SOLUTIONS OF PHYSICS PROBLEMS

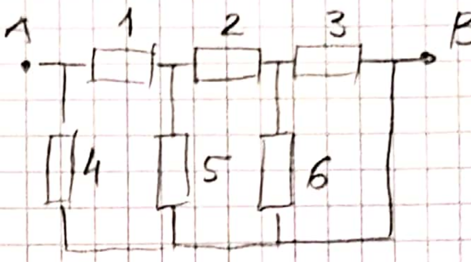
10th GRADE

1. $R_1 = 1\,\Omega$

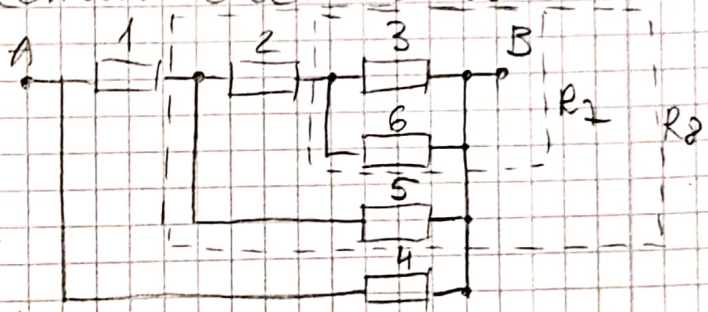
$R_2 = 3\,\Omega$

$R_3 = R_4 = R_6 = 2\,\Omega$

$R_5 = 4\,\Omega$



Redraw electrical circuit



Apply parallel combination of R_1 and R_4 to find equivalent resistance between A and B points:

$$\frac{1}{R_{AB}} = \frac{1}{R_1 + R_8} + \frac{1}{R_4}$$

for R_8: $$\frac{1}{R_8} = \frac{1}{R_2 + R_7} + \frac{1}{R_5}$$

for R_7: $$\frac{1}{R_7} = \frac{1}{R_3} + \frac{1}{R_6}$$

In numerical values:

$$R_{AB} = \frac{(R_1 + R_8) R_4}{R_1 + R_8 + R_4} = \frac{(1+2)\,2}{1+2+2} = \frac{6}{5}\,\Omega$$

$$\underline{R = 1{,}2\,\Omega}$$

2nd way: to apply Kirchhof's rules to find current between A and B points and apply Ohm's law

$$R_{AB} = \frac{U_{AB}}{I_{AB}}$$

(2) $h = 2,5$ m

$\rho_1 = 800$ kg/m^3

$\rho_2 = 1000$ kg/m^3

V_b - ?

a - ?

s - ?

A buoy undergoes free fall, so velocity of it will be find by equation:

a) $v^2 = v_0^2 + 2gh$

$v = 0$

$v_0 = \sqrt{2gh}$

$v_0 = \sqrt{2 \cdot 10 \cdot 2,5} = 5\sqrt{2}$

or

7,071 m/s

b) $\Sigma F_B > W$ ($\therefore$ W - weight)

$\rho_2 > \rho_1$

from 2nd Newton law

$F_B - mg = ma$

or

net retardation inside the water

$$a = \frac{\text{upthrust} - \text{weight}}{\text{mass}}$$

$$a = \frac{F_B - mg}{m}$$

mass in terms of density and volume

$$a = \frac{\rho_2 Vg - \rho_1 Vg}{\rho_1 V} = \frac{(\rho_2 - \rho_1) g}{\rho_1}$$

$$a = \frac{(1000 - 800) \cdot 10}{1000} = 2,5 \ (m/s^2)$$

Depth $v^2 = v_0^2 - 2aS$

$0 = (\sqrt{2gh})^2 - 2aS$

$2gh = 2aS$

$$S = \frac{gh}{a} = \frac{10 \cdot 2,5}{2,5} = 10 m$$

(3) $T_m = 960{,}8\,°C$

$T_{room} = 30\,°C$

$c_{Ag} = 235\ J/kg\,K$

$L_{Ag} = 8{,}82 \times 10^4\ J$

The heat that must be added to a silver bullet of mass m to melt is

$$Q = mc\Delta T + mL_{Ag}$$

where $mc\Delta T$ is heat required to raise the from 30 °C to melting point, mL_{Ag} is heat required to make solid → liquid phase change.

$$E_K = Q$$

$$\frac{1}{2}\cancel{m}v^2 = \cancel{m}c\Delta T + \cancel{m}L_{Ag}$$

$$v = \sqrt{2(c\Delta T + L_{Ag})}$$

$$v = \sqrt{2\left(235 \times (960{,}8 - 30) + 8{,}82 \times 10^4\right)} =$$

$$= \underline{783{,}5\ m/s}$$

In practice not all initial kinetic energy is converted to heat that remains in the bullet.

(4) $d = 3688\ m$

$\rho_{sw} = 1028\ kg/m^3$

$\rho_{salt} = 2200\ kg/m^3$

$h - ?$

$h' - ?$

Mass of the seawater

$m_{sw} = \rho_{sw} V_{sw} =$

$= \rho_{sw}\ 0{,}7\ 4\pi R_E^2 d$

Mass of salt

$m_{salt} = 0{,}034\ m_{sw}$

Volume of salt

$V_{salt} = hS = 4\pi R_E^2 h$

$$h = \frac{V_{salt}}{4\pi R_E^2} = \frac{m_{salt}}{\rho_{salt}\ 4\pi R_E^2} = \frac{0{,}034\ \rho_{sw}\ 0{,}7 \cdot \cancel{4\pi R_E^2}\ d}{\rho_{salt}\ \cancel{4\pi R_E^2}}$$

$$h = \frac{0{,}034\ \rho_{sw} \cdot 0{,}7\ d}{\rho_{salt}}$$

$$h = \frac{0{,}034 \cdot 1028 \cdot 0{,}7 \cdot 3688}{2200} = 41\ m$$

If it was covered only continental part

$$h' = \frac{h}{0{,}3} = 136{,}6\ m$$