Assignment-7

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Download all python codes from

https://github.com/satyasm45/Summer−Internship/tree/main/Assignment−7/Codes

and latex-tikz codes from

https://github.com/satyasm45/Summer−Internship/tree/main/Assignment−7

1 Question No. 2.22

Give the magnitude and direction of the net force acting on a stone of mass 0.1 kg,

(a) just after it is dropped from the window of a stationary train
(b) just after it is dropped from the window of a train running at a constant velocity of 36 km/h,
(c) just after it is dropped from the window of a train accelerating with $1ms^{-2}$
(d) lying on the floor of a train which is accelerating with $1ms^{-2}$, the stone being at rest relative to the train.

2 Explanation

For a body of constant mass the force $\mathbf{F}$ acting on it is given by mass(m) times its acceleration($\mathbf{a}$).

$$\mathbf{F} = m \times \mathbf{a} \tag{2.0.1}$$

The acceleration of a body under the influence of gravity is given by:

$$\mathbf{a} = \mathbf{g} = \begin{pmatrix} 0 \\ -9.8 \end{pmatrix} \tag{2.0.2}$$

(a) The stone is dropped from stationary train

$$m = 0.1, \mathbf{a} = \mathbf{g} = \begin{pmatrix} 0 \\ -9.8 \end{pmatrix} \tag{2.0.3}$$

$$\mathbf{F}_a = \begin{pmatrix} 0 \\ -0.98 \end{pmatrix} \tag{2.0.4}$$

$$\tag{2.0.5}$$

The magnitude of force is 0.98N and direction is vertically downwards.

(b) Since the train has a constant velocity $\mathbf{v}$,acceleration of stone is zero and force acting on it inside train is also zero.Just after it is dropped:

$$m = 0.1, \mathbf{a} = \mathbf{g} = \begin{pmatrix} 0 \\ -9.8 \end{pmatrix} \tag{2.0.6}$$

$$\mathbf{F}_b = \begin{pmatrix} 0 \\ -0.98 \end{pmatrix} \tag{2.0.7}$$

The magnitude of force is 0.98N and direction is vertically downwards.

(c) The force acting on a body at an instant depends on that instant.So even if an additional force acted on the stone when it was inside, but once stone is dropped it ceases to act. The net force acting on it is again given by:

$$m = 0.1, \mathbf{a} = \mathbf{g} = \begin{pmatrix} 0 \\ -9.8 \end{pmatrix} \tag{2.0.8}$$

$$\mathbf{F}_c = \begin{pmatrix} 0 \\ -0.98 \end{pmatrix} \tag{2.0.9}$$

The magnitude of force is 0.98N and direction is vertically downwards.

(d) The acceleration of stone will be same as the train.Hence,the force:

$$m = 0.1, \|\mathbf{a}\| = 1 \tag{2.0.10}$$

$$\mathbf{F}_d = 0.1 \times \mathbf{a} \tag{2.0.11}$$

$\therefore$ magnitude of force is 0.1N and direction is along the direction of motion of train.

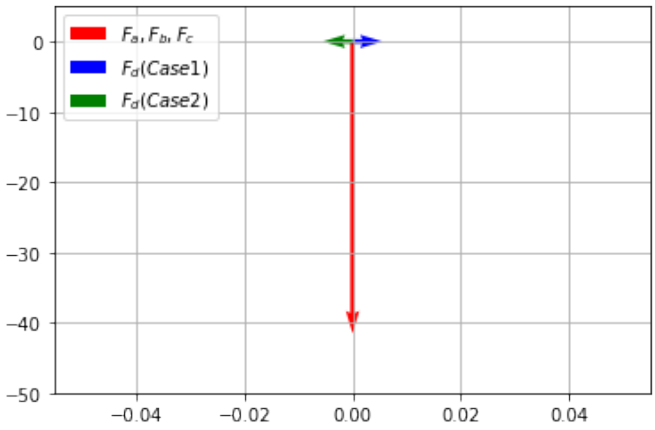

Fig. 2.1: The Force vectors