

Estat #7 p571 Problems 44, 47

(1)

p571 - Problems

(2)

44) Body cell membrane a) $E = ?$ $V = Ed$

$V = .07V$
 $d = 7.5 \times 10^{-9}m$

$E = \frac{V}{d} = \frac{.07V}{7.5 \times 10^{-9}m}$

$E = 9.3 \times 10^6 N/C$

(1)

b) sodium ion $q = +1e = +1.60 \times 10^{-19}C$
dielectric is 1.0

$F = Eq = (9.3 \times 10^6 N/C)(1.60 \times 10^{-19}C)$

$F = 1.5 \times 10^{-12} N$

47) // plate capacitor

$V = 120V$
 $r = .50 cm = .0050m$

a) $E = ?$ $V = Ed$

$E = \frac{V}{d} = \frac{120V}{.0050m}$

$E = 24,000 N/C$
 $2.4 \times 10^4 N/C$

(1)

b) spark jumps if E exceeds $3 \times 10^6 N/C$.
Closest w/o spark?

$V = Ed$ $d = \frac{V}{E} = \frac{120V}{3 \times 10^6 N/C} = 4 \times 10^{-5} m$

Estat #8

p 569 Concept 20

p 571 Problems 48, 51, 55

Online - Capacitance Review

7-8

p569 - Concept 20

(6)

20) A) What does it mean if K is 81?

• magnitude of E in vacuum due to charged source w/ \downarrow by factor of 81 in H_2O

(1)

B) K of paperclip?

• Infinity

p571 - Problems

48) capacitor capacitance C , vacuum, pot diff ΔV

a) Expression charge each plate

$$C = \frac{Q}{\Delta V} \quad Q = C \Delta V$$

b) Expression total energy stored

$$U_C = \frac{1}{2} C (\Delta V)^2$$

c) Fill w/ dielectric, new Q

$$Q = K C \Delta V$$

e) Where U come from?

d) fill w/ dielectric, new U

$$U_C = \frac{K}{2} C (\Delta V)^2$$

The new + charge flows out of \oplus terminal so battery supplies additional energy

7-8

51) long thin cylinder axon of nerve

$$l = 1.0 \text{ m}$$

$$r = 4 \times 10^{-6} \text{ m}$$

$$d = \text{thick} = 8 \times 10^{-9} \text{ m}$$

$$K = 6.0$$

a) $C = ?$

$$C = K \epsilon_0 \frac{A}{d}$$

area of cylinder wall



$$C = K \epsilon_0 \left(\frac{2\pi r l}{d} \right)$$

$$C = 6.0 (8.85 \times 10^{-12} \frac{\text{C}^2}{\text{Nm}^2}) \left(\frac{2\pi (4 \times 10^{-6} \text{ m})(1.0 \text{ m})}{8 \times 10^{-9} \text{ m}} \right)$$

$$C = 1.67 \times 10^{-7} \text{ F}$$

(2)

b) charge on walls if $V = .070 \text{ V}$

$$q = C \Delta V = (1.67 \times 10^{-7} \text{ F})(.070 \text{ V})$$

$$q = 1.17 \times 10^{-8} \text{ C}$$

c) $U_c = ?$ energy stored in axon

$$U_c = \frac{1}{2} C \Delta V^2 = \frac{1}{2} (1.67 \times 10^{-7} \text{ F})(.070 \text{ V})^2$$

$$U_c = 4.09 \times 10^{-10} \text{ J}$$

55) ventricular fibrillation - heart muscles contract

$$C = 6 \times 10^{-6} \text{ F}$$

$$U_c = 250 \text{ J}$$

$$\Delta V = ?$$

$$U_c = \frac{1}{2} C \Delta V^2$$

$$\Delta V = \sqrt{\frac{2U_c}{C}} = \sqrt{\frac{2(250 \text{ J})}{6 \times 10^{-6} \text{ F}}}$$

$$\Delta V = 9128 \text{ V}$$

(1)

- Online - Capacitance Review

A) What property is measured by capacitance?

• ability to store charge

B) Air filled capacitor. How $\uparrow C$?

$$C = \epsilon_0 A/d \quad \uparrow C \quad \uparrow A \quad \downarrow d$$

(i)

• decrease spacing

c) // plate capacitor. How half C ?

$$C = \epsilon_0 A/d \quad \frac{1}{2} A \quad 2d$$

• Halve plate area

• double plate separation

d) // plate capacitor. Combo to quadruple C

$$C = \epsilon_0 A/d \quad 2A \quad \frac{1}{2}d$$

• Halve plate separation + double plate A