ASSIGNMENT-6

Unnati Gupta

Download all python codes from

https://github.com/unnatigupta2320/Assignment_8/blob/master/codes

and latex-tikz codes from

https://github.com/unnatigupta2320/Assignment_8

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 Solution

Given that:

$$\text{mass of stone, } m = 0.1kg \tag{2.0.1}$$

a.) Here, the stone is just dropped from window of stationary train.

- So acceleration $\mathbf{a}$ will be equal to acceleration due to gravity $\mathbf{g}$.

$$\therefore \mathbf{a} = \mathbf{g} = 10ms^{-2} \tag{2.0.2}$$
$$\implies \text{Net force, } \mathbf{F} = m\mathbf{a} \tag{2.0.3}$$
$$\implies \mathbf{F} = 0.1 \times 10 \text{ N} \tag{2.0.4}$$
$$\implies \mathbf{F} = 1 \text{ N} \tag{2.0.5}$$

- This force $\mathbf{F}$ will be **acting vertically downwards**.

b.) Here velocity of train is constant.

$$\therefore \text{acceleration, } \mathbf{a} = 0. \tag{2.0.6}$$

- No force acts on the stone due to motion of train.
- The force $\mathbf{F}$ acting on stone will be weight of stone.

$$\therefore \mathbf{F} = \text{weight of stone} \tag{2.0.7}$$
$$\implies \mathbf{F} = m\mathbf{g} \tag{2.0.8}$$
$$\implies \mathbf{F} = 0.1 \times 10 \text{ N} \tag{2.0.9}$$
$$\implies \mathbf{F} = 1 \text{ N} \tag{2.0.10}$$

- This force $\mathbf{F}$ will also be **acting vertically downwards**.

c.) When the train is accelerating with $1ms^{-2}$ an additional force $\mathbf{F}'$ will be acting on stone where,

$$\mathbf{F}' = m\mathbf{a} \tag{2.0.11}$$
$$\mathbf{F}' = 0.1 \times 1 \text{ N} \tag{2.0.12}$$
$$\mathbf{F}' = 0.1 \text{ N} \tag{2.0.13}$$

- This $\mathbf{F}'$ will be acting in the horizontal direction.But once the stone is dropped from the train, $\mathbf{F}'$ becomes zero.
- Now,the force $\mathbf{F}$ acting on stone will be weight of stone.

$$\therefore \mathbf{F} = \text{weight of stone} \tag{2.0.14}$$
$$\implies \mathbf{F} = m\mathbf{g} \tag{2.0.15}$$
$$\implies \mathbf{F} = 0.1 \times 10 \text{ N} \tag{2.0.16}$$
$$\implies \mathbf{F} = 1 \text{ N} \tag{2.0.17}$$

- This force $\mathbf{F}$ will also be **acting vertically downwards**.

d.) As the stone is lying on the floor of the train,its acceleration is the same as that of the train.

- So it's acceleration $\mathbf{a} = 1ms^{-2}$.

$$\implies \text{Net force, } \mathbf{F} = m\mathbf{a} \tag{2.0.18}$$
$$\implies \mathbf{F} = 0.1 \times 1 \text{ N} \tag{2.0.19}$$
$$\implies \mathbf{F} = 0.1 \text{ N} \tag{2.0.20}$$

- This force is **along the horizontal direction of motion of the train**.