2022 Ph H1 Q25

Section: Our Dynamic Universe
Topic: The Expanding Universe

Astronomers use:

$$M = \frac{v^2 r}{G}$$

to estimate the mass M of a galaxy.

- $v = 120\,\text{km/s} = 1.2 \times 10^5\,\text{m/s}$
- $r = 4.0 \times 10^{20}\,\text{m}$
- $G = 6.67 \times 10^{-11}\,\text{N m}^2/\text{kg}^2$

Step-by-step solution:

$$M = \frac{(1.2 \times 10^5)^2 \cdot 4.0 \times 10^{20}}{6.67 \times 10^{-11}} = \frac{1.44 \times 10^{10} \cdot 4.0 \times 10^{20}}{6.67 \times 10^{-11}} = \frac{5.76 \times 10^{30}}{6.67 \times 10^{-11}} \approx 8.$$

Final Answer:

E

Revision Tips:

- This is a **gravitational mass estimation** using Newton's law
- The high speed of stars at the galaxy's edge suggests mass that isn't visible
- This is strong evidence for **dark matter**