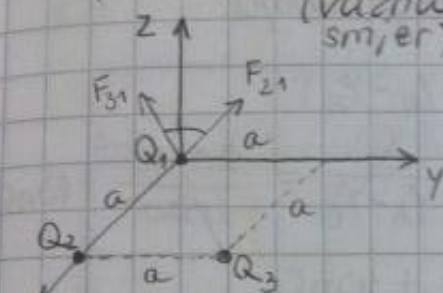
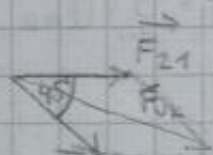


MASOVNE INSTRUKCIJE - ELEKTROSTATIKA

- 5.) Tri točkasta naboja $Q_1 = Q_2 = 1 \text{ nC}$ i $Q_3 = 2 \text{ nC}$ nalaze se u vrhovima kvadrata stranice $a = 1 \text{ m}$ prema slici. Odredite silu na naboj Q_1 ako nije (važna je udaljenost između naboja i zadan ϵ smjer) - su istog predznaka onda je ϵ_0



$$F_{31} = \frac{1 \cdot 10^{-9} \cdot 2 \cdot 10^{-9}}{4\pi \epsilon_0 \cdot (\sqrt{2})^2} = 8,987 \text{ N}$$

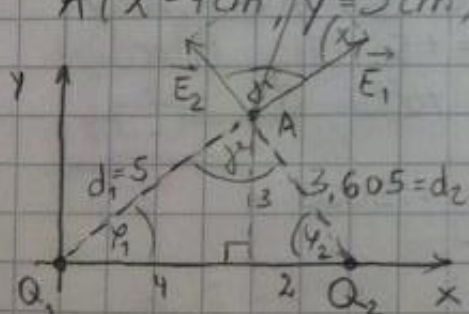


$$F_c = \frac{Q_1 \cdot Q_2}{4\pi \epsilon_0 d^2}$$

$$F_{21} = \frac{1 \cdot 10^{-9} \cdot 1 \cdot 10^{-9}}{4\pi \epsilon_0 \cdot 1^2} = 8,987 \text{ N}$$

kosinusov poučak $c^2 = a^2 + b^2 - 2ab \cos(\gamma)$
 $F_{ok}^2 = 8,987^2 + 8,987^2 - 2 \cdot 8,987 \cdot 8,987 \cdot \cos(135^\circ) = 16,6 \text{ nN}$

- 1.) Dva su točkasta naboja $Q_1 (x=0, y=0) = 2 \text{ nC}$ i $Q_2 (x=6 \text{ cm}, y=0) = 2 \text{ nC}$ prikazana slikom. Odredite iznos jakosti električnog polja E u točki $A (x=4 \text{ cm}, y=3 \text{ cm})$, prema slici.



$$E = \frac{Q}{4\pi \epsilon d^2}$$

$$E_1 = 7190,04 \frac{\text{V}}{\text{m}}$$

$$E_{ok} = 15935 \frac{\text{V}}{\text{m}}$$

$$E_2 = 13831,23 \frac{\text{V}}{\text{m}}$$

$$E_{ok}^2 = 7190,04^2 + 13831,23^2 - 2 \cdot 7190,04 \cdot 13831,23 \cdot \cos(93,2^\circ)$$

$$\gamma_1 = \arctg\left(\frac{3}{4}\right) = 36,86^\circ$$

$$\gamma_2 = \arctg\left(\frac{3}{2}\right) = 56,309^\circ$$

$$\gamma = 180^\circ - 36,86^\circ - 56,309^\circ = 86,831^\circ$$

$$x = \frac{360^\circ - 2 \cdot 86,831^\circ}{2}$$

$$x = 93,2^\circ$$

izračunamo x i kosinusov poučak

krski por
- Dan p
nber - S

33 34

vgust

10 17

11 18

12 19

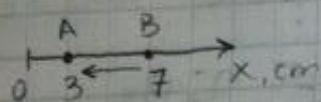
13 20

14 21

15 22

16 23

1.) U točkama na osi x postoji električno polje. Promjena potencijala u tom polju duž osi x zadana je funkcijom $\varphi(x) = K \cdot x$ za $x \geq 0$ (konstanta $K = 500 \text{ V/m}$). Ako se prilikom pomicanja probnog naboja Q_p iz točke A u točku B treba uložiti mehanički rad od $20 \mu\text{J}$, odredite predznak i iznos tog probnog naboja.



$$\varphi(A) = 1500 \text{ V}$$

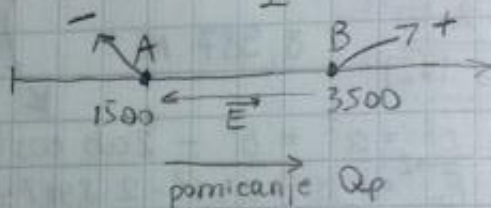
$$\varphi(B) = 3500 \text{ V}$$

polje ide od većeg potencijala prema manjem

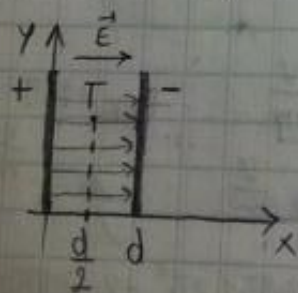
$$A = q \cdot U_{AB} = q (\varphi_A - \varphi_B)$$

$$q = \frac{A}{\varphi_A - \varphi_B} = \frac{20 \cdot 10^{-6}}{2000} = 10 \text{ nC}$$

$$q = +10 \text{ nC}$$



1.) Ploče kondenzatora razmaknute su $d = 5 \text{ cm}$ i nabijene raznoimenim nabojem istog apsolutnog iznosa. Iznos rada dobivenog za vrijeme pomicanja probnog naboja $q = +10 \text{ nAs}$ iz točke $x = 0$ do točke $x = d$ (s lijeve na desnu ploču) iznosi $A = +50 \mu\text{Ws}$. Odredite iznos i smjer električnog polja u točki T.



$$A = q \cdot U \rightarrow U = \frac{A}{q} = 5000 \text{ V}$$

$$U = E \cdot d$$

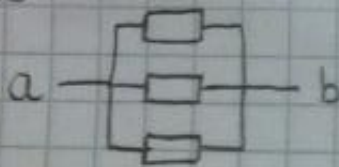
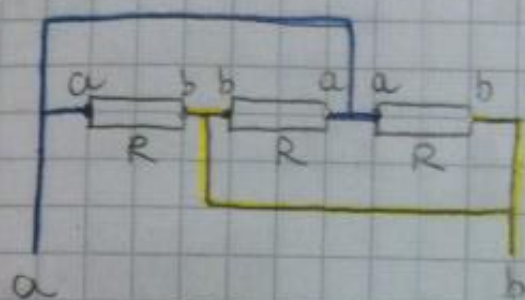
$$E = \frac{U}{d} = \frac{5000}{5 \cdot 10^{-2}} = 100 \frac{\text{V}}{\text{m}}$$

polje je homogeno pa udaljenost od točke T nema veze

- RASPETLJAVANJE OTPORA

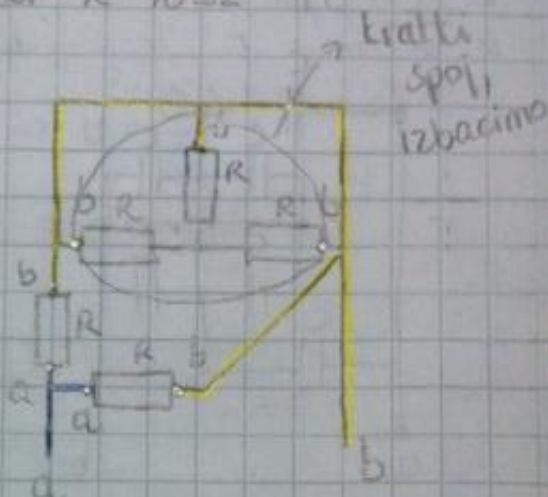
11.2-9. Odredite utupni otpor s točaka a i b u prikazanim spojevima ako je otpor $R = 10 \Omega$

a)



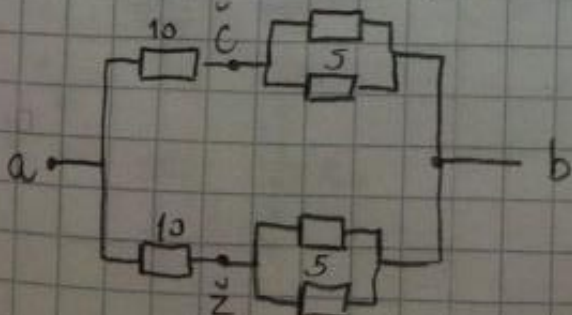
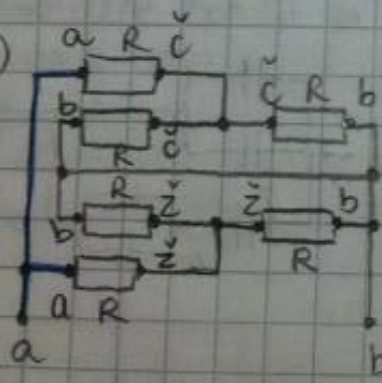
$$R = \frac{10}{3} = 3,33 \Omega$$

b)



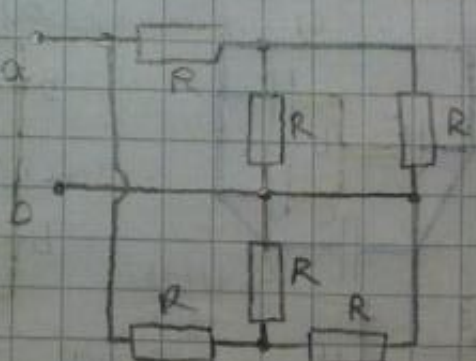
$$R_1 = 5 \Omega$$

c)



$$R_{uk} = 7,5$$

d)



Praznik
ske zah
ember

18 39

ember

4 21

6 22

23

24

25

26

27

52

ber

1 28

2 9 18 23 30

5 12 19 26

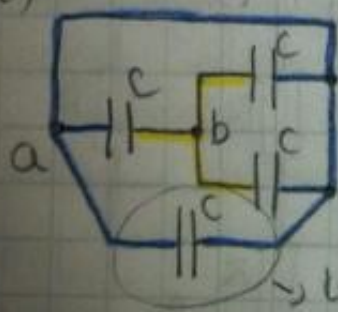
18 1 8 15 22

4 11 18 25

8 15 22 29

III.2-2 Koliki je utupni kapacitet sa stezaljki a i b u spoju prema slici

a)

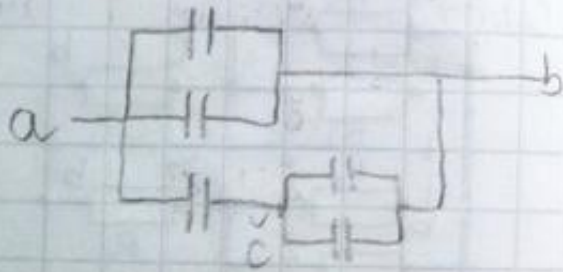
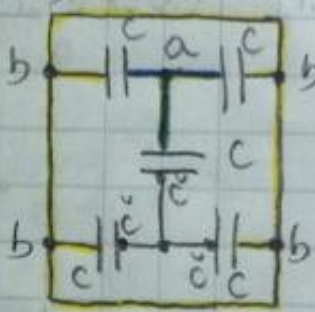


kratki spoj, izbačimo



$$C_{uk} = 3C$$

b)



2. (2)

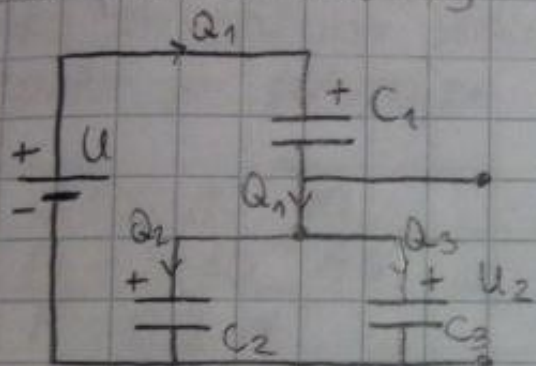
izvor
odred
izvora

$$U = 48$$

$$C_1 = 6$$

$$C_2 = C$$

5.) Kondenzatori $C_1 = C_2 = 10 \mu\text{F}$ i C_3 spojeni su na izvor napona U prema slici. Ako vrijedi da je omjer napona $U/U_2 = 4$ odredite vrijednost kapaciteta kondenzatora C_3



$$Q_1 = Q_2 + Q_3$$

$$Q = U \cdot C \Rightarrow U = \frac{Q}{C}$$

$$\frac{U}{U_2} = 4 = \frac{\frac{Q_1}{C_{\text{uk}}}}{\frac{Q_1}{C_2 + C_3}} \quad \left\{ \begin{array}{l} U = \frac{Q_1}{C_{\text{uk}}} \\ U_2 = \frac{Q_1}{C_2 + C_3} \end{array} \right.$$

$$C_{\text{uk}} = \frac{C_1 \cdot (C_2 + C_3)}{C_1 + C_2 + C_3}$$

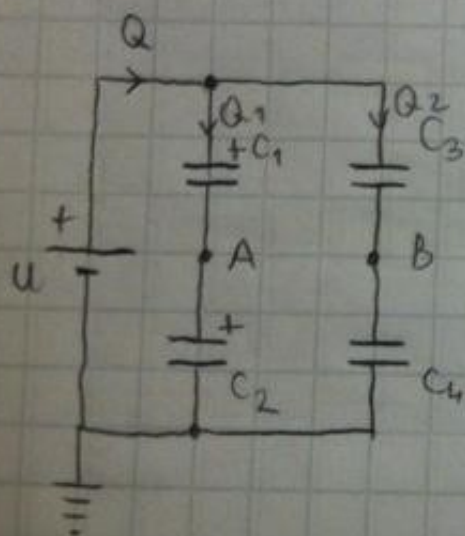
$$= \frac{C_1 + C_3}{C_{\text{uk}}} = 4$$

$$= \frac{C_1 + C_3}{\frac{C_1 \cdot (C_2 + C_3)}{C_1 + C_2 + C_3}} = 4 = \frac{C_1 + C_2 + C_3}{C_1} \dots$$

$$C_3 = 20 \mu\text{F}$$

2. (2) Ako na spoj (nenabijenih) kondenzatora priključimo izvor stalnog napona U , napon U_{AB} jednak je nuli. Odredite koliki bi bio napon U_{AB} ako bi prije priključenja izvora zamijenili mjesta kondenzatora C_1 i C_2

6.) Prethodno nabijeni kondenzatori spojeni su na izvor napona $U = 48\text{ V}$, pri čemu je napon između točaka A i B jednak nuli. Ako je $C_1 = 60\text{ nF}$, a $C_2 = C_3 = 30\text{ nF}$, odredite koliki bi bio napon U_{AB} da su kondenzatorima C_1 i C_2 prije spajanja na izvor bila zamijenjena mjesta?

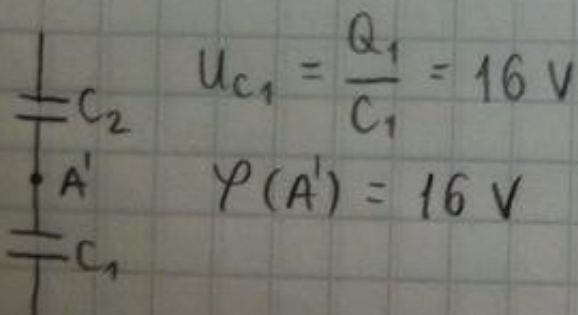


$$Q_1 = U \cdot \frac{C_1 \cdot C_2}{C_1 + C_2} = 960\text{ nC}$$

$$U_{C2} = \frac{Q_1}{C_2} = 32\text{ V}$$

$$\varphi(A) = 32\text{ V}$$

$$\varphi(B) = 32\text{ V}$$



$$U_{C1} = \frac{Q_1}{C_1} = 16\text{ V}$$

$$\varphi(A') = 16\text{ V}$$

$$U_{ab} = \varphi(A') - \varphi(B) = -16\text{ V}$$

8. Pločasti
Ako se ploč
privlače sil

$$r = 0,15\text{ m}$$

- PRORAČUN KONDENZATORA

1. (3) Pločasti zračni kondenzator s kružnim pločama razmaknutim za 0,5 mm, nabijen je nabojem $Q = 0,5 \mu\text{As}$. Ako se pritom ploče kondenzatora privlače silom od 0,2 N koliki je polumjer ploča?

$$d = 5 \cdot 10^{-4} \text{ m}$$

$$Q = 5 \cdot 10^{-7} \text{ As}$$

$$F = 0,2 \text{ N}$$

$$C = \epsilon \cdot \frac{S}{d} \Rightarrow S = \frac{C \cdot d}{\epsilon} = 0,0705 \text{ m}^2$$

$$r = ?$$

$$F \cdot d = W = \frac{QU}{2} \Rightarrow F = \frac{1}{2} \frac{Q \cdot U}{d}$$

$$S = r^2 \pi$$

$$C = \frac{Q}{U} = 1,254 \text{ F}$$

$$U = 400 \text{ V}$$

$$r = 0,15 \text{ m}$$

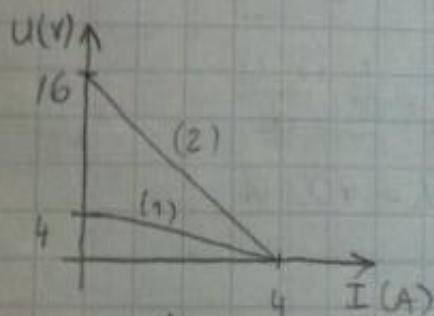
8. Pločasti kondenzator priključen je na napon $U = 2 \text{ kV}$.

Ako se ploče kondenzatora, razmaknute za $d = 1 \text{ mm}$ privlače silom $F = 20 \text{ mN}$, odredi kapacitet kondenzatora.

- DC

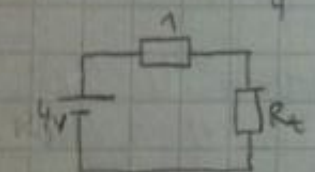
1. međuispit 12-13 1. zadatak

Na slici su prikazane vanjske karakteristike dva realna izvora (1) i (2). Ako na stezaljke izvora (2) priključimo trošilo R_t , kroz trošilo će poteći 2 puta veća struja nego u slučaju kad isto trošilo priključimo izvor (1). Kolika je vrijednost otpora R_t ?



(1)
 $U_{ph} = 4 \text{ V}$
 $I_{ks} = 4 \text{ A}$
 $R_v = 1 \Omega$

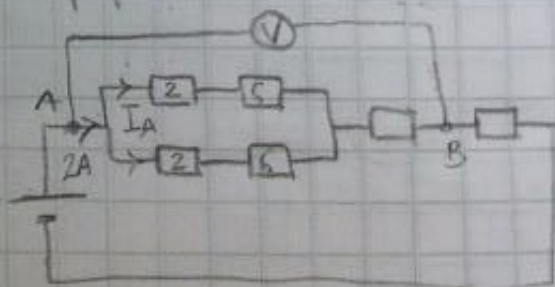
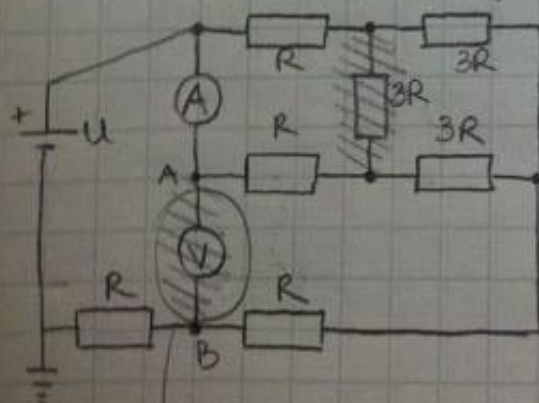
(2)
 $U_{ph} = 16 \text{ V}$
 $I_{ks} = 4 \text{ A}$
 $R_v = \frac{U_{ph}}{I_{ks}} = 4 \Omega$



naponski ili strojni - surjedrin
 $I_1 = \frac{4}{1+R_t}$ $I_2 = \frac{16}{4+R_t}$ $\frac{16}{4+R_t} = 2 \cdot \frac{4}{1+R_t}$

Zimski rok 12-13 5. zadatak

Koliko je pokazivanje ampermetra u spoju na slici ako voltmetar pokazuje 12 V, a $R = 2 \Omega$?
 - masni spoj



$R' = 6$

$I_A = 2 \cdot \frac{8}{8+8}$

voltmetar ima beskonačan R , struja ne teče, izbacimo ga

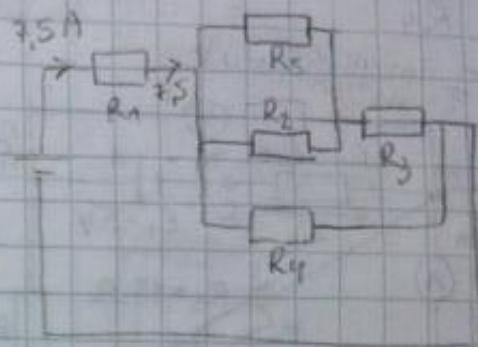
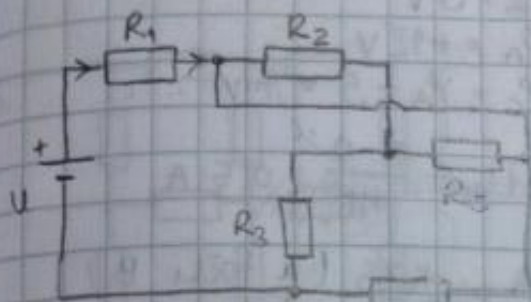
1. međuispit 12-13 8. zadatak

Odredite iznos struje kroz otpornik R_2 ako je zadano:

$$U = 12 \text{ V}$$

$$R_1 = R_2 = R_3 = R_4 = R_5 = 1 \Omega$$

(2)
sta
čimo



$$R_{\text{uk}} = (R_5 \parallel R_2 + R_3) \parallel R_4 + R_1$$

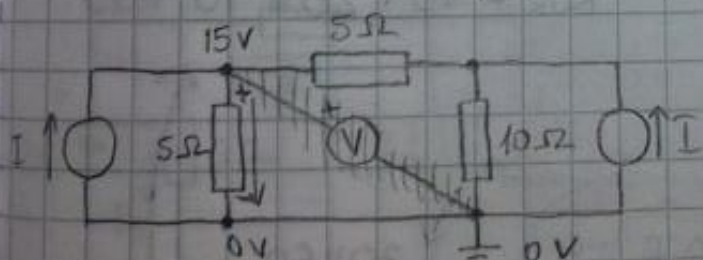
$$R_{\text{uk}} = \frac{8}{5} \Omega$$



$$I' = 7.5 \cdot \frac{1}{1+1.5} = 3$$

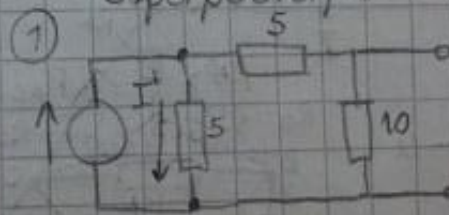
Zimski rok 12-13 14. zadatak

Kolika je struja izvora I ako voltmetar pokazuje $U_v = 15 \text{ V}$ označenog polariteta?

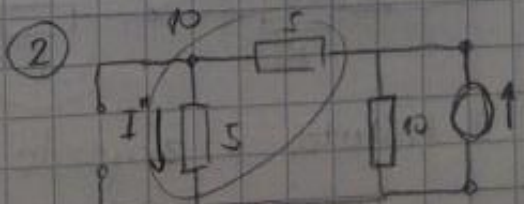


$$I = \frac{15-0}{5} = 3 \text{ A}$$

- superpozicija



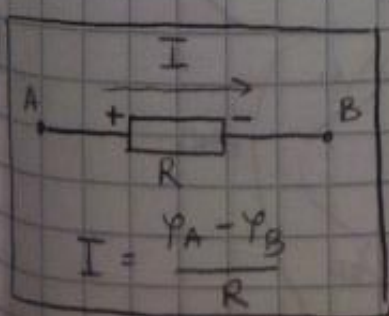
$$I' = I \cdot \frac{15}{15+5} = \frac{3}{4} I (+)$$



$$I'' = I \cdot \frac{10}{10+10} = \frac{I}{2} (+)$$

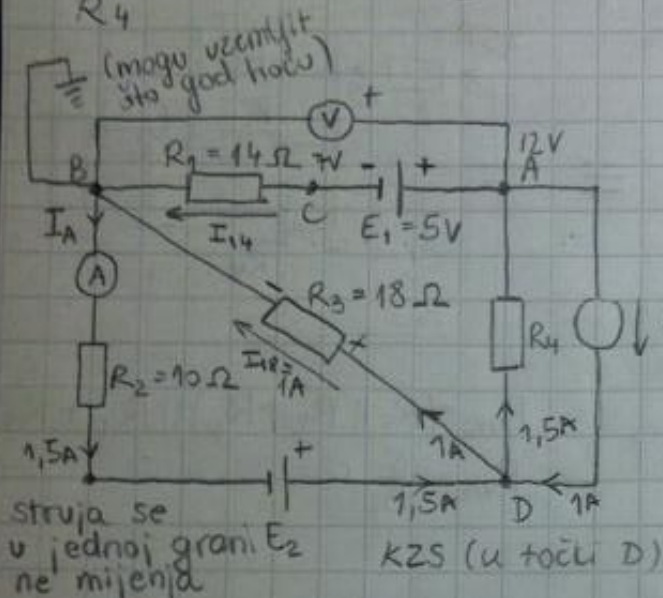
$$\frac{3}{4} I + \frac{1}{2} I = 3$$

$$I = 2.4$$



Jesenški rok 12-13 7. zadatak

Ako idealni ampermetar pokazuje $I_A = 1.5 \text{ A}$, a idealni voltmetar $U_V = U_{AB} = 12 \text{ V}$, odredite iznos otpornika R_4



$$\begin{aligned} \varphi_B &= 0 \text{ V} \\ \varphi_A &= +12 \text{ V} \\ \varphi_C &= \varphi_A - 5 = 7 \text{ V} \\ I_{14} &= \frac{7 - 0}{14} = 0.5 \text{ A} \end{aligned}$$

KZS (u točki B)

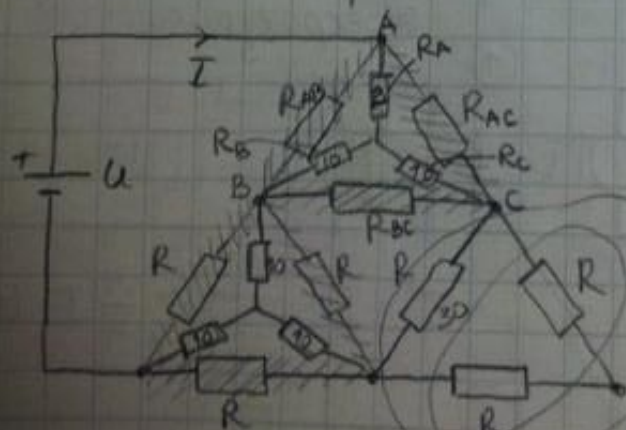
$$\sum i_{ul} = \sum i_{iz}$$

$$\begin{aligned} \varphi_D &= \varphi_B + I_{18} \cdot R_3 \\ &= 0 + 1 \cdot 18 = 18 \text{ V} \end{aligned}$$

$$R_4 = \frac{\varphi_D - \varphi_A}{1.5} = 4 \Omega$$

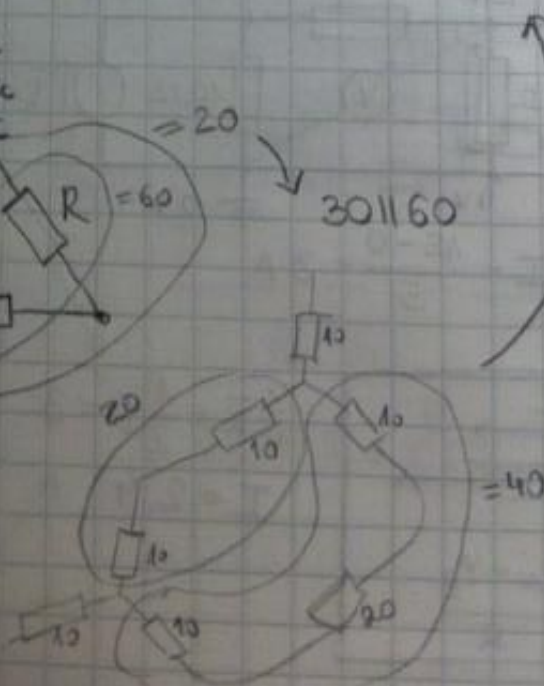
Jesenški rok 11-12 2. zadatak

Odredite struju I na stezaljkama izvora napona $U = 100 \text{ V}$ ako je $R = 30 \Omega$



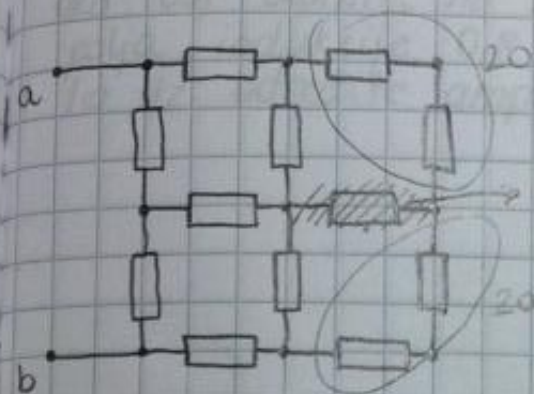
$$R_{uk} = 10 + 20 \parallel 40 + 10$$

2 trokuta u zvijezde

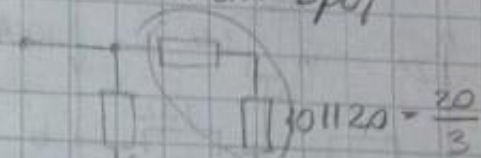


Dekanski rok 10-11

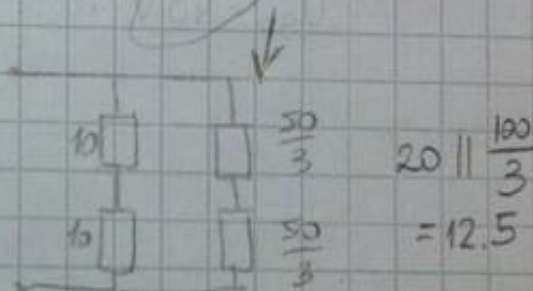
Odredite otpor R_{ab} između stezaljki a i b u mreži prema slici ukoliko su svi otpornici jednaki i iznos otpora svakog otpornika je 10Ω .



- masni spoj

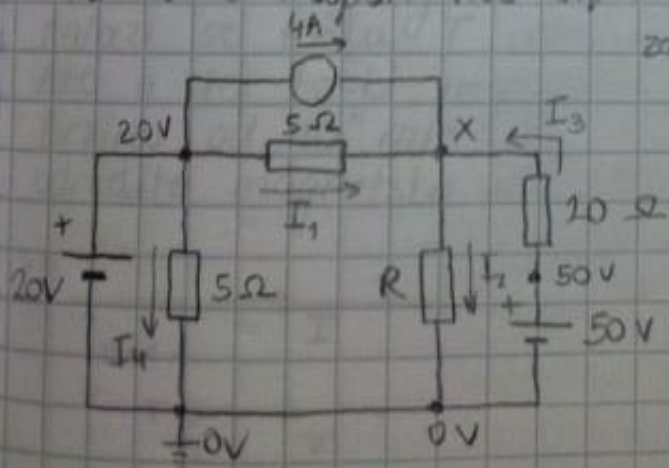


$$10 || 20 = \frac{20}{3}$$



1. međuispit 13-14

Odredite napon na otporniku $R=10 \Omega$



20 čvor

X: K2S

$$\sum i_{ul} = \sum i_{iz}$$

$$I_1 + I_3 + 4 = I_2$$

$$\frac{20 - V_x}{5} + \frac{50 - V_x}{20} + 4 = \frac{V_x - 0}{10} \quad / \cdot 20$$

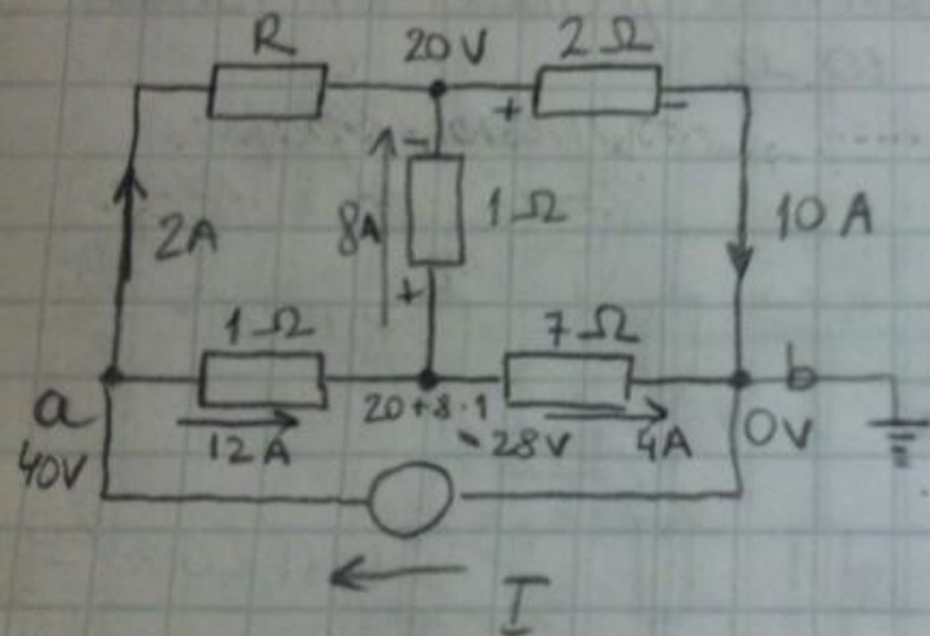
$$80 - 4V_x + 50 - V_x + 80 = 2V_x$$

$$-7V_x = -210$$

$$V_x = 30V$$

Ljetni rok 13-14 6. zadatak

Uz poznate otpore i struje, odredite napon U_{ab}



$$U_{ab} = 40 \text{ V}$$