CHAPTER: 02

KINEMATICS

Numericals

Question 1(a)

Convert 160 km/h into m/s

Given Data:

Speed

$$v = 160\,\text{km/h}$$

To Find:

Speed in m/s = ?

Solution:

$1\,\text{km/h} = \frac{1000}{3600}\,\text{m/s}\; v = 160 \times \frac{1000}{3600}\; v = 44.44\,\text{m/s}$

Answer:

$$\boxed{44.44\ \text{m/s}}$$

Question 1(b)

Convert 36 m/s into km/h

Given Data:

Speed

$$v = 36\,\text{m/s}$$

To Find:

Speed in km/h = ?

Solution:

$1\,\text{m/s} = 3.6\,\text{km/h}\; v = 36 \times 3.6\; v = 129.6\,\text{km/h}$

Answer:

$$\boxed{129.6\ \text{km/h}}$$

Question 1(c)

Convert 15 km/h^2 into m/s^2

Given Data:

Acceleration

$$a = 15\,\text{km/h}^2$$

To Find:

Acceleration in m/s^2 = ?

Solution:

$1\,\text{km/h}^2 = \frac{1000}{3600^2}\,\text{m/s}^2\ a = 15 \times \frac{1000}{3600^2}\ a \approx 0.001\,\text{m/s}^2$

Answer:

$$\boxed{0.001\ \text{m/s}^2}$$

Question 1(d)

Convert 1 m/s^2 into km/h^2

Given Data:

Acceleration

$$a = 1\,\text{m/s}^2$$

To Find:

Acceleration in km/h^2 = ?

Solution:

$1\,\text{m/s}^2 = \frac{3600^2}{1000}\,\text{km/h}^2\ a = 12{,}960\,\text{km/h}^2$

Answer:

$$\boxed{12{,}960\ \text{km/h}^2}$$

Question 2

In 10 s, a cyclist increases speed from 5 km/h to 7 km/h, while a car moves from rest to 20 km/h. Calculate and compare accelerations.

(a) Cyclist

Given Data:

Initial speed

$$u = 5\,\text{km/h} = 1.39\,\text{m/s}$$

Final speed

$$v = 7\,\text{km/h} = 1.94\,\text{m/s}$$

Time

$$t = 10\,\text{s}$$

To Find:

Acceleration = ?

Solution:

$a = \frac{v-u}{t}\, a = \frac{1.94-1.39}{10}\, a = 0.055\,\text{m/s}^2$

Answer:

$$\boxed{0.055\ \text{m/s}^2}$$

(b) Car

Given Data:

Initial speed

$$u = 0\,\text{m/s}$$

Final speed

$$v = 20\,\text{km/h} = 5.56\,\text{m/s}$$

Time

$$t = 10\,\text{s}$$

To Find:

Acceleration = ?

Solution:

$a = \frac{v-u}{t}\, a = \frac{5.56-0}{10}\, a = 0.55\,\text{m/s}^2$

Answer:

$$\boxed{0.55\ \text{m/s}^2}$$

Question 3

A ball is thrown vertically upward and takes 2 s to reach the highest point. Find the initial speed.

Given Data:

Time to reach top

$$t = 2\,\text{s}$$

Acceleration due to gravity

$$g = 9.8\,\text{m/s}^2$$

Final velocity at top

$$v = 0\,\text{m/s}$$

To Find:

Initial speed u =?

Solution:

$v = u - gt\ 0 = u - (9.8 \times 2)\ u = 19.6\,\text{m/s}$

Answer:

$$\boxed{19.6\ \text{m/s}}$$

Question 4

A car moves with uniform velocity of 20 m/s for 20 s, then comes to rest uniformly in 30 s. Find the distance covered.

Given Data:

Uniform speed

$$v = 20\ \text{m/s}$$

Time at constant speed

$$t_1 = 20\ \text{s}$$

Time during braking

$$t_2 = 30\ \text{s}$$

To Find:

Total distance = ?

Solution:

Distance during uniform motion:

$$s_1 = vt_1 = 20 \times 20 = 400\ \text{m}$$

Distance during deceleration (triangle area):

$$s_2 = \frac{1}{2}vt_2 = \frac{1}{2} \times 20 \times 30 = 300\ \text{m}$$

Total distance:

$$s = s_1 + s_2 = 400 + 300 = 700\ \text{m}$$

Answer:

$$\boxed{700\ \text{m}}$$

Question 5

A girl rides a bicycle at 50 km/h and stops in 60 s. Find her acceleration.

Given Data:

Initial speed

$$u = 50\ \text{km/h} = 13.9\ \text{m/s}$$

Final speed

$$v = 0\ \text{m/s}$$

Time

$$t = 60\ \text{s}$$

To Find:

Acceleration = ?

Solution:

$a = \frac{v-u}{t}\, a = \frac{0-13.9}{60}\, a = -0.23\ \mathrm{m/s^2}$

(Magnitude taken)

Answer:

$$\boxed{0.23\ \mathrm{m/s^2}}$$

Question 6(a)

From the speed–time graph, identify acceleration, deceleration and zero acceleration.

Answer:

- **Acceleration:** OA
- **Zero acceleration:** AB
- **Deceleration:** BC

Question 6(b)

Calculate distance covered from 10 s to 20 s.

Given Data:

Speed

$$v = 50\ \mathrm{m/s}$$

Time interval

$$t = 10\ \mathrm{s}$$

To Find:

Distance = ?

Solution:

$s = vt = 50 \times 10\ s = 500\ \mathrm{m}$

Answer:

$\boxed{500 \text{ m}}$

