7. A DC winch motor is rated at 20.00 A with a voltage of 115 V. When the motor is running at its maximum power, it can lift an object with a weight of 4900.00 N a distance of 10.00 m, in 30.00 s, at a constant speed. (a) What is the power consumed by the motor? (b) What is the power used in lifting the object? Ignore air resistance. (c) Assuming that the difference in the power consumed by the motor and the power used lifting the object are dissipated as heat by the resistance of the motor, estimate the resistance of the motor?

a.) $P = IV = 20A * 115V = \boxed{2300W}$ b.) $P = Fv = (4900N)(0.33\frac{m}{s}) = \boxed{1633.33W}$

$v = \frac{10.0m}{30.0s} = 0.33\frac{m}{s}$

c.) $R = \frac{P}{I^2} = \frac{666.67W}{(20.00A)^2} = \boxed{1.67\,\Omega}$

$P = 2300 - 1633.33 = 666.67W$

8. Suppose a a battery is conneted in series with a resistor. The ϵ, or emf of the battery is 14 V and the resistance is 50Ω. The current is measured to be 266 mA. What is the *internal resistance* of the battery?

$r = \frac{E}{I} - R = \frac{14V}{0.266A} - 50\Omega = \boxed{2.63\,\Omega}$

$266\,mA\left(\frac{1\,A}{1000\,mA}\right) = 0.266A$

9. Consider Fig. 2, in which a DC power generator is depicted inside a 0.05 T B-field. Suppose the area of the loop is 10^{-2} m^2, the voltage in the circuit is 24 V, and the circuit resistance is 50 Ω. Also assume that there is just one loop of wire in the rotor. What is the *maximum torque* the system could achieve?

$\mu = IA$

$\frac{V}{I\,|\,R}$

$\vec{\tau} = \vec{\mu} \times \vec{B}$ or $\vec{\tau} = IAB\sin\theta\,\hat{i}$ Max when $\theta = 0$ so that $\sin = 1$

$\vec{\tau} = NIA \times B =$ So $IAB = \frac{V}{R}(A)(B)$

$N = 1$

$\vec{\tau} = \frac{24V}{50\Omega}(1\times10^{-2}m^2)(0.05T)$

$= \boxed{2.4\times10^{-4}\frac{N}{m}}$

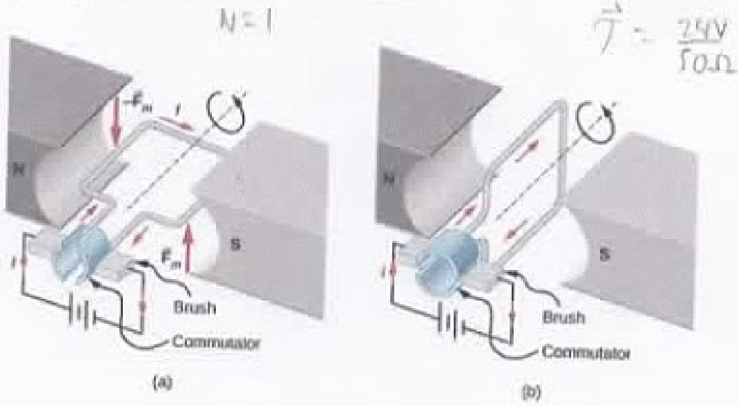


Figure 2: An illustration of how a power generator works. This version uses DC current and a commutator.

10. What would the maximum torque be if there were $N = 100$ turns of wire?

100 N means $\vec{\tau} \times 100 \rightarrow 2.4\times10^{-4}\frac{N}{m} \times 100 = \boxed{2.4\times10^{-2}\frac{N}{m}}$

11. Consider Fig. 3. Suppose that the angle between the area vector and the magnetic field is $\theta = \omega t$. (a) Show that

$$\phi(t) = BA\cos(\omega t) \tag{2}$$

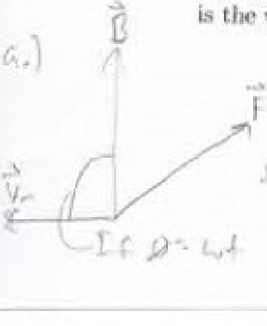
(b) Given Eq. 2, it turns out that the voltage generated in the loop is proportional to $\sin(\omega t)$ and ω itself. That is,

$$\epsilon(t) = BA\omega\sin(\omega t) \tag{3}$$

What is the voltage at a time $t = 1/240$ seconds, $\omega = 120\pi$ Hz, $B = 0.1$ T, and $A = 0.01$ m^2? (c) At what time is the voltage zero?

$\sin(\frac{\pi}{2}) = 1$

a.)



then $\phi(t) = BA\cos(\theta) \rightarrow BA\cos(\omega t)$

b.) $\epsilon(t) = (0.1)(0.01)(120\pi)\sin\left(\frac{120\pi}{240}\right) \rightarrow 1$

$= \boxed{0.377V}$

c.) when $\sin(0)$ or $\sin(x\pi)$ 0 → ∞, all whole numbers $120\pi t$ where t = any whole number ... I guess