17) $$I_x = \iint_D y^2 \rho(x,y)\,dA = \int_1^3\int_1^4 k y^4\,dy\,dx = 2k\int_1^4 y^4\,dy = 2k\left[\tfrac{1}{5}y^5\right]_1^4$$

$$= \frac{2k}{5}(4^5-1) = \frac{2046}{5}k = \boxed{409.2k = I_x}$$

$$I_y = \iint_D x^2 \rho(x,y)\,dA = \int_1^3\int_1^4 k x^2 y^2\,dy\,dx = k\int_1^3 x^2\,dx \int_1^4 y^2\,dy$$

$$= k\left(9-\tfrac{1}{3}\right)\left(\frac{64}{3}-\frac{1}{3}\right) = k\left(9-\tfrac13\right)\left(\tfrac{63}{3}\right) = k\left(9-\tfrac13\right)(21) = \boxed{182k = I_y}$$

$$I_0 = \iint_D (x^2+y^2)\rho(x,y)\,dA = k\int_1^3\int_1^4 (x^2+y^2)\,y^2\,dy\,dx = k\int_1^3\left[\tfrac13 x^2y^3 + \tfrac15 y^5\right]_1^4 dx$$

$$\cancel{= k\int_1^3 \frac{63}{3}x^2 + \frac15(4^5-1^5)\,dx = k\int_1^3 21x^2 + \frac{1023}{5}\,dx = 9(26) + \frac{1023}{5}(2)}$$

$$I_0 = I_x + I_y = \int_1^3\int_1^4 k y^4\,dy\,dx + \int_1^3\int_1^4 k x^2y^2\,dy\,dx = (409.2+182)k$$

$$= \boxed{591.2k = I_0}$$

19) $$I_x = \int_0^a\int_0^{a-x} y^2(x^2+y^2)\,dy\,dx = \int_0^a\left[\tfrac13 y^3x^2 + \tfrac15 y^5\right]_0^{a-x} dx = \int_0^a \tfrac13(a-x)^3x^2 + \tfrac15(a-x)^5\,dx$$

$$= k\int_0^a ax^4 - x^5 + \frac{a^3x^2}{3} - \frac{x^5}{3} - a^2x^3 + ax^4\,dx = k\left[\frac{ax^5}{5} - \frac{x^6}{6} + \frac{a^3x^3}{9} - \frac{x^6}{18} - \frac{a^2x^4}{4} + \frac{ax^5}{5}\right]_0^a$$

$$= ka^6\left(\tfrac15 - \tfrac16 + \tfrac19 - \tfrac1{18} - \tfrac14 + \tfrac15\right] = ka^6\left(\frac{7}{180}\right) = \boxed{\frac{7ka^6}{180} = I_x}$$

$I_x = I_y$ if symmetric across $y=x$ $\boxed{I_y = \dfrac{7ka^6}{180}}$

$$I_0 = I_x + I_y = 2\left(\frac{7ka^6}{180}\right) = \boxed{\frac{7ka^6}{90} = I_0}$$

if vertex is symmetric and positive on $y=x$.