

Black Holes Lab Exercise:**Escape Velocity**

Formula for Escape Velocity:

$$V_{esc} = \sqrt{\frac{2GM}{r}}$$

Calculate Escape Velocity (V_{esc}) for Earth

Given:

Radius of Earth: 6378 Km

Mass of Earth: 6.0×10^{24} KgUniversal Gravitational Constant (G): 6.672×10^{-11}

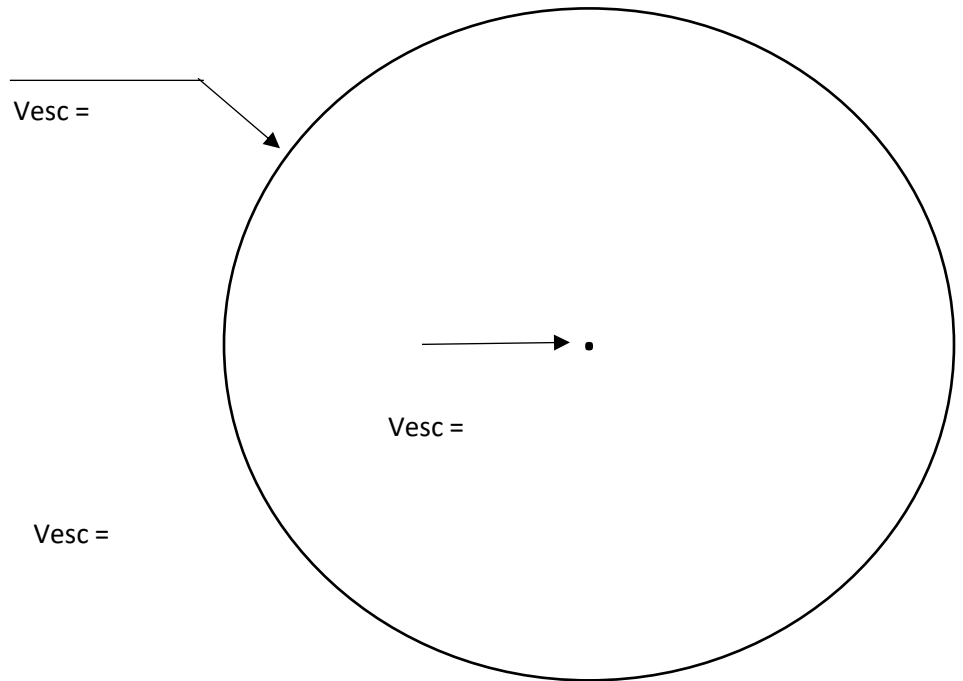
Where:

 V_{esc} = Escape velocity in meters/sec $1M_{\odot} = 1.99 \times 10^{30}$ Kg r = radius in meters C = speed of light = 3.0×10^8
meters/sec

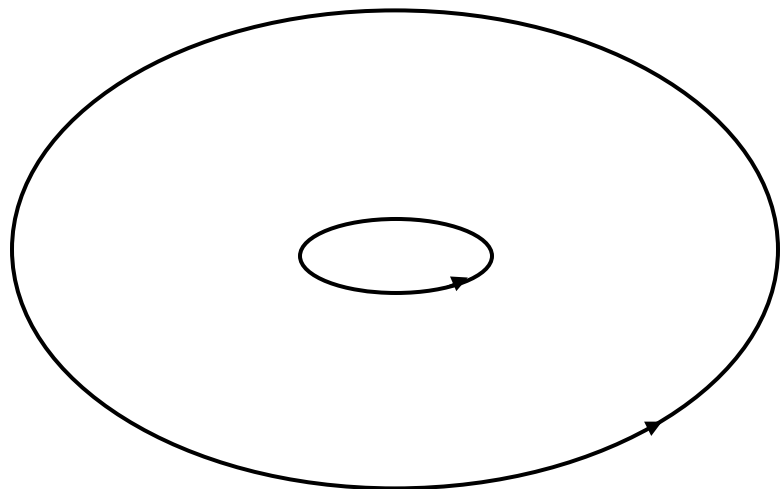
Now let's change the radius of the Earth to 7.8 mm (7.8×10^{-3} m)



Schwarzschild Black Hole



Kerr Black Hole



Basic Formulas for Black Holes

Given:

$$V_{esc} = \sqrt{\frac{2GM}{r}}$$

If we stipulate "c" as Escape Velocity, then:

$$c = \sqrt{\frac{2GM}{r}}$$

Therefore:

$$c^2 = \left(\sqrt{\frac{2GM}{r}}\right)^2 = \frac{2GM}{r}, \text{ so } c^2 = \frac{2GM}{r}, \text{ and}$$

$$r_{sch} = \frac{2GM}{c^2}$$

r_{sch} = Swarchild Radius : _____