9^{th} Class Physics Chapter 2 Notes

FBISE National Book Foundation

NUMERICAL RESPONSE QUESTIONS

Solve the following.

Q1. Convert the following:

a. 160kmh^{-1} Into ms^{-1} **b. $36\ \text{ms}^{-1}$ Into kmh^{-1}**

c. 15kmh^{-2} Into ms^{-2} **d. $1\ \text{ms}^{-2}$ Into kmh^{-2}**

Ans: To convert between these units, we use the following relationships:

- $1\text{kmh}^{-1} = \frac{1}{3.6}\ \text{ms}^{-1}$
- $1\ \text{ms}^{-1} = 3.6\text{kmh}^{-1}$
- $1\text{kmh}^{-2} = \left(\frac{1}{3.6}\right)^2\ \text{ms}^{-2}$
- $1\ \text{ms}^{-2} = (3.6)^2\text{kmh}^{-2}$

Now, applying these conversions:

a. 160kmh^{-1} Into ms^{-1}

$$160\text{kmh}^{-1} \times \frac{1\ \text{ms}^{-1}}{3.6\text{kmh}^{-1}} = \frac{160}{3.6}\ \text{ms}^{-1} = 44.44\ \text{ms}^{-1}$$

b. $36\ \text{ms}^{-1}$ Into kmh^{-1}

$$36\ \text{ms}^{-1} \times 3.6\text{kmh}^{-1} = 129.6\text{kmh}^{-1}$$

c. 15kmh^{-2} Into ms^{-2}

$$15\text{kmh}^{-2} \times \left(\frac{1}{3.6}\right)^2\ \text{ms}^{-2} = 15 \times \frac{1}{12.96}\ \text{ms}^{-2} = 1.157\ \text{ms}^{-2}$$

d. $1\ \text{ms}^{-2}$ into kmh^{-2}

$$1\ \text{ms}^{-2} \times (3.6)^2\text{kmh}^{-2} = 12.96\text{kmh}^{-2}$$

Q2. In 10 seconds, a cyclist increases its speed from 5kmh^{-1} to 7kmh^{-1}, while a car moves from rest to 20kmh^{-1} in same time. Calculate and compare acceleration in each case.
(Ans. $0.055\ \text{ms}^{-2}$ and $0.55\ \text{ms}^{-2}$)

Ans:

Given data:

Time taken $= t = 10\ \text{s}$

Initial speed of cyclist = $v_1 = 5\mathbf{kmh}^{-1}$

Final speed of cyclist = $\mathrm{v_f} = 7\mathrm{kmh}^{-1}$

Initial speed of car = $v_1 = 20\mathbf{kmh}^{-1}$

Final speed of car = $v_\mathrm{f} = 0\mathrm{kmh}^{-1}$

Required:

Acceleration of cyclist = $\mathbf{a}_{\text{cyctist}} = ?$

Acceleration of ear = $\mathrm{a}_{\text{car}} = ?$

Solution:

First we will convert all the given speeds into m/s.

Initial speed of cyclist

Final speed of cyclist

Initial speed of car

$$v_1 = 5\mathrm{kmh}^{-1} = \frac{5 \times 1000\ \mathrm{m}}{3600\ \mathrm{s}} = 1.39\ \mathrm{ms}^{-1}$$
$$v_\mathrm{f} = 7\mathrm{kmh}^{-1} = \frac{7 \times 1000\ \mathrm{m}}{3600\ \mathrm{s}} = 1.94\ \mathrm{ms}^{-1}$$
$$v_1 = 20\mathrm{kmh}^{-1} = \frac{20 \times 1000\ \mathrm{m}}{3600\ \mathrm{s}} = 5.56\ \mathrm{ms}^{-1}$$
$$v_1 = 0\mathrm{kmh}^{-1} = \frac{0 \times 1000\ \mathrm{m}}{3600\ \mathrm{s}} = 0\ \mathrm{ms}^{-1}$$

Final speed of car

Now acceleration of cyclist is given by:

$$a_{cyclist} = \frac{v_f - v_i}{\Delta t} = \frac{1.94 - 1.39}{10s} = 0.05\ \mathrm{ms}^{-2}$$

Now acceleration of car is given by:

$$a_{\text{car}} = \frac{v_f - v_i}{\Delta t} = \frac{5.56 - 0}{10s} = 0.556\ \mathrm{ms}^{-2}$$

Car has a much greater acceleration (about 10 times) than the cyclist.

Q3. A ball is thrown straight up such that it took 2 seconds to reach the top after which it started falling back. What was the speed with which the ball was thrown up? (Ans. $19.6\ \mathrm{ms}^{-1}$)

Ans:

Given data:

Final velocity at the top $(v) = 0\ \text{ms}^{-1}$

Acceleration due to gravity $(a) = 9.8\ \text{ms}^{-2}$

[Acting downward, so it's negative in our equation because we consider upward movement as positive]

Time to reach the top $(t) = 2$ seconds

Speed with which the ball was thrown up $(V_1) = ?$

Solution:

We can use the formula that relates initial velocity (V_L), acceleration (a), and time (t) :

$$V = V_1 + at$$

Rearranging the formula to solve for $\boldsymbol{v}_i$, we have:

$V = V_t + at$

$0 = V_1 - (9.8 \times 2)$

$V_t = 9.8 \times 2 \Rightarrow V_t = 19.6\ \text{ms}^{-1}$

Therefore, the initial speed with which the ball was thrown up is $19.6\ \text{ms}^{-1}$,

Q4. A car is moving with uniform velocity of $20\ \text{ms}^{-1}$ for 20 seconds. Then brakes are applied and it comes to rest with uniform deceleration in 1 minute. Plot the graph to calculate this distance using speed time graph?(Ans. 1 km)

Ans:

Given data:

Uniform speed $= v_1 = 20\ \text{ms}^{-1}$

time taken $= \hat{t}_1 = 20$ s

Final speed of car $= v_f = 0\ \text{ms}^{-1}$

Time taken to stop $= \text{t}_2 = 1$ minute $= 60$ s

Required:

Distance covered using graph $= \mathbf{S} = ?$

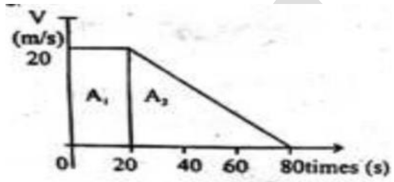
Solution:

To find distance covered using velocity time graph, we will find area under the curve. Area is divided into two parts A_1 and A_2 as shown in the figure.

The total distance covered will then be given by:

Distance covered $= \text{Area A}_1 + \text{Area A}_2$

$$S = v \times t + \frac{1}{2} v \times t$$



Putting values: $S = 20 \times 20 + \frac{1}{2}(20 \times 60)$

$S = 400 \text{ m} + 600 \text{ m} = 1000 \text{ m} = 1 \text{ km}$

Thars the power of using graphs. A very complicated problem is solved in just three steps.

Q5. A girl starts her motion by a racing bicycle in a straight line at a speed of 50kmh^{-1}. Her speed is changing at a constant rate. If she stops after 60 s, what is her acceleration? (Ans. 0.23 ms^{-2})

Ans:

Given datal:

Initial velocity $= (v_l) = 50\mathbf{kmh}^{-1}$

Final velocity $= (v_f) = 0 \text{ ms}^{-1}$ (Since she comes to a stop)

Time $= (t) = 60$ s

Required:

Acceleration $= (a) = ?$

Solution:

Convert the initial velocity from kilometers per hour to meters per second:

$$50\text{kmh}^{-1} = 50 \times \frac{1}{3.6} \text{ ms}^{-1} = 13.89 \text{ ms}^{-1}$$

Use the formula for acceleration to solve for a :

$$v_f = v_i + at$$

$0 = 13.89 + a \times 60 =$, $-13.89 = 60 \times a$

$a = \frac{-13.89}{60}$

$a = -0.23\ \text{ms}^{-2}$

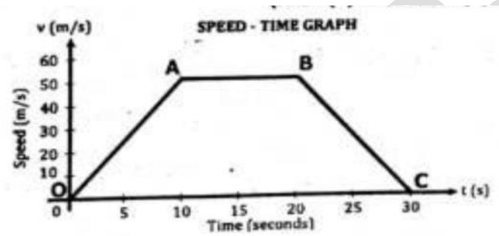
Therefore, the acceleration of the girl on her bicycle is $-0.23\ \text{ms}^{-2}$. The negative sign indicates deceleration, as expected since she comes to a stop.

Q6. Consider the following speed time graph. Tell:

a. Which part of the graph is showing acceleration, deceleration and zero acceleration?

b. Calculate covered distance from 10 seconds to 20 seconds from the graph.

(Ans. (a) OA, BC, AB, (b) 500 m)



Ans:

Solution: Graph is a trapezium

(a) The first part of the graph (OA) shows **acceleration** . The speed of the body is increasing.

The second part of the graph A to B moving with uniform velocity show **zero acceleration**

And B to C is decreasing velocity So **deceleration**

(b) Distance travelled from 10 seconds to 20 seconds can be found by finding the area under the AB curve, which is given by:

Distance travelied $s =$ speed $\times$ time

$S = 50 \times 10 = 500$ m