TOPIC 6: HYDRAULICS

MEMORANDUM

Activity 6.1: Pressure

1. B
2. C
3. B
4.

4.1 1 torr = 133 Pa
Thus 300 torr = (133)(300) Pa = 39 900 Pa

4.2
From 4.1: 300 torr = 39 900 Pa = y bar
1 bar = 1 x 10^5 Pa
y = $\frac{39900\times1}{1\times10^5}$ = 0,399 bar
OR
1 bar = 1,33 x 10^7 torr
300 torr =

4.3 From 4.1: 300 torr = 39 900 Pa = y atm
1 atm = 1,01325 x 10^5 Pa
y = $\frac{39900\times1}{1,01325\times10^5}$ = 0,394 atm

5. $p = \frac{F}{A}$ ∴ $p = \frac{40(9,8)}{1\times10^{-4}}$ = 3,92 x 10^6 Pa

6. $p = \frac{F}{A} = \frac{40}{0,004}$ = 10 000 Pa

7. $p = \frac{F}{A}$ ∴ $4\ 500 = \frac{450}{A}$ ∴ A = 0,1 m^2

8. $p = \frac{F}{A}$ ∴ $6,9 \times 10^6 = \frac{F}{\pi(0,075)^2}$ ∴ F = 1,22 X 10^5 N

9. $p = \frac{F}{A}$ ∴ $4 \times 200 \times 10^3 = \frac{1,2\times10^4}{A}$ ∴ A = 0,015 m^3

Activity 6.2: Fluid pressure

1. A
2. A,
3. A
4. C
5. B
6. C
7. C
8. D

9. p = ρgh ∴ 4 980 = ρ(9,8)(2,4) ∴ ρ = 211,73 $kg\cdot m^{-3}$

10. p = ρgh ∴ 18 130 = (1 000)(9,8)h ∴ h = 1,85·m
Height above bottom = 2,2 – 1,85 = 0,35 m
11. p = ρgh = (13 593)(9,8)(0,2) = 26 642,28 Pa

12. $P = \frac{F}{A}$

$P = \frac{mg}{4\pi r^2}$

$1,013 \times 10^5 = \frac{(m)(9,8)}{4 \times \pi \times (6,37 \times 10^6)^2}$

$m = 5,27 \times 10^{18}$ kg

Activity 6.3: Pascal's law

1. B
2. C
3. A
4. B

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

$\frac{F_1}{0,03} = \frac{2\,000 \times 9,8}{0,5}$

$F_1 = \frac{2\,000 \times 9,8}{0,5} \times 0,03$

$F_1 = 1\,176\ N$

6.

6.1 $P = \frac{F}{A}$

$P = \frac{80}{\pi\left(\frac{40}{2} \times 10^{-3}\right)^2}$

$P = 6,37 \times 10^4$ Pa

6.2 $\frac{F_2}{A_2} = 6,37 \times 10^4$

$\frac{320}{\pi r^2} = 6,37 \times 10^4$

$\pi r^2 = 5,0235 \times 10^{-3}$

$r^2 = 1,6 \times 10^{-3}$

$r = 4 \times 10^{-2}$ m $= 40$ m

$\therefore d = 80$ mm

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

$\frac{100}{0,01} = \frac{F_2}{0,1}$

$F_2 = \frac{100}{0,01} \times 0,1$

$F_2 = 1000$ N

This is the combined weight of the chair and the customer. Their combined mass is calculated as follows:

$w = mg$

$1000 = m(9,8)$

$m = 102,04$ kg

Therefore, the mass of the customer is:

$m = 102 - 5 = 97$ kg

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

$\frac{F_1}{400} = \frac{54 \times 9,8}{600}$

$F_1 = \frac{54 \times 9,8}{600} \times 400$

$F_1 = 352,8 \text{ N}$

9.

9.1 $P = \frac{F}{A}$

$35 \times 10^6 = \frac{(100)(9,8)}{\pi r^2}$

$r^2 = 8,91 \times 10^{-6}$

$r = 2,99 \times 10^{-3} \text{ m} = 2,99 \text{ mm}$

$\therefore d = 2 \times 2,99 \text{ mm} = 5,98 \text{ mm}$

9.2 $P = \frac{F}{A}$

$150 \times 10^3 = \frac{mg}{\pi r^2}$

$150 \times 10^3 = \frac{(m)(9,8)}{\pi(8,91 \times 10^{-6})}$

$m = 0,43 \text{ kg}$