Given : Velocity fields listed below. (a and b are constants)

Determine: (a) Dimensions of each velocity field
(b) Whether the flow is steady or unsteady

Solution:

The dimensions of each velocity field will be determined relative to an xyz coordinate system.

FIELD	DIMENSIONS	STEADY or UNSTEADY?
(1) $\vec{V} = [ae^{-bx}]\hat{i}$	one-dimensional $\vec{V} = \vec{V}(x)$	steady $\vec{V} \neq \vec{V}(t)$
(2) $\vec{V} = ax^2\hat{i} + bx\hat{j}$	one-dimensional $\vec{V} = \vec{V}(x)$	steady $\vec{V} \neq \vec{V}(t)$
(3) $\vec{V} = [ax^2e^{-bt}]\hat{i}$	one-dimensional $\vec{V} = \vec{V}(x)$	unsteady $\vec{V} = \vec{V}(t)$
(4) $\vec{V} = ax\hat{i} - by\hat{j}$	two-dimensional $\vec{V} = \vec{V}(x,y)$	steady $\vec{V} \neq \vec{V}(t)$
(5) $\vec{V} = (ax+t)\hat{i} - by^2\hat{j}$	two-dimensional $\vec{V} = \vec{V}(x,y)$	unsteady $\vec{V} = \vec{V}(t)$
(6) $\vec{V} = ax^2\hat{i} + bxz\hat{j}$	two-dimensional $\vec{V} = \vec{V}(x,z)$	steady $\vec{V} \neq \vec{V}(t)$
(7) $\vec{V} = a(x^2+y^2)^{1/2}(1/z^3)\hat{k}$	three-dimensional $\vec{V} = \vec{V}(x,y,z)$	steady $\vec{V} \neq \vec{V}(t)$
(8) $\vec{V} = axy\hat{i} - byzt\hat{j}$	three-dimensional $\vec{V} = \vec{V}(x,y,z)$	unsteady $\vec{V} = \vec{V}(t)$