

Note: \oint is an integral over a surface area.

Newton's Law of Universal Gravitation is

A) $\oint g \, ds = \frac{M}{G}.$

B) $\oint g \, ds = \frac{4 \pi M}{G}.$

C) $\oint g \, dA = G M.$

D) $\oint g \, dA = 4 \pi G M.$

A high school physical science textbook uses $F = G \frac{M m}{r^2}$.

To check to see if this is correct, for a spherical shell (surface area is $4 \pi r^2$) about a point mass M , we have

$$\oint g \, dA = 4 \pi G M$$

$$g \oint dA = 4 \pi G M, \quad g \text{ is constant}$$

$$g 4 \pi r^2 = 4 \pi G M$$

$$g r^2 = G M$$

$$g = G \frac{M}{r^2}, \quad \text{so}$$

$$F = m g = G \frac{M m}{r^2}, \quad \text{Q.E.D.}$$

Answer **D**.

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