

# ASSIGNMENT-6

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Download all python codes from

[https://github.com/unnatigupta2320/Assignment\\_8/blob/master/codes](https://github.com/unnatigupta2320/Assignment_8/blob/master/codes)

and latex-tikz codes from

[https://github.com/unnatigupta2320/Assignment\\_8](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.

- Just after it is dropped from the window of a stationary train.
- Just after it is dropped from the window of a train running at a constant velocity of 36 km/h.
- Just after it is dropped from the window of a train accelerating with  $1\text{ms}^{-2}$
- Lying on the floor of a train which is accelerating with  $1\text{ms}^{-2}$ , the stone being at rest relative to the train.

## 2 SOLUTION

Given that:

$$\text{mass of stone, } m = 0.1\text{kg} \quad (2.0.1)$$

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

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

$$\therefore \mathbf{a} = \mathbf{g} = 10\text{ms}^{-2} \quad (2.0.2)$$

$$\Rightarrow \text{Net force, } \mathbf{F} = m\mathbf{a} \quad (2.0.3)$$

$$\Rightarrow \mathbf{F} = 0.1 \times 10 \text{ N} \quad (2.0.4)$$

$$\Rightarrow \mathbf{F} = 1 \text{ N} \quad (2.0.5)$$

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

- Here velocity of train is constant.

$$\therefore \text{acceleration, } \mathbf{a} = 0. \quad (2.0.6)$$

- No force acts on the stone due to motion of train.

- The force  $\mathbf{F}$  acting on stone will be weight of stone.

$$\therefore \mathbf{F} = \text{weight of stone} \quad (2.0.7)$$

$$\Rightarrow \mathbf{F} = m\mathbf{g} \quad (2.0.8)$$

$$\Rightarrow \mathbf{F} = 0.1 \times 10 \text{ N} \quad (2.0.9)$$

$$\Rightarrow \mathbf{F} = 1 \text{ N} \quad (2.0.10)$$

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

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

$$\mathbf{F}' = m\mathbf{a} \quad (2.0.11)$$

$$\mathbf{F}' = 0.1 \times 1 \text{ N} \quad (2.0.12)$$

$$\mathbf{F}' = 0.1 \text{ N} \quad (2.0.13)$$

- 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.

$$\therefore \mathbf{F} = \text{weight of stone} \quad (2.0.14)$$

$$\Rightarrow \mathbf{F} = m\mathbf{g} \quad (2.0.15)$$

$$\Rightarrow \mathbf{F} = 0.1 \times 10 \text{ N} \quad (2.0.16)$$

$$\Rightarrow \mathbf{F} = 1 \text{ N} \quad (2.0.17)$$

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

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

- So its acceleration  $\mathbf{a} = 1\text{ms}^{-2}$ .

$$\Rightarrow \text{Net force, } \mathbf{F} = m\mathbf{a} \quad (2.0.18)$$

$$\Rightarrow \mathbf{F} = 0.1 \times 1 \text{ N} \quad (2.0.19)$$

$$\Rightarrow \mathbf{F} = 0.1 \text{ N} \quad (2.0.20)$$

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