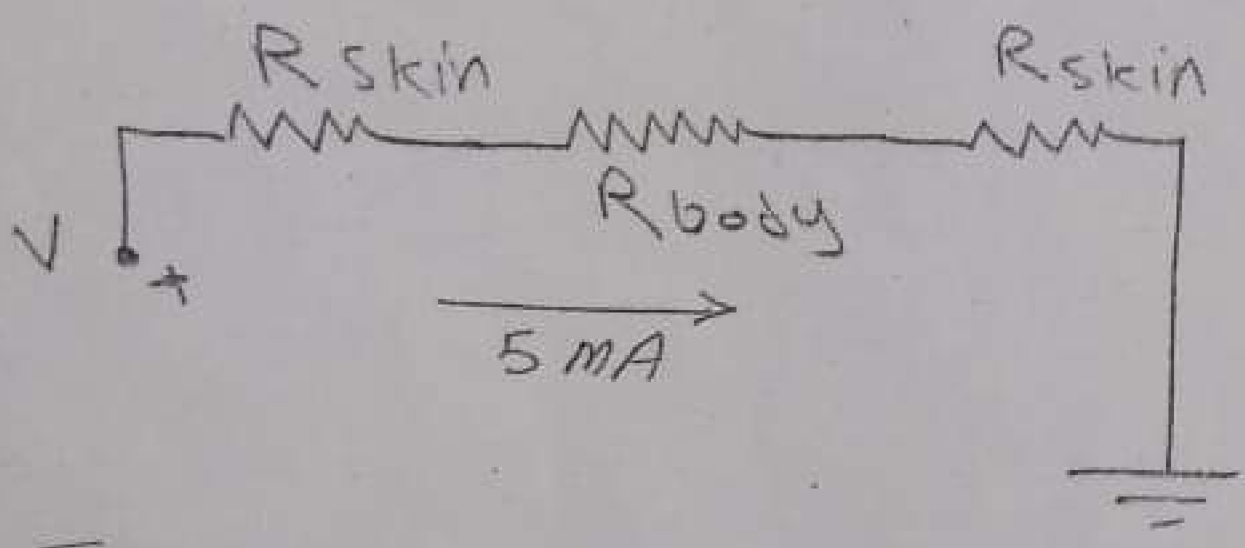
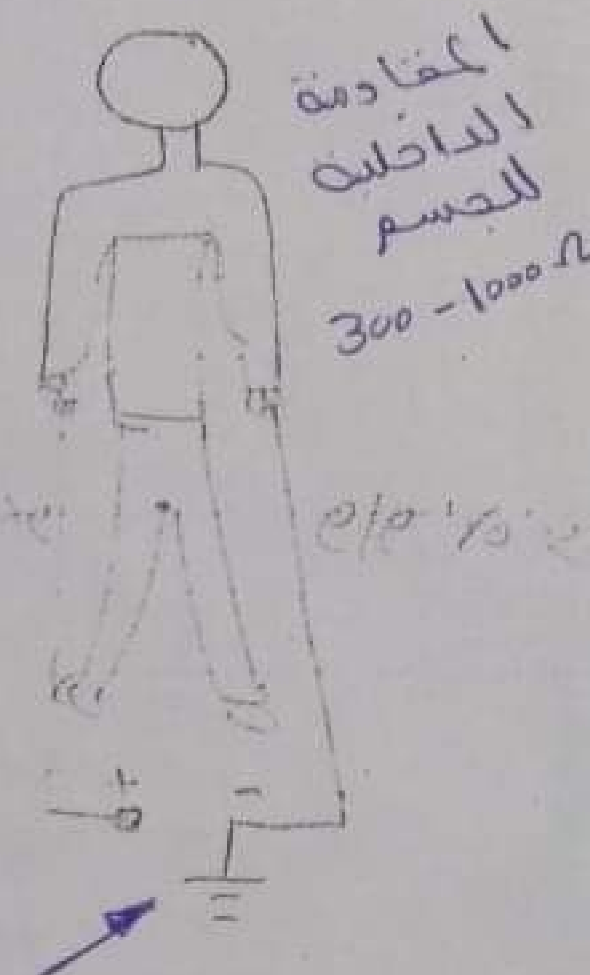
Sheet ①

1- Rbody if given ≠ مسامات الجلد [illegible]
not given → الكهرباء موجوده





- $I_{macroShock} = 5\,mA$
- electrode area = $15.5\ cm^2$

Compute the Voltage Level that would deliver macroShock current.

Solution

- $R_{skin}\big|_{dry} = \frac{93 \times 10^3}{15.5} = 6\,k\Omega$
- ✓ $R_{skin}\big|_{gel} = \frac{10.8 \times 10^3}{15.5} = 696.7\,\Omega$
- ✓ $R_{skin}\big|_{penetrated} = \frac{200}{15.5} = 12.9\,\Omega$

$V\big|_{Dry} = I\,R_{tot} = 5m[(2 \times 6k) + 500] = 62.5V$

$V\big|_{gel} = I\,R_{tot} = 5m[(2 \times 696.77) + 500] = 9.47V$

$V_{penetrated} = I\,R_{tot} = 5m[(2 \times 12.9) + 500] = 2.6?$

50Hz
120V

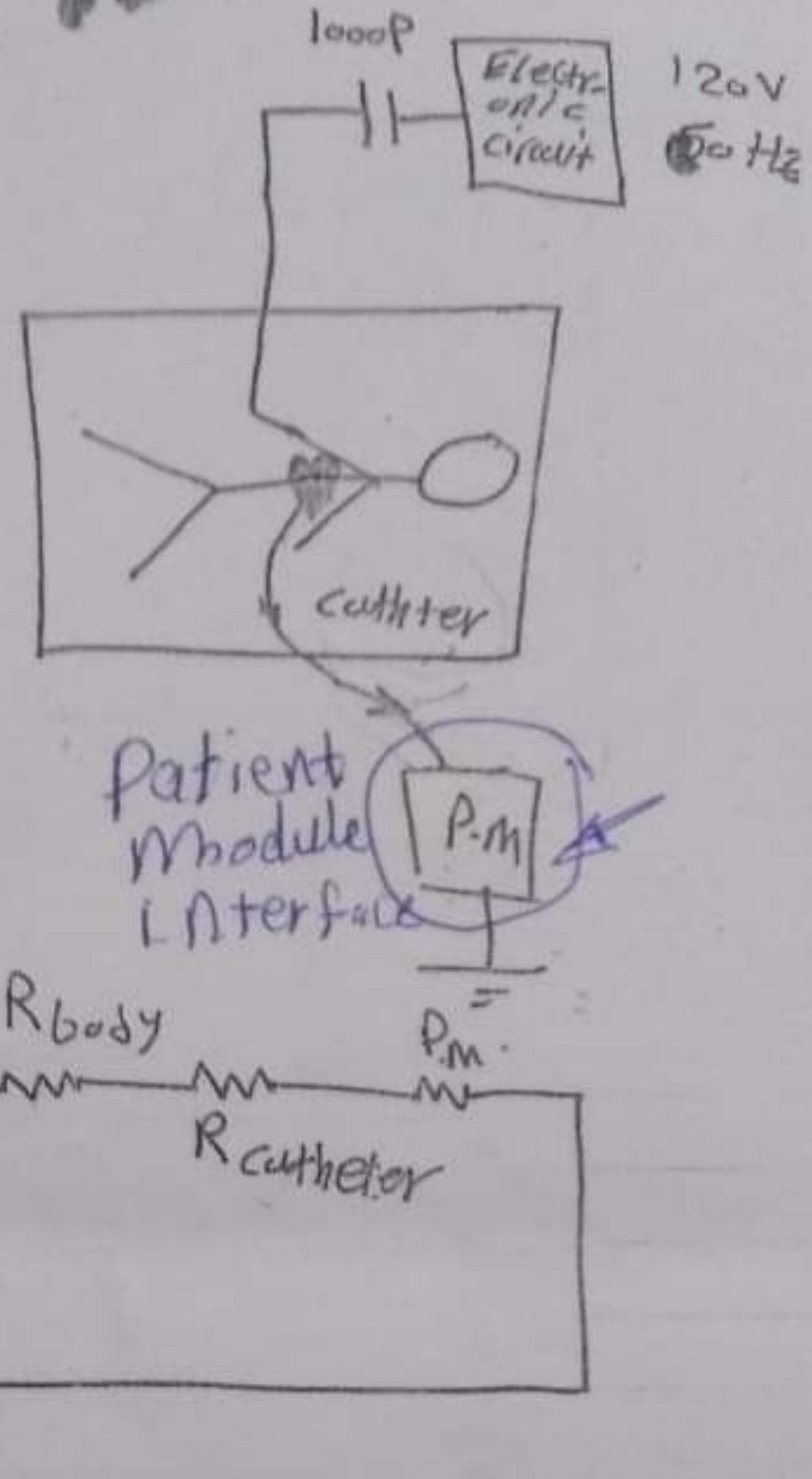
2

$R_{Cath} = 10k\Omega$

$R_{skin} = 10k\Omega$

$R_{body} = 200\Omega$

$I_{Leakage} = ??$



$$\frac{V}{Z} = I_{Leakage} \quad \frac{120\angle 0}{[10k + 200 + 10k] - j\frac{1}{2*3.14*50*1000*10^{-12}}}$$

$$= \frac{120\angle 0}{20200 - j\,3184713.376} = \frac{120\angle 0}{31866.19\angle -89.02^\circ}$$

$I_{Leakage} = 37.7\,\mu A > 10\,\mu A$

∴ The Patient unsafe.

(3)

① RL ⟷ grounded.

Rbody = 500Ω

Rwire = 0.1Ω

V [RL, Blood Pressure filles catheter] = 40mV

diffV s.c = 1 * 0.1 = 0.1V = 100V

Vaccume cleaner

S.C فيمن الجهد اللى هيتولد نتيجة تيار S.C

$$I = \frac{(100 - 40)m}{5000 + 500} = 10.9\,\mu A$$

Safe ≤ 10μA

Rcatheter Rbody

100mV 40m

IR + IR + 40 - 100 = 0

-60

∴ The patien is unsafe

60/R

Vaccume cleaner

ECG monitor with

Right leg

Power distribution Panel

Pressure Trans-ducer

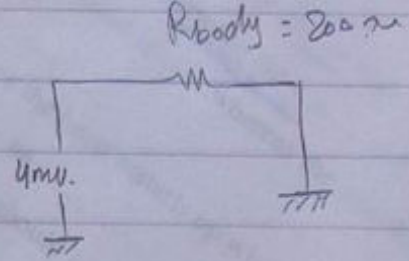
1 AmP

(4) $V = 4mV$, $R_{body} = 200\,\Omega$

$I_{Patient} = ??$

$I = \frac{4\,mV}{200} = 2\mu A > 10\mu A$

un safe macro check

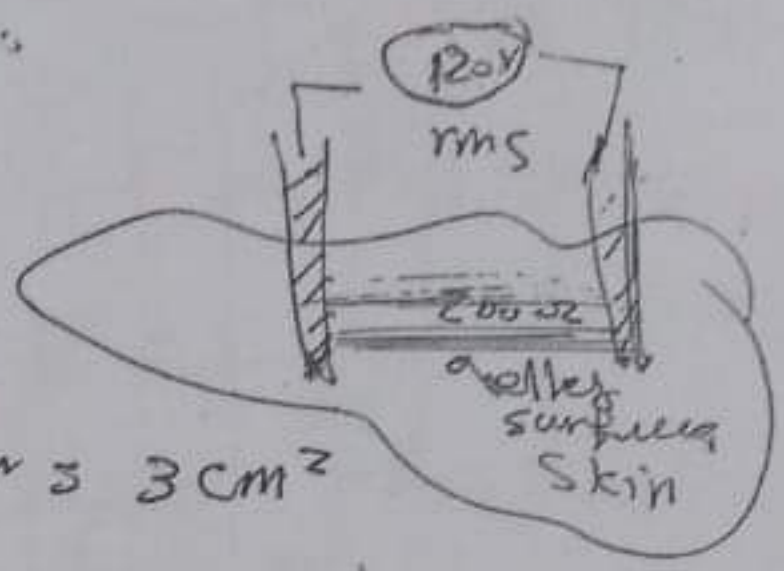


5

$V = 120 V_{rms}$

electrode cross-section area = $3\,cm^2$

$R_{body} = 200\ \Omega$, $R_{skin} = 10.8k$

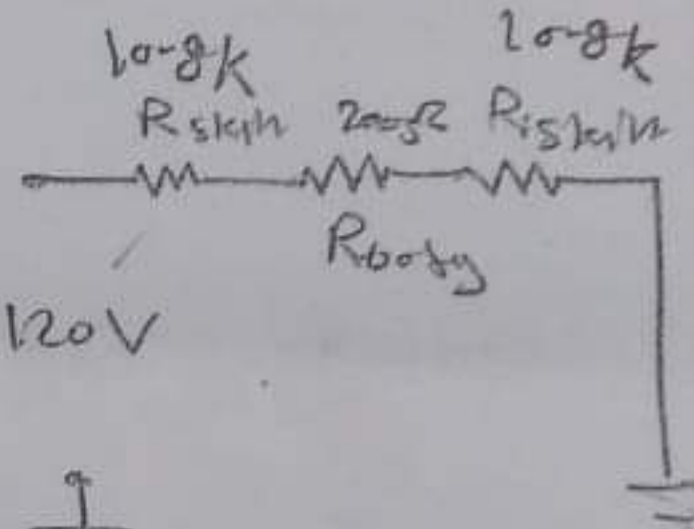


Solution.

[1] what's the resultant current?

$$\frac{V}{Z} = I = \frac{120V}{200 + 2\left(\frac{10.8k}{3}\right)}$$

$$I = 16.2\ mA$$



[2] what will be the physiological effect of this current?

Let - no current (6 - 100 mA)

[3] what will be the effect on the current when the cross-section area of electrode is reduced to $0.3\ cm^2$?

$$I = \frac{V}{Z} = \frac{120}{200 + 2\left(\frac{10.8}{0.3}\right)} = 1.662\ mA$$

Hence this current in threshold critical situation $< 6mA$