2024-Ph-H1-Q5

Section: Our Dynamic Universe
Topic: Energy and Power

Summary:
In a hydroelectric power station, water flows at $\dot{m} = 4.5 \times 10^6\,\text{kg/min}$ from a reservoir 150 m above turbines. The power delivered by the falling water is required.

Solution:

1. Convert mass flow rate to seconds:

$$\dot{m} = \frac{4.5 \times 10^6}{60} = 7.5 \times 10^4\,\text{kg/s}.$$

2. Power is:

$$P = \dot{m}gh = 7.5 \times 10^4 \times 9.8 \times 150.$$

3. Calculate:

$$P = 7.5 \times 10^4 \times 1470 = 1.1025 \times 10^8\,\text{W} \approx 1.1 \times 10^8\,\text{W}.$$

Answer: C. $1.1 \times 10^8\,\text{W}$

Guidance for Students:

- Always convert minutes to seconds for power calculations.
- Use $P = \dot{m}gh$ when mass flow and height are known.

Revision Tips:

- Check units: kg/s × m/s² × m = W.
- Be careful with large numbers and scientific notation.