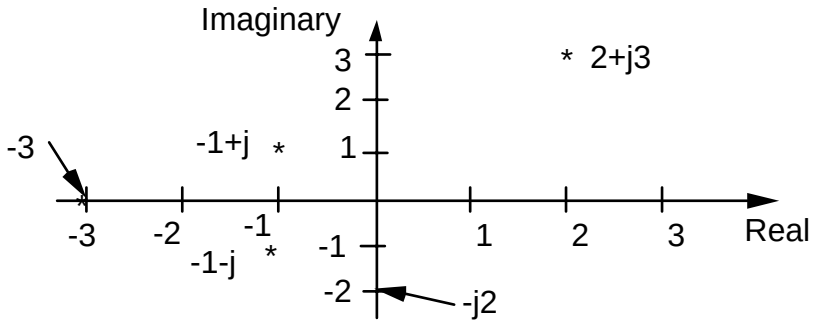
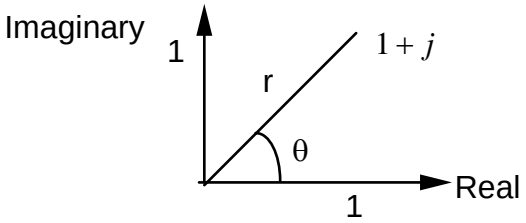
Complete solutions to Exercise 10(b)

1.



2.(a) Remember , sketch these on an Argand diagram first.

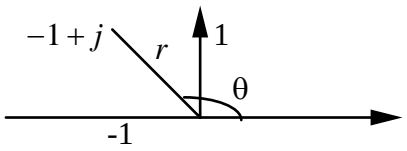


By (10.15) $r = \sqrt{1^2 + 1^2} = \sqrt{2}$

By (10.16) $\theta = \tan^{-1}(1/1) = 45°$

Hence $1 + j = \sqrt{2} \angle 45°$

(b) The complex number $-1 + j$ on an Argand diagram is



By (10.15) $r = \sqrt{(-1)^2 + 1^2} = \sqrt{2}$

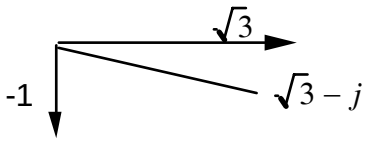
By (10.16) $\text{angle} = \tan^{-1}\left(\frac{1}{-1}\right) = -45°$

By looking at the diagram we know $\theta \neq -45°$ (wrong quadrant)

$$\theta = 180° - 45° = 135°$$

Hence $-1 + j = \sqrt{2} \angle 135°$.

(c)



By (10.15) $\left|\sqrt{3} - j\right| = \sqrt{\left(\sqrt{3}\right)^2 + (-1)^2} = 2$

By (10.16) $\arg\left(\sqrt{3} - j\right) = \tan^{-1}\left(\frac{-1}{\sqrt{3}}\right) = -30°$

(10.15) $r = \sqrt{x^2 + y^2}$

(10.16) $\theta = \tan^{-1}\left(\frac{y}{x}\right)$

Hence

$$\sqrt{3} - j = 2\angle(-30°)$$

(d) Very similar to (a), (b) and (c). We have

$$-1 - j\sqrt{3} = 2\angle(-120°)$$

(e) $j = 1\angle 90°$

(f) $jx = x\angle 90°$

(g) $-3 = 3\angle 180°$

(h) $5 = 5\angle 0°$

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3. Very similar to **EXAMPLE 12**.

(a) $2\angle 30° = 2[\cos(30°) + j\sin(30°)] = 1.73 + j$

(b) $5\angle 23° = 4.6 + j1.95$

(c) $2\angle(-45°) = 2[\cos(-45°) + j\sin(-45°)] = 1.41 - j1.41$

(d) $1.4\angle(-130°) = -0.90 - j1.07$

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4. By using a calculator we place each force into rectangular form:

$$F_1 = 100\angle 0° = 100$$

$$F_2 = 70\angle 150° = -60.62 + j35$$

$$F_3 = 110\angle 190° = -108.33 - j19.10$$

$$F_4 = 20\angle 250° = -6.84 - j18.79$$

Adding the real and imaginary parts separately

$$F = F_1 + F_2 + F_3 + F_4 = 100 - 60.62 - 108.33 - 6.84 + j(35 - 19.10 - 18.79)$$

$$F = -75.79 - j2.89 = 75.85\angle(-177.82°) \qquad [\text{By calculator}]$$

The magnitude $|F| = 75.85N$, direction $\arg(F) = -177.82°$

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5. Putting each of the forces into rectangular form by using a calculator

$$F_1 = 107.59\angle 45° = 76.08 + j76.08$$

$$F_2 = 87.85\angle(90° + 60°) = 87.85\angle 150° = -76.08 + j43.92$$

$$F_3 = 120\angle(-90°) = 0 - j120$$

$$F = F_1 + F_2 + F_3 = (76.08 + j76.08) + (-76.08 + j43.92) + (0 - j120) = 0$$

F_1, F_2 and F_3 are in equilibrium .
