Expression for acceleration of a ring, solid cylinder, solid sphere & hollow sphere,

General expression for acceleration,

$$a = \frac{g\sin\theta}{\left(1 + \frac{k^2}{R^2}\right)} \quad \text{---- (1)}$$

1) Acceleration of Ring

$$\boxed{k = R}$$

Putting value in eqn (1),

$$a = \frac{g\sin\theta}{\left(1 + \frac{R^2}{R^2}\right)}$$

$$a = \frac{g\sin\theta}{2}$$

$$\boxed{a = \frac{1}{2} g\sin\theta}$$

## 2) Acceleration of solid cylinder or disc

$$k = \frac{R}{\sqrt{2}}$$

Putting value in eqn (1),

$$a = \frac{g\sin\theta}{\left(1 + \frac{k^2}{R^2}\right)}$$

$$a = \frac{g\sin\theta}{\left(1 + \frac{\left(\frac{R}{\sqrt{2}}\right)^2}{R^2}\right)} \Rightarrow 1 + \frac{\frac{R^2}{2}}{R^2}$$

$$a = \frac{g\sin\theta}{1 + \frac{R^2}{2R^2}}$$

$$a = \frac{g\sin\theta}{\frac{3}{2}}$$

$$\boxed{a = \frac{2}{3} g\sin\theta}$$

## 3) Acceleration of solid sphere

$$k = \sqrt{\frac{2}{5}}R$$

Putting in eqn (1),

$$a = \frac{g\sin\theta}{\left(1+\frac{k^2}{R^2}\right)}$$

$$a = \frac{g\sin\theta}{\left(1+\frac{\left(\sqrt{\frac{2}{5}}R\right)^2}{R^2}\right)} \Rightarrow 1+\frac{\frac{2}{5}R^2}{R^2}$$

$$a = \frac{g\sin\theta}{\left(1+\frac{2R^2}{5R^2}\right)}$$

$$a = \frac{g\sin\theta}{\left(\frac{7}{5}\right)}$$

$$a = \frac{5g\sin\theta}{7}$$

$$\boxed{a = \frac{5}{7}\sin\theta g}$$

4) Acceleration of hollow sphere,

$$k = \sqrt{\frac{2}{3}}R$$

Putting value in eqn (1)

$$a = \frac{g\sin\theta}{\left(1+\frac{k^2}{R^2}\right)}$$

$$a = \frac{g\sin\theta}{\left(1+\frac{\left(\sqrt{\frac{2}{3}}R\right)^2}{R^2}\right)}$$

$$a = \frac{g\sin\theta}{\left(1+\frac{2R^2}{3R^2}\right)}$$

$$a = \frac{g\sin\theta}{\left(\frac{5}{3}\right)}$$

$$\boxed{a = \frac{3}{5}g\sin\theta}$$

This is the expression for ring, solid cylinder, solid sphere, hollow sphere.