

## HW A Solutions

### HW1:

(1) Pressure = Force per unit area .

$$\begin{array}{l} \text{Unit of } F : \text{ kg m/s}^2 \\ \text{Unit of Area : } \text{m}^2 \end{array} \quad \left. \vphantom{\begin{array}{l} \text{Unit of } F : \text{ kg m/s}^2 \\ \text{Unit of Area : } \text{m}^2 \end{array}} \right\} \frac{F}{\text{Area}} = \text{kg/m}\cdot\text{s}^2 = \text{Pa (pascal)} .$$

(2) Mass  $m = 100 \text{ kg}$ .

$$F = mg = (100)(9.8) \approx (100)(10) = 1000 \text{ (N)} .$$

(3) To know pressure applied by the cube, we need to calculate the contact area of the cube.

(i) Measure the length of a side of the cube :  $L$

(ii)  $\text{Area} = L^2$

(iii)  $p = \frac{1000}{L^2}$

### HW2

Speed of light  $c = 3 \times 10^8 \text{ m/s}$  : Fundamental Phys. Const.

Shortest length : Planck's Length  $L_p \approx 10^{-35} \text{ m}$

$$\frac{(\text{length})}{(\text{speed})} \rightarrow (\text{time}) ; \quad t_p \approx \frac{L_p}{c} \approx 3 \times 10^{-44} \text{ (s)} .$$

### HW3

Size of our galaxy  $\approx 100,000$  light year

The meaning of this unit is the length that light travels for a year .

$\therefore$  light will travel  $\sim 100,000$  yrs to travel our galaxy .

### HW4

$$F = ma \rightarrow a = \frac{F}{m} \rightarrow v = at \text{ for const } a$$

(1) Assuming there is no other force than the pulling,

$$F = 4 \text{ N} \rightarrow \left\{ \begin{array}{l} a_{1\text{kg}} = \frac{4}{1} = 4 \text{ m/s}^2 \\ a_{4\text{kg}} = \frac{4}{4} = 1 \text{ m/s}^2 \end{array} \right\} \text{ const acceleration.}$$

Two objects accelerate for 3s.

$$\therefore v_{1\text{kg}} = 4 \cdot 3 = 12 \text{ m/s}$$

$$v_{4\text{kg}} = 1 \cdot 3 = 3 \text{ m/s}.$$

(2) If there is no friction, after 3s no force is acting on the object. Therefore, by Newton's 1<sup>st</sup>, two objects will move at the speed given above on a straight line (uniform motion).

If there is a friction proportional to mass, 4kg object will experience 4 times larger force against the motion than 1kg object. Friction will slow down the objects.

4kg object will slow down at a rate 4 times larger than the other one.

### HW5

