^{j\frac{\pi}{12}}$

4.　①　$\dot{z}'=-2+j3$　　　②　$\dot{z}'=10\varepsilon^{-j\frac{\pi}{3}}$

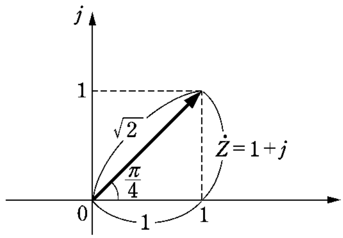
章末問題 7

1．与えられた複素数を複素平面にベクトル表示して考えるとよい．

① $\sqrt{2}\left(\cos\dfrac{\pi}{4}+j\sin\dfrac{\pi}{4}\right)$

② $\sqrt{2}\,\varepsilon^{j\frac{\pi}{4}}$

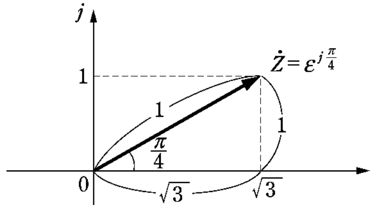
③ $\sqrt{2}\angle\dfrac{\pi}{4}$



④ $\sqrt{3}+j$

⑤ $2\left(\cos\dfrac{\pi}{6}+j\sin\dfrac{\pi}{6}\right)$

⑥ $2\angle\dfrac{\pi}{6}$



2．① $z=\sqrt{7^2+5^2}\fallingdotseq 8.6$，$\theta=\tan^{-1}\dfrac{5}{-7}\fallingdotseq -35.54°$

② $z=\sqrt{11^2+18^2}\fallingdotseq 21.1$，$\theta=\tan^{-1}\dfrac{-18}{11}\fallingdotseq -58.57°$

③ $z=14$，$\theta=-30°$

④ $z=23$，$\theta=90°$

⑤ $z=20$，$\theta=30°$

3．$\vec{A}$：②，$\vec{B}$：③，$\vec{C}$：①，$\vec{D}$：④

4．① $\dot{z}_1+\dot{z}_2=(-7+j5)+(11-j18)=4-j13$

② $\dot{z}_1-\dot{z}_2=(-7+j5)-(11-j18)=-18+j23$

③ $\dot{z}_1\times\dot{z}_2=(-7+j5)\times(11-j18)=-77+j126+j55-j^2 90=13+j181$

④ $\dot{z}_1\div\dot{z}_2=\dfrac{-7+j5}{11-j18}=\dfrac{(-7+j5)(11+j18)}{(11-j18)(11+j18)}=\dfrac{-77-j126+j55+j^2 90}{11^2+18^2}$

$$=\frac{1}{445}(-167-j71)\fallingdotseq -0.38-j0.16$$

5．① $\dot{z}_1\times\dot{z}_2=6\varepsilon^{j20°}\times 4\varepsilon^{-j30°}=(6\times 4)\varepsilon^{j\{20°+(-30°)\}}=24\varepsilon^{-j10°}$

② $\dot{z}_1\div\dot{z}_2=6\varepsilon^{j20°}\div 4\varepsilon^{-j30°}=\dfrac{6}{4}\varepsilon^{j\{20°-(-30°)\}}=1.5\varepsilon^{j50°}$

6．①
$$\frac{(2-j)(4+j2)}{j(10+j5)}=\frac{8+j4-j4-j^2 2}{j10+j^2 5}=\frac{10}{-5+j10}=\frac{2}{-1+j2}$$
$$=\frac{2(-1-j2)}{(-1+j2)(-1-j2)}=\frac{-2-j4}{(-1)^2+2^2}=-0.4-j0.8$$

②
$$\frac{6+j5}{-5j}\div\frac{7-j}{-6j}=\frac{6+j5}{-5j}\times\frac{-6j}{7-j}=\frac{6}{5}\times\frac{6+j5}{7-j}$$
$$=\frac{6}{5}\times\frac{(6+j5)(7+j)}{(7-j)(7+j)}=\frac{6}{5}\times\frac{42+j6+j35+j^2 5}{7^2+1^2}$$
$$=\frac{6}{5}\times\frac{37+j41}{50}=0.888+j0.984$$