

Uitwerkingen extra opgaven hoofdstuk 5

Opgave 5.1

$$p = \frac{F}{A}$$
$$F = m \cdot g = 20 \text{ kg} \times 9,81 \text{ N/kg} = 196,2 \text{ N}$$
$$A = 2,0 \times 2,0 = 4,0 \text{ cm}^2 = 4,0 \times 10^{-4} \text{ m}^2$$
$$p = \frac{196,2 \text{ N}}{4,0 \times 10^{-4} \text{ m}^2} = 490500 \text{ Pa} = 490 \text{ kPa}$$

Opgave 5.2

De druk van het staande boek is 3,5x zo groot als de druk van het liggende boek
Omdat de kracht hetzelfde is en de oppervlakte 3,5x zo klein.

Opgave 5.3

omdat 1 m^2 10.000x zo groot is als 1 cm^2

$$\frac{10.000 \text{ N}}{\text{m}^2} = 10.000 \text{ N/m}^2 = 10.000 \text{ Pa} = 10 \text{ kPa}$$

Opgave 5.4

Antwoord:

lengte olie=29 mm

lengte benzine= 37 mm

$$\rho_{olie} \cdot g \cdot h_{olie} = \rho_{benzine} \cdot g \cdot h_{benzine} \rightarrow \rho_{olie} \cdot h_{olie} = \rho_{benzine} \cdot h_{benzine}$$
$$\rightarrow \frac{\rho_{olie}}{\rho_{benzine}} = \frac{h_{benzine}}{h_{olie}} = \frac{37}{29} = 1,28$$

Opgave 5.5

$$p_{overdruk} = \rho \cdot g \cdot h = 800 \frac{\text{kg}}{\text{m}^3} \times 9,81 \frac{\text{N}}{\text{kg}} \times 0,020 \text{ m} = 157 \text{ Pa} = 0,16 \text{ kPa}$$

Opgave 5.6

$$vacuum = \frac{F_z}{A} = \frac{m \cdot g}{A}$$
$$F_z = 20 \text{ kg} \cdot 9,8 \frac{\text{N}}{\text{kg}} = 196,2 \text{ N}$$
$$A = \pi \cdot r^2 = \pi \cdot (5 \cdot 10^{-2})^2 = 78,5 \cdot 10^{-4} \text{ m}^2$$
$$vacuum = \frac{196,2 \text{ N}}{78,5 \cdot 10^{-4} \text{ m}^2} = 24993 \text{ Pa} = 25,0 \text{ kPa}$$

Opgave 5.7

Gegeven:

$$h_{\text{water}} = 0,50 \text{ m}; \quad d_{\text{plaatje}} = 10,0 \text{ cm}; \quad h_{\text{gem}} = \frac{35 \text{ cm} + 45 \text{ cm}}{2} = 40 \text{ cm};$$

$$\rho_{\text{water}} = 1000 \frac{\text{kg}}{\text{m}^3}; \quad g = 9,81 \frac{\text{N}}{\text{kg}}$$

Gevraagd: kracht op plaatje

Oplossing:

$$F = p_{\text{gem}} \cdot A$$

$$p_{\text{gem}} = \rho \cdot g \cdot h_{\text{gem}} = 1000 \frac{\text{kg}}{\text{m}^3} \cdot 9,81 \frac{\text{N}}{\text{kg}} \cdot 0,40 \text{ m} = 3924 \frac{\text{N}}{\text{m}^2}$$

$$A = \pi \cdot r^2 = \pi \cdot (5 \cdot 10^{-2})^2 = 78,5 \cdot 10^{-4} \text{ m}^2$$

$$F = 3924 \frac{\text{N}}{\text{m}^2} \cdot 78,5 \cdot 10^{-4} \text{ m}^2 = 30,8 \text{ N}$$

$$\text{afgerond: } F = 31 \text{ N}$$

Opgave 5.8

Het hoogteverschil tussen de vloeistofniveaú's is bepalend voor de uitstroomsnelheid. Voorwaarde is dat de hevel volledig gevuld moet zijn met vloeistof.

Opgave 5.9

$$p = \frac{F_z}{A} \rightarrow p = \frac{20.000 \text{ kg} \times 9,81 \frac{\text{N}}{\text{kg}}}{2500 \text{ cm}^2} = 78 \frac{\text{N}}{\text{cm}^2} = 78 \times 10^4 \frac{\text{N}}{\text{m}^2} = 7,8 \times 10^5 \text{ Pa} = 7,8 \text{ bar}$$

Opgave 5.10

Gegeven:

$$\rho = 1000 \frac{\text{kg}}{\text{m}^3}; \quad v = \frac{50 \text{ km}}{\text{h}} = \frac{50 \times 1000 \text{ m}}{3600 \text{ s}} = 13,9 \frac{\text{m}}{\text{s}}; \quad A = \pi \cdot r^2 = 7,065 \text{ cm}^2$$

Gevraagd:

Kracht door de waterstraal.

Oplossing:

$$p = 0,5 \times 1000 \frac{\text{kg}}{\text{m}^3} \times 13,9^2 \frac{\text{m}^2}{\text{s}^2} = 96605 \frac{\text{kg}}{\text{m} \cdot \text{s}^2} = 96605 \frac{\text{N}}{\text{m}^2}$$

$$F = p \cdot A = 96605 \frac{\text{N}}{\text{m}^2} \times 7,065 \cdot 10^{-4} \text{ m}^2 = 68 \text{ N}$$

Opgave 5.11

Gegeven:

$$h_{\text{water}} = 60 \text{ mm}; \quad h_{\text{suiker}} = 40 \text{ mm}$$

Gevraagd:

- $p_{\text{onderdruk}}$
- ρ_{zoutopl}

Oplossing:

a)

$$p_{\text{onderdruk}} = \rho_{\text{water}} \cdot g \cdot h_{\text{water}} = 1000 \frac{\text{kg}}{\text{m}^3} \times 9,81 \frac{\text{N}}{\text{kg}} \times 0,060 \text{ m} = 589 \frac{\text{N}}{\text{m}^2} = 590 \text{ Pa} = 0,59 \text{ kPa}$$

b)

$$p_{\text{onderdruk}} = \rho_{\text{zoutopl.}} \cdot g \cdot h_{\text{zoutopl.}}$$

$$589 = \rho_{\text{zoutopl.}} \times 9,81 \times 0,040 \rightarrow \rho_{\text{zoutopl.}} = \frac{589 \frac{\text{N}}{\text{m}^2}}{9,81 \frac{\text{N}}{\text{kg}} \times 0,040 \text{ m}} = 1500 \frac{\text{kg}}{\text{m}^3}$$

$$\text{afgerond: } \rho_{\text{zoutopl.}} = 1,5 \times 10^3 \frac{\text{kg}}{\text{m}^3}$$

Opgave 5.12

Gegeven:

$$h_{\text{water}} = 0,50 \text{ m}; \quad d_{\text{plaatje}} = 10,0 \text{ cm}; \quad h_{\text{gem}} = \frac{35 \text{ cm} + 45 \text{ cm}}{2} = 40 \text{ cm}; \quad p_{\text{boven}} = 2,0 \times 10^5 \text{ Pa}$$

$$\rho_{\text{water}} = 1000 \frac{\text{kg}}{\text{m}^3}; \quad g = 9,81 \frac{\text{N}}{\text{kg}}; \quad p_b = 10^5 \text{ Pa}$$

Gevraagd: kracht op plaatje

Oplossing:

$$p = p_{\text{gem}} + p_{\text{boven}} - p_b$$

$$F = p \cdot A$$

$$p_{\text{gem}} = \rho \cdot g \cdot h_{\text{gem}} = 1000 \frac{\text{kg}}{\text{m}^3} \times 9,81 \frac{\text{N}}{\text{kg}} \times 0,40 \text{ m} = 3924 \frac{\text{N}}{\text{m}^2}$$

$$p = 3924 + 2,0 \times 10^5 - 1 \times 10^5 = 103924 \frac{\text{N}}{\text{m}^2}$$

$$A = \pi \cdot r^2 = 314 \text{ cm}^2 = 314 \times 10^{-4} \text{ m}^2$$

$$F = 103.924 \frac{\text{N}}{\text{m}^2} \times 314 \times 10^{-4} \text{ m}^2 = 3263 \text{ Pa}$$

$$\text{afgerond: } F = 3,3 \text{ kPa}$$

De druk van het water is 120 Pa = 0,12 kPa, dus te verwaarlozen.