

Answer on Question #75106, Physics / Electric Circuits

A fan is operated with a 6v battery, which is driven by a permanent magnet dc motor. by using an ammeter we found that when the fan was held stationary, the motor drew 1 amp and when it was released it rotated at 6000rpm and drew 500 mA (0.5A). How much torque is required to drive the fan at this speed? How much power is the motor developing? How efficiently is the motor running?

Solution.

Torque is required to drive the fan at this speed

$$\omega = 6000 \text{ rpm} = 100 \text{ cycle per second}$$

$$M = \frac{P}{\omega} = \frac{U \cdot I}{\omega} = \frac{6 \cdot 0.5}{100} = 0.03 \text{ N} \cdot \text{m}$$

Power is the motor developing

$$P = U \cdot I = 6 \cdot 0.5 = 3 \text{ W}$$

Efficiently is the motor running

$$\eta = \frac{P}{P_{max}} = \frac{U \cdot I}{U \cdot I_{max}} = \frac{6 \cdot 0.5}{6 \cdot 1} = 0.5 \text{ (50\%)}$$

Answer: $M = 0.03 \text{ N} \cdot \text{m}$; $P = 3 \text{ W}$; $\eta = 0.5 \text{ (50\%)}$

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