9. solve the following numerical problems.

a. the weight of a piece of stone when fully immersed in water is 20N. If it displaces 5N of water, what will be weight of the stone in air?

→ Sol-n
Given,
weight of stone fully immersed in water (w_2) = 20N
upthrust (water displaced's weigh) (U) = 5N
weight of stone in Air (w_1) = ?

now,
we know that,
$$U = w_1 - w_2$$
or $$5 = w_1 - 20$$
$$w_1 = 25N$$

weight of stone in Air will be 25N.

b. In a hydraulic press, area of the large piston is 40cm² coheras the area of small piston is 8cm². what weight can be balanced in the large piston if 200N effort is applied on small piston?

→ Sol-h
Area of large piston (A_2) = 40cm²
Area of small piston (A_1) = 8cm²
Force applied on small piston (F_1) = 200N
Force obtained on large piston (F_2) = ?
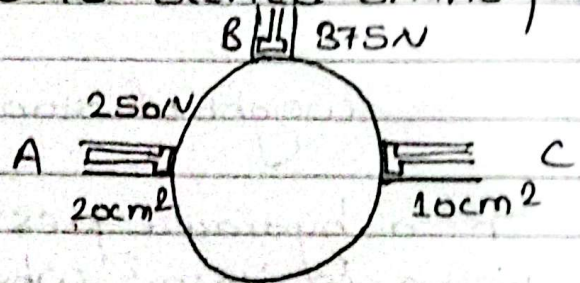
now,
we know that,

From pascal's law

$$R = r_2$$

$$\frac{F_1}{A_1} = \frac{r_2}{A_2}$$

or, $$\frac{200}{8} = \frac{r_2}{40} s$$

or, $$F_2 = 1000 N$$

Thus, weight of 1000N can be balanced on large piston.

c. Pistons A, B and C of the apparatus given are frictionless. What is the Area of the piston B? What force is exerted on the piston C?

Sol-n

Given

piston A Area (A_A) = 20cm^2
piston A Force (F_A) = 250N

Piston B Area (A_B) = ?
Piston B Force (F_B) = 375N

Piston C Area (A_C) = 10cm^2
Piston C Force (F_C) = ?

Now,

• From pascal's law

$$\frac{F_1}{A_1} = \frac{F_2}{A_2} = \frac{F_3}{A}$$

$$\frac{F_A}{A_A} = \frac{F_B}{A_B} = \frac{F_C}{A_C}$$

or, $\quad \dfrac{250N}{20cm^2} = \dfrac{375N}{A_B} = \dfrac{F_C}{10cm^2}$

Now,

$$\frac{250}{20} = \frac{375}{A_B}$$

$$A_B = \frac{375 \times 20}{250}$$

$$A_B = 30cm^2$$

Also,

$$\frac{250}{20} = \frac{F_C}{10}$$

$$F_C = \frac{\overset{125}{\cancel{250}} \times \cancel{10}}{\cancel{20}_{\cancel{2}}}$$

$$F_C = 125N$$

Thus, Area of piston B is $30cm^2$,
Force exerted on piston C is $125N$.

d. A pressure of 50,000N has been developed in liquid used in a hydraulic lift of a house. If the area of cross-section of the piston used to lift the load is 0.1m². Calculate the weight that lift can raise.

→ Sol-n :

pre Given,

pressure developed in hydraulic lift $(P) = 50,000$

Area of piston $(A) = 0.1m^2$

Force or weight that can be lifted $(F) = ?$

Now,

We know that,

$$p = \frac{F}{A}$$

$$50,000 = \frac{F}{0.1}$$

$$F = 5000 N.$$

Thus, weight of 5000N can be lifted.

e. A piece of stone with volume 4000cm³ and density 7800 Kg/m³ is immersed completely in water. If the density of water is 1000 Kg/m³, calculate the weight of stone in air water. What is upthrust of water?

→ Sol-n

Given

volume of piece of stone $(v) = 4000cm^3 = 0.004m^3$

density of stone $(ds) = 7800 Kg/m^3$

density of water $(dw) = 1000 Kg/m^3$

weight of stone in Air $(w) = ?$

upthrust of water $(u) = ?$

Now

we know, that

weight of stone in Air $= d_s \times g \times V$

$= 7800 \times 10 \times 0.0004$

$= 31.2N$

[since stone is fully immersed water or displaced water and stone have same v]

Also,

upthrust due to water u $= d_w \times g \times v$

$= 1000 \times 10 \times 0.0004$

$= 4N$

Thus,

weight of stone in Air is $31.2N$.

upthrust of water is $4N$.

f The cross-sectional areas of small and big pistons of a hydraulic lift are in the ratio 1:6. If an effort of 500N is applied through small piston, what weight will be lifted by the large piston?

Sol-n

Given,

Ratio of Areas of small and big piston $\left(\frac{A_1}{A_2}\right) = 1:6$
Force applied on small piston $(F_1) = 500N$
Force obtained on large piston $(F_2) = ?$

Now,
we know that,

$$\frac{F_1}{A_1} = \frac{F_2}{A_2}$$

$$F_2 = \frac{F_1 \times A_2}{A_1}$$

$$F_2 = F_1 \times \frac{1}{\frac{A_1}{A_2}}$$

$$F_2 = 500 \times \frac{1}{\frac{1}{6}}$$

$$F_2 = 5000 \times 6$$
$$F_2 = 3000N$$

f Thus, weight of 3000N can be lifted by large piston.

9. Weights of stone in three different mediums air, water and salt solutions are as follows:

medium	weight
A	10N
B	15N
C	12N

i. Which medium is Air and which one is water? Why?

Soln

Medium B is Air due to less upthrust by Air causing be highest weight of stone.

Medium C is water because of upthrust stone's weight being lesser than medium B and higher than medium A, medium A being most dense will have most upthrust making stone's weight lightest.

ii. What is upthrust given by water and salt solution to the Stone?

upthrust given by water = weight of stone in Air − weight of stone in water

= 15 − 12

= 3 N

upthrust given by salt solution = weight of stone in Air − weight of stone in salt solution

= 15 − 10

= 5N"