PRINCIPLES OF TECHNOLOGY
Chapter 2 Work
Test Review

Name: McElwee

Period: Key

Define "Force" (review)
is a push or a pull

Net force (review)
the sum of forces acting on an object

Torque (review) is a quantity that causes rotation

Work – applied force times the distance moved in the direction of the force

Work Input – work done on the machine to make it operate

Work Output – work done by the machine

Efficiency formula $Eff = \frac{\text{Work output}}{\text{Work Input}}$

Radian (rad) Angle measure in radians $= \frac{\text{arc length}}{\text{radius}}$

Joule – 1 N·m

Pi (π) 1 rev = 360° = $\frac{\text{arc length}}{r} = \frac{2\pi r}{r} = 2\pi$ radians

$\pi = 3.14$ radians = ½ rev.

Theta (θ) $\theta = \frac{\text{arc length}}{r}$ $W = \tau \times \theta$

Degrees $360^\circ = 1 \text{ rev} = 2\pi$ radians

What are the English and S.I units of:

a) Force Eng: lb SI: N

b) Distance ft m

c) Work ft·lb N·m = J

Pressure difference - change in pressure

What does the symbol "Δ" mean? "change in"

Open system - when a fluid flows through a system only one time (it is not recirculated or recycled)

Closed system - retains and recirculates the fluid

Formula for work in an open system (density is constant, pressure changes)

$W = -\Delta P \times V$

Formula for work in a closed system (boundary moves and pressure is constant)

$W = P \times \Delta V$

Re-arrange the equations to solve for all variables

Open Fluid System	Closed Fluid System
$W = -\Delta P \times V$	$W = P \times \Delta V$
$V = -\frac{W}{\Delta P}$	$\Delta V = \frac{W}{P}$
$\Delta P = -\frac{W}{V}$	$P = \frac{W}{\Delta V}$

Electron – negative charge in an atom

Charge

Coulomb – unit of electric charge

How many electrons are in 1 coulomb? 6.25×10^{18} electrons

V – Volts

$I = \frac{q}{\Delta t}$ I = current $q = I \Delta t$

q – charge

$\frac{1 \text{ electron}}{1.6 \times 10^{-19} C} = \frac{N \text{ electron}}{1 C}$

Units of electrical work $1 J = 1 V \cdot C$

$W = \Delta V \times q$ W = potential difference x charge moved

What is the relationship between Joules and Newton·meters

$1 J = N \cdot m$

Formula for electrical work (and solve using the units)

$W = \Delta V \cdot q$

$1J = 1V \cdot 1C$

Formula for electrical charge (and solve using the units)

$I = \frac{q}{\Delta t}$ $\quad I\Delta t = q$ $\quad (1 C/s)(s) = 1C$ $\quad 1\ amp = 1\ C/s$

Formula for electrical efficiency (and solve using the units)

$Efficiency = \frac{output\ work}{input\ work}$ $\quad Eff = \frac{J}{J}$

Eff. has no units

How much work does an air conditioner (pressure = 33.83 lbs/ft2) do to completely replace the air in a room which measures 17 feet by 32 feet by 8 feet?

open $W = P \times \Delta V$

$= \left(33.83 \frac{lb}{ft^2}\right)(17 \times 32 \times 8) = 147{,}228.16\ lb\text{-}ft$

A pressure of 337 lb/in^2 is applied to the face of a piston in a closed hydraulic cylinder, causing a total force of 32.27 lb. on the face of the piston. Calculate the following:

a. The area of the piston face.

$P = 337 \frac{lb}{in^2}$ $\quad F = 32.27\ lb$

$P = \frac{F}{A}$ $\quad 337A = 32.27$ $\quad A = \frac{32.27}{337} = 0.096\ in^2$

$337(A) = 32.27\ lb$

$A = 0.096\ in^2$

b. The diameter of the piston.

$A = \pi r^2$ $\quad 0.96 = \pi r^2$

$\frac{0.96}{\pi} = r^2$ $\quad r^2 = 0.30$ $\quad r = \sqrt{0.30}$ $\quad r = 0.55$ $\quad d = 1.10\ in$

$0.096\ in^2 = \pi r^2$

$\sqrt{r^2} = \sqrt{0.03}$ $\quad r = 0.17$ $\quad d = 0.34\ in$

c. The volume of fluid displaced when the piston moves 9.3 inches.

$\Delta V = A \times d$

$= 0.96 \times 9.3\ in$

$= 8.93\ in^3$

$\Delta V = A \times d$

$\Delta V = (0.096)(9.3)$

$\Delta V = 0.89\ in^3$

closed

d. The fluid work done by the piston when moving the 9.3 inches.

$W = P \times \Delta V$

$= \left(337 \frac{lb}{in^2}\right)(8.93\ in^3) = 3008.7\ lb \cdot in$

$W = (337 \frac{lb}{in^2})(0.89) = 300\ lb \cdot in$

How much work is needed to recharge a dead 12 volt battery if it can hold 24,000 coulombs of charge?

$\Delta V = \frac{W}{q}$ $\quad W = \Delta V \times q$

$= (12V)(24{,}000\ C)$

$= 288000\ J$

$= 288\ kJ$

Nathan is using a 110 volt AC Skilsaw which draws 13 amps. He operates it for 2 minutes while attempting to cut out some plywood shelving. Assuming he doesn't cut off his foot in the process, how much charge is moved, and how much work is done moving it?

$I = \frac{q}{\Delta t}$ $\quad 13\ amp = \frac{q}{120\ s}$

$q = 1560\ C$ $\quad \Delta V = \frac{W}{q}$ $\quad W = \Delta V \times q$

$W = (110\ V)(1560\ C)$

$W = 171{,}600\ J = 171.6\ kJ$

Also Review all examples in Chapter 2