

ASSIGNMENT-8

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Download all python codes from

https://github.com/unnatigupta2320/Assignment_8

and latex-tikz codes from

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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 1ms^{-2}
- 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:

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

- 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 1ms^{-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**.