1) \[ z = 8 \left( \cos \frac{\pi}{6} + i \sin \frac{\pi}{6} \right) \]

\[ w = 3 \left( \cos \frac{\pi}{2} + i \sin \frac{\pi}{2} \right) \]

\[ 2z w = 8 \cdot 3 \left( \cos \left( \frac{\pi}{6} + \frac{\pi}{2} \right) + i \sin \left( \frac{\pi}{6} + \frac{\pi}{2} \right) \right) \]

\[ = 24 \left( \cos \frac{4\pi}{6} + i \sin \frac{4\pi}{6} \right) \]

\[ = 24 \left( \cos \frac{2\pi}{3} + i \sin \frac{2\pi}{3} \right) \]

2) \[ \left[ 2 \left( \cos 75^\circ + i \sin 75^\circ \right) \right]^3 = 2^3 \left( \cos (3 \cdot 75^\circ) + i \sin (3 \cdot 75^\circ) \right) \text{ (De Moivre)} \]

\[ = 8 \left( \cos 225^\circ + i \sin 225^\circ \right) \]

Because \[ 225^\circ = 180^\circ + 45^\circ \]
we have

\[ \cos 225^\circ = -\cos 45^\circ = -\frac{\sqrt{2}}{2} \]

\[ \sin 225^\circ = -\sin 45^\circ = -\frac{\sqrt{2}}{2} \]

Therefore,

the result is \[ 8 \left( -\frac{\sqrt{2}}{2} + i \cdot \frac{\sqrt{2}}{2} \right) = -4\sqrt{2} - 4\sqrt{2} i \]
3) vertex = \((3,6)\) and focus = \((8,6)\)

\[ \text{Draw these two points in the plane:} \]

\[ V \quad F \quad \text{We see that the focus lies on the left of the vertex. Thus, the parabola is open left.} \]

\[ \text{The equation of the parabola looks like } y^2 = \ldots \]

\[ \text{Since } V = (3,6), \text{ it should have the form } \]
\[ (y-6)^2 = -4a(x-3) \]

\[ \text{the minus sign is because the parabola is open left.} \]

\[ a \text{ is the distance from } V \text{ to } F, \text{ which is 5.} \]

\[ \text{Therefore the equation is } (y-6)^2 = -20(x-3). \]
4) \((y+2)^2 = 12(x-4)\)

- By setting both sides zero, we get \(x = 4\) and \(y = -2\). Thus the vertex is \((4, -2)\).

- The distance between the vertex and the focus is \(a = \sqrt{4} = 2\).

- Because the equation is of the form \(y^2 = 4ax\), the parabola is open left or right.

- Because we see the plus sign in front of 12, the parabola is open right.

\[\text{V} \leftarrow F\]

- Therefore, \(F = (4 + 3, -2) = (7, -2)\)

- The directrix is obtained by taking the reflection of \(F\) with respect to \(V\).

\[D \quad \text{and} \quad F\]

Therefore the equation of \(D\) is \(x = 4 - 3 = 1\)

In short,

\[
\begin{align*}
V &= (4, -2) \\
F &= (7, -2) \\
D: x &= 1
\end{align*}
\]