

**Vibrations of Circular Plates - clamped vs. free vs. simply supported edges:**

TABLE 3.1. Vibration frequencies of a circular plate with clamped edge.

$f_{01} = 0.4694c_L h/a^2$	$f_{11} = 2.08f_{01}$	$f_{21} = 3.41f_{01}$	$f_{31} = 5.00f_{01}$	$f_{41} = 6.82f_{01}$
$f_{02} = 3.89f_{01}$	$f_{12} = 5.95f_{01}$	$f_{22} = 8.28f_{01}$	$f_{32} = 10.87f_{01}$	$f_{42} = 13.71f_{01}$
$f_{03} = 8.72f_{01}$	$f_{13} = 11.75f_{01}$	$f_{23} = 15.06f_{01}$	$f_{33} = 18.63f_{01}$	$f_{43} = 22.47f_{01}$

TABLE 3.2. Vibration frequencies of a circular plate with free edge.

—	—	$f_{20} = 0.2413c_L h/a^2$	$f_{30} = 2.328f_{20}$	$f_{40} = 4.11f_{20}$	$f_{50} = 6.30f_{20}$
$f_{01} = 1.73f_{20}$	$f_{11} = 3.91f_{20}$	$f_{21} = 6.71f_{20}$	$f_{31} = 10.07f_{20}$	$f_{41} = 13.92f_{20}$	$f_{51} = 18.24f_{20}$
$f_{02} = 7.34f_{20}$	$f_{12} = 11.40f_{20}$	$f_{22} = 15.97f_{20}$	$f_{32} = 21.19f_{20}$	$f_{42} = 27.18f_{20}$	$f_{52} = 33.31f_{20}$

TABLE 3.3. Vibration frequencies of a circular plate with a simply supported edge.

$f_{01} = 0.2287c_L h/a^2$	$f_{11} = 2.80f_{01}$	$f_{21} = 5.15f_{01}$
$f_{02} = 5.98f_{01}$	$f_{12} = 9.75f_{01}$	$f_{22} = 14.09f_{01}$
$f_{03} = 14.91f_{01}$	$f_{13} = 20.66f_{01}$	$f_{23} = 26.99f_{01}$

**Vibrations of a Circular Plate:**  
**Free Edge**

**Chladni's Law (1802):**  
$$f_{m,n} = v(m + 2n)^p$$

Mode #  $(n, m)$  are  $(\varphi, r)$  integers  
(e.g. = 0,1,2,3, ... etc.)

For flat circular plates:  $p = 2$   
For non-flat circular plates:  $p < 2$   
(e.g. cymbals)

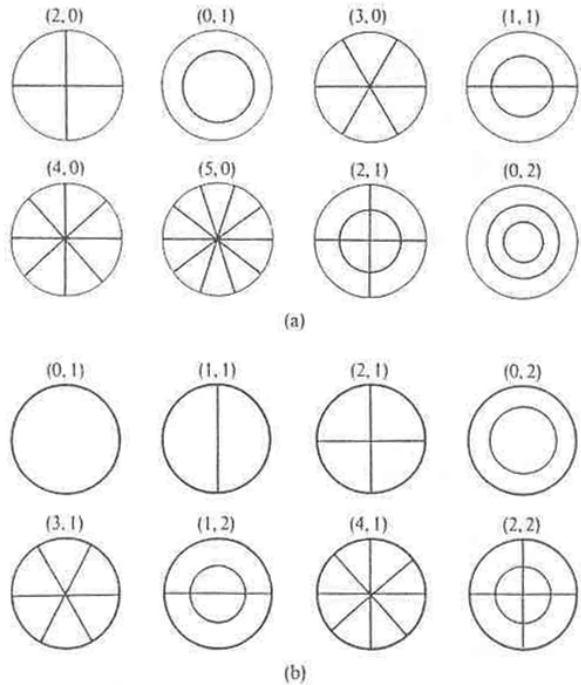


FIGURE 3.8. Vibrational modes of circular plates: (a) free edge and (b) clamped or simply supported edge. The mode number  $(n, m)$  gives the number of nodal diameters and circles, respectively.