(1

3-17-14

section 26.2

Kirchoff's rules (KR)

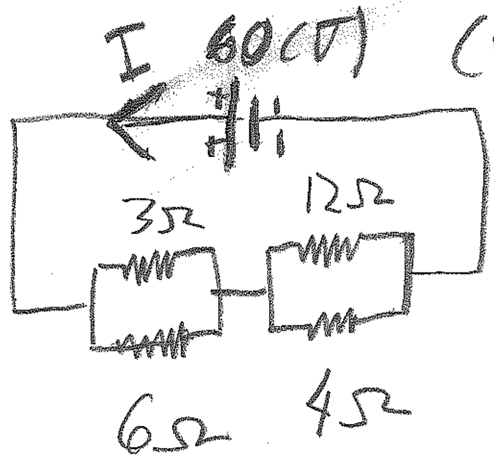
Good for ENG 43

– circuits

Let's do a comparison of of KR and simpler circuits:

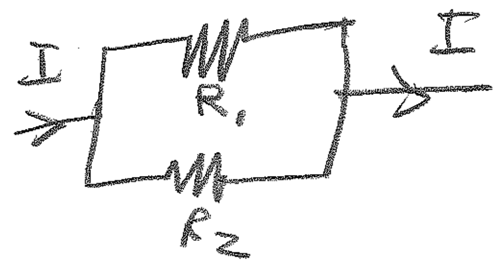
Quiz 6 # (14)

(r = 0 = internal battery resistance)

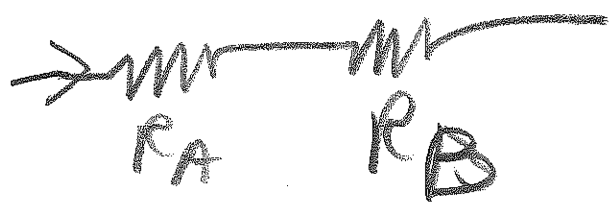


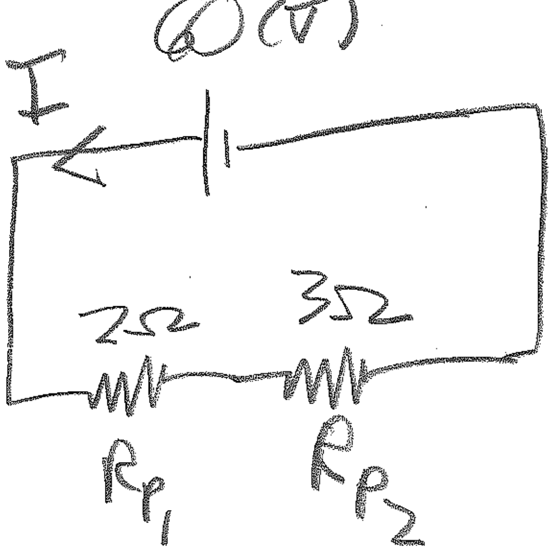
⇓ use:

$$\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2}$$



$$R_S = R_A + R_B$$





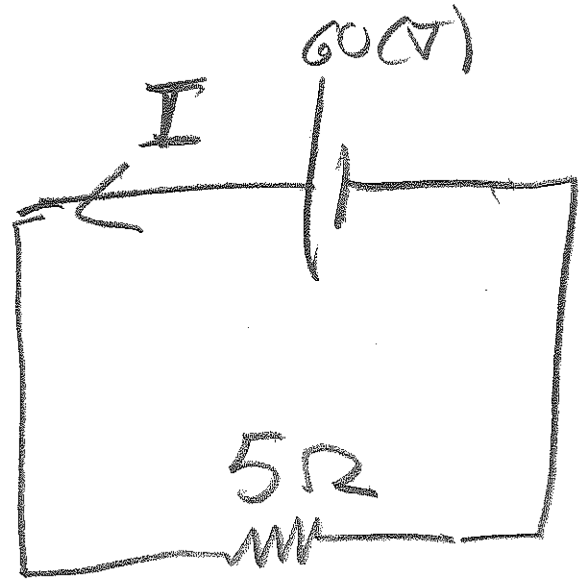
NOTE: GENERAL

$$\frac{1}{R_P} = \frac{1}{R_A} + \frac{1}{R_B} = \frac{R_B + R_A}{R_A \cdot R_B}$$

$$R_{P_1} = \frac{(3)(6)}{3+6} = \frac{18}{9} = 2\,\Omega$$

$$R_{P_2} = \frac{(12)(4)}{12+4} = \frac{48}{16} = \frac{24}{8} = 3\,\Omega$$

NOW ADD:

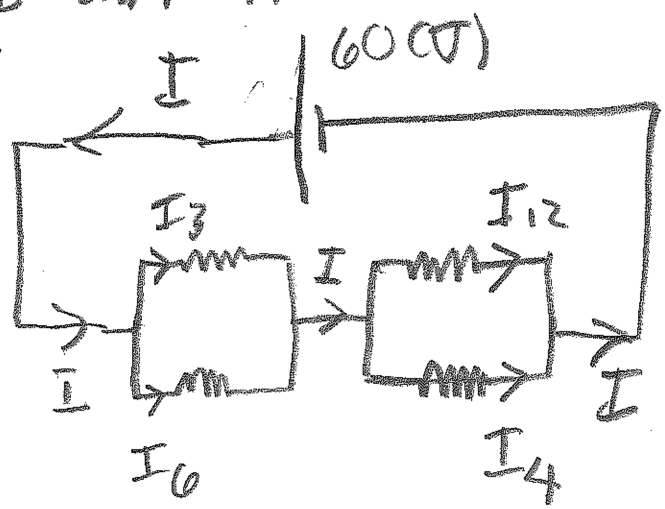


<u>ohm's LAW</u>:

$$\Rightarrow I = \frac{60\,(V)}{5\,\Omega} = 12\,(A)$$

↑ amperes!

- now <u>FIND</u> current EACH RESISTOR:



<u>NOTE:</u>

$$I = I_3 + I_6 = 12\,(A)$$

$$I = I_{12} + I_4 = 12\,(A)$$

NOW, ΔV_{3-6} (ACROSS 3Ω & 6Ω)

$$= I \cdot R_{p_1}$$

$$= (12)(2)\,(V) = 24\,(V)$$

THUS: $I_3 = \dfrac{24\,(V)}{3\Omega} = 8\,(A)$

$I_6 = \dfrac{24\,(V)}{6\Omega} = 4\,(A)$

SUMS TO 12 (A)

ALSO:

$$\Delta V_{12-4} = I \cdot R_{P_2} = (12)(3) = 36\ (V)$$

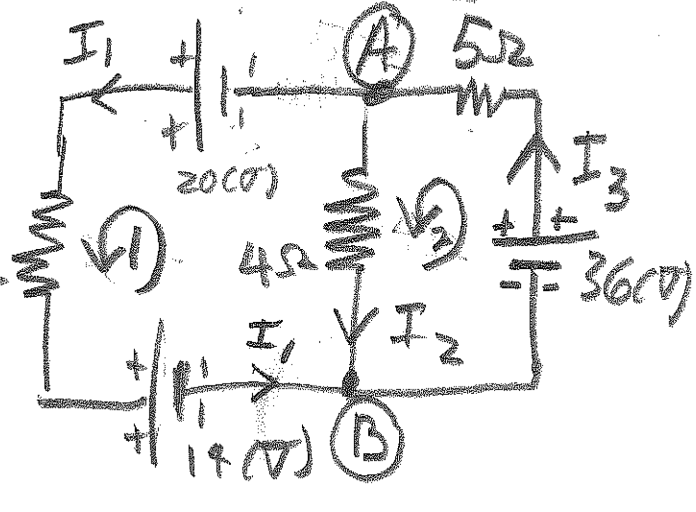
$$I_{12} = \frac{36(V)}{12\,\Omega} = 3\ (A)$$

$$I_4 = \frac{36(V)}{4\,\Omega} = 9(A)$$

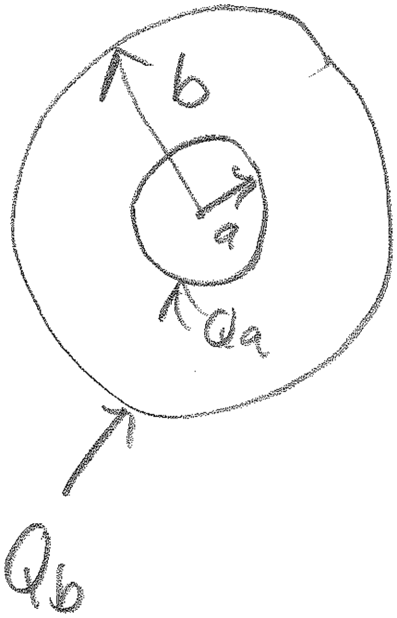
} SUMS TO 12(A)

NOW COMPARE with KR in Example 26.4

OR (#65) (QUIZ 6)



Sample test 2 explanation
(# 4—MAIN 46SampleT2.htm)



$r > b$

$$E = \frac{k(Q_a + Q_b)}{r^2}$$

THUS: $$\boxed{V = \frac{k(Q_a + Q_b)}{r}}$$

$a < r < b$

$$E = \frac{kQ_a}{r^2}$$

THUS: $$V = \frac{kQ_a}{r} + \frac{kQ_b}{b}$$

$r < a$

$$E = 0$$

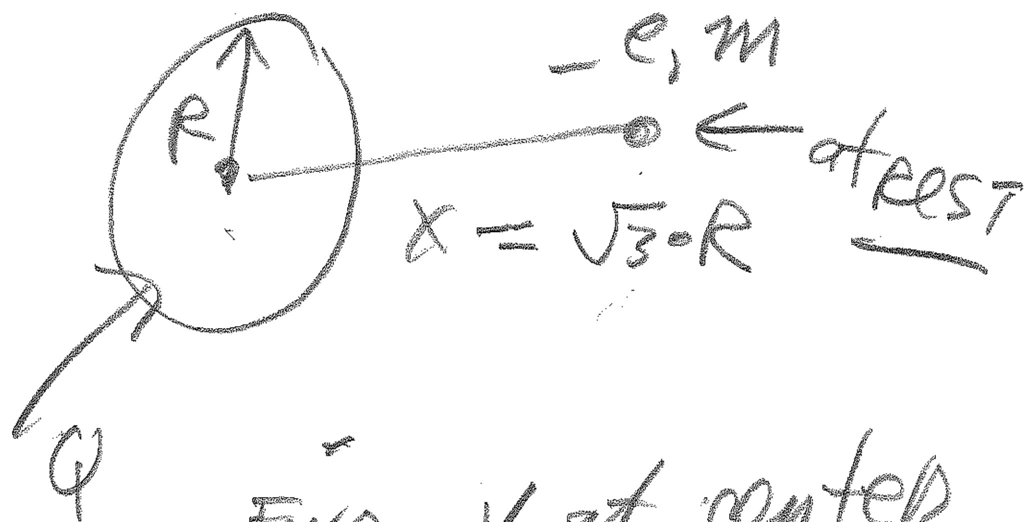
THUS: $V = \text{constant}$

$$V = \frac{kQ_a}{a} + \frac{kQ_b}{b}$$

Note the outer shell imposes a constant potential since the $\vec{E}$-field it creates is ZERO.

Sample Test 2

(# 4_E2aa00.1fm)



FIND V at center
↑
speed

$KE_i + U_i = KE_f + U_f$

↓

$0 + (-e \cdot V_i) = \frac{1}{2} m v^2 + (-e \cdot V_f)$

note $U = q \cdot V$; define $\rightsquigarrow$ $V_i = \frac{kQ}{\sqrt{x^2 + R^2}} = \frac{kQ}{2R}$

$$V_f = \frac{kQ}{\sqrt{0^2+R^2}} = \frac{kQ}{R}$$

$$0 - \frac{ekQ}{2R} = \frac{1}{2}mv^2 - \frac{ekQ}{R}$$

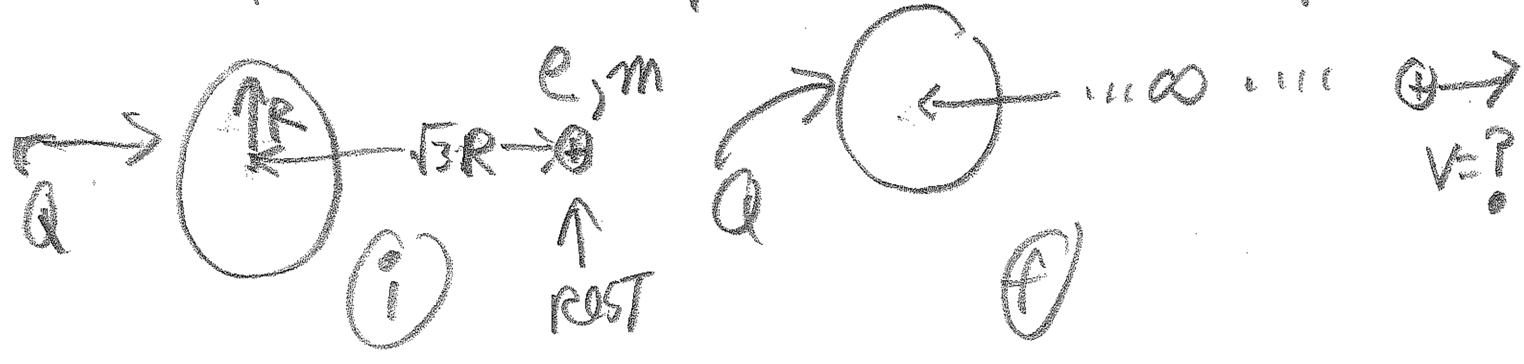
$$\frac{1}{2}mv^2 = ekQ\left[\frac{1}{R} - \frac{1}{2R}\right]$$

$$\frac{1}{2}mv^2 = \frac{ekQ}{2R}$$

$$\rightarrow v = \sqrt{\frac{ekQ}{m \cdot R}}$$ SYMBOLS!

---

test 2 manipulation $\qquad V_f = 0$



(i) $\quad$ (f)

$$0 + \frac{ekQ}{2R} = \frac{1}{2} m v^2 + 0$$

$$\rightarrow \quad v = \sqrt{\frac{ekQ}{m \cdot R}}$$

same speed!
BUT different
DIRECTION of motion.

(I) Sample T3 Examples:

(a) $Q = 2\pi R \cdot \lambda$ 4b SampleT3.htm
$Q = \lambda \cdot 2\pi R$

(b) $\quad$ $q, m \oplus$ $\uparrow$ $v_f = ?$

$Q \rightarrow$ (i) ($e \oplus m$) $\quad$ (f) ( )

(b)

$$KE_i + U_i = KE_f + U_f$$

$$0 + \frac{k e \cdot Q}{R} = \frac{1}{2} m v_f^2 + \frac{k \cdot e \cdot Q}{\sqrt{0.20^2 + R^2}}$$

$r^2 = x^2$

$$\frac{1}{2} m v_f^2 = k e Q \cdot \left[\frac{1}{R} - \frac{1}{\sqrt{0.04 + R^2}} \right]$$

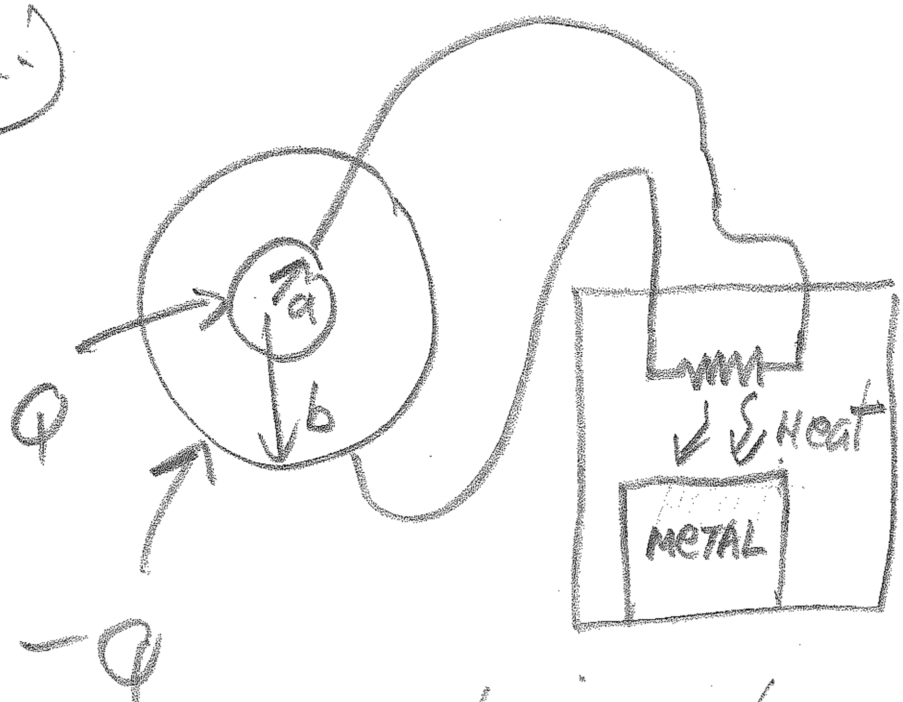
$$R = 0.20 \Rightarrow R^2 = 0.04$$

$$\frac{1}{2} m v_f^2 = k e Q \left[\frac{1}{R} - \frac{1}{\sqrt{2} \cdot R} \right]$$

solve for v_f

(c) $0 + \frac{keQ}{R} = \frac{1}{2}mv^2 + 0$

(2.)



Heat is used to warm a metal

(a) Derive

$C = \frac{4\pi\varepsilon_0 ab}{b - a}$

(b.) $\frac{1}{2}CV^2 = \frac{Q^2}{2C}$ = Heat

$$\text{Heat} = m \cdot \hat{C} \cdot \Delta T$$ ⇐ EXTRA credit

- m ← mass of metal
- $\hat{C}$ ← specific heat
- ΔT ← change in temperature

$$\Delta T = \frac{\text{Heat}}{m \cdot \hat{C}}$$

LARGE m → small ΔT

(regular credit) In conclusion: CH25 = E.C. — from textbook problems in Q5.

But Lab 2 could be on Test 2: $\Delta V = I \cdot R$

$R = \rho \cdot L / \text{Area}$