



DBS 10042 ENGINEERING SCIENCE

LINEAR MOTION



$$E=mc^2$$

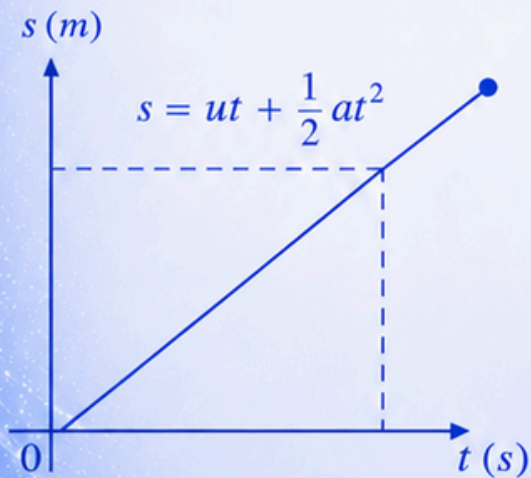
$$Ek_i$$

EMILAWATI BINTI OTHMAN
NAJAH BINTI MOHD NAWI



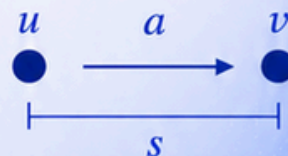
LINEAR MOTION

Pocket Notes for Polytechnic Students



$$v = u + at$$

$$v^2 = u^2 + 2as$$



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PREFACE

All praise be to Allah S.W.T. for His grace and mercy, we have finally succeeded in completing this e-book. The purpose of developing this e-book is to help students such in an easy way in the topic of differential equations. This e-book follows the polytechnic syllabus **(DBS10042 Engineering Science)** and can serve as concise notes to enhance students' understanding of this topic. With this e-book, students can make quick references since the notes can be accessed easily through mobile devices by obtaining the e-book link. Convenient, isn't it? We hope that this e-book will give the benefit to students and serve as pocket notes to make learning easier.

*Emilawati Binti Othman
Najah Binti Mohd Nawi*

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INTRODUCTION

“ Motion can be simple or complicated.
One basic concept that we need to understand is
LINEAR MOTION. ”



THE CONCEPT OF **LINEAR MOTION**

Let's understand it with a simple example!



A STRAIGHT LINE

This is **LINEAR MOTION**.

START



END

The motion follows a **straight path** from the **starting point** to the **end point**.

NOT A STRAIGHT LINE

This is **NON-LINEAR MOTION**.

START



END

The motion does not follow a straight path.
It **changes direction** along the way.



KEY POINT



LINEAR MOTION is the motion of an object along a **STRAIGHT LINE**.



NON-LINEAR MOTION is the motion of an object that is **NOT** along a straight line.



Physics Talk: Linear vs Non-Linear Motion

Okay everyone, before we go home, let's learn something simple!

Alright! What are we learning today?

Let's start with **LINEAR MOTION**. It means movement in a straight line.

Example: A car moving straight on the road.



So, linear motion is just going straight?

Exactly! 👍

Now, **NON-LINEAR MOTION**. It is movement that curves or rotates. It does not go in a straight line.

Example: A ball rolling, a fan spinning, or a Ferris wheel turning.



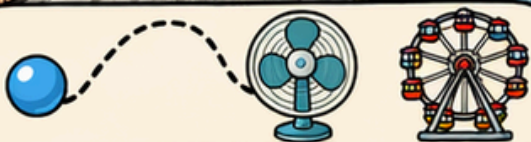
So, if it turns or curves, it's non-linear motion?

Yes! That's right.

Ohh... now I get it! Linear is straight. Non-linear is curved or turning!

Physics can be simple and fun when we learn together!

Let's pack up, eat more cookies, and keep learning! 😊



LET'S
LEARN!



DISTANCE (d) AND DISPLACEMENT (s)

SAME JOURNEY
BUT DIFFERENT
MEANING!



DISTANCE (d)



HOW FAR an object travels.
NO DIRECTION needed!

EXAMPLE:



Distance = total path travelled
= 5 m + 3 m
= **8 meters**



We **ADD** all the
paths travelled!



SCALAR QUANTITY

Only has **MAGNITUDE** (size).



DISPLACEMENT (s)

SHORTEST PATH from start
to end **WITH DIRECTION**!

EXAMPLE:



Displacement = **2 meters**
to the **RIGHT**

We only look at the
STRAIGHT LINE
from start to end!



VECTOR QUANTITY

Has **MAGNITUDE** and **DIRECTION**.

KEY DIFFERENCE



DISTANCE (d)



TOTAL PATH TRAVELLED.
Always **POSITIVE**, never negative.

DISPLACEMENT (s)



SHORTEST STRAIGHT PATH
from start to end + **DIRECTION**.



LET'S LOVE PHYSICS!

PHYSICS TALK:
DISTANCE vs DISPLACEMENT

KEEP LEARNING!

1

Hi everyone!
What are we learning today?

Distance and Displacement!



2

WHAT IS DISTANCE?

Distance is how far you travel in total.

EXAMPLE:

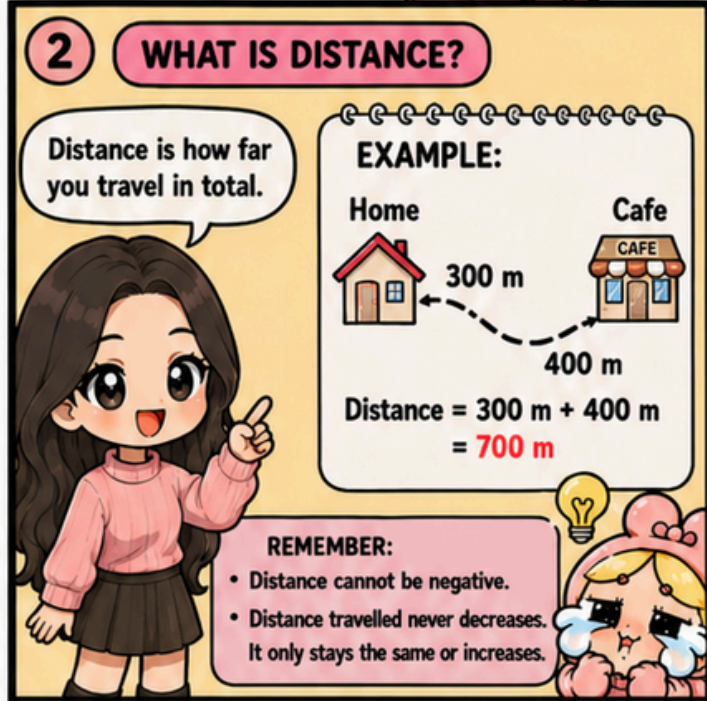
Home Cafe

300 m 400 m

Distance = 300 m + 400 m
= 700 m

REMEMBER:

- Distance cannot be negative.
- Distance travelled never decreases. It only stays the same or increases.



3

So distance is everything we walk, every turn and stop?

Exactly! We add all the paths. That's why distance can't be negative and never goes down!



4

WHAT IS DISPLACEMENT?

Displacement is the shortest straight distance from the starting point to the ending point. It also has direction!

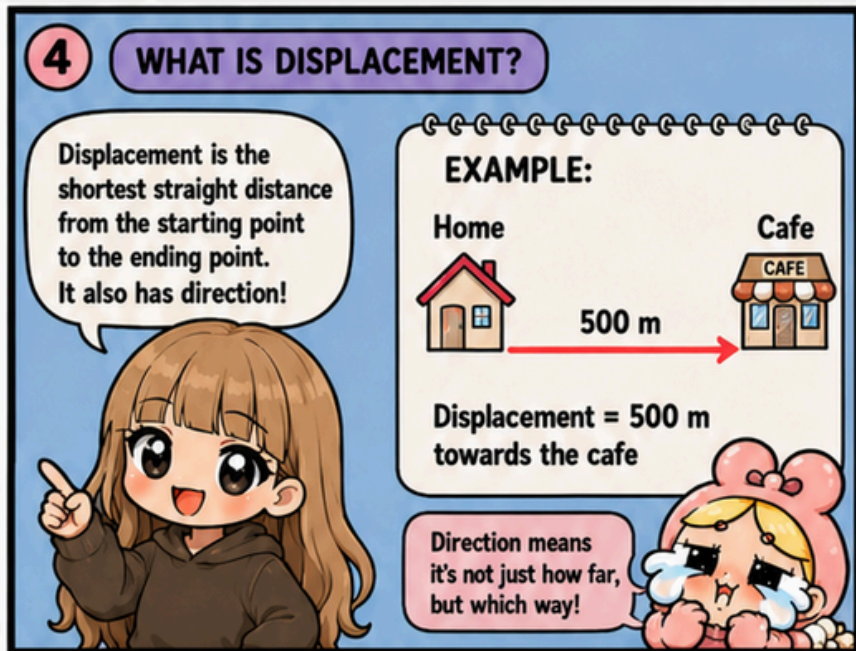
EXAMPLE:

Home Cafe

500 m

Displacement = 500 m towards the cafe

Direction means it's not just how far, but which way!



5

QUICK SUMMARY

FEATURE	DISTANCE	DISPLACEMENT
Meaning	Total path travelled	Shortest straight line from start to end
Direction?	No direction	Has direction
Can it be negative?	No, distance cannot be negative	Yes, displacement can be positive, negative or zero
	No, distance never decreases. It only stays the same or increases.	It can change (value can increase, decrease or be zero)

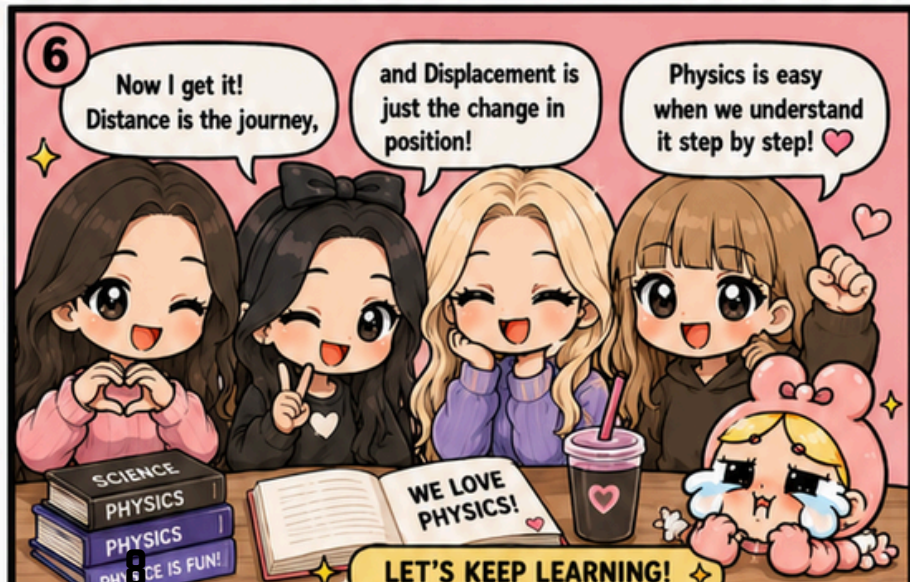


6

Now I get it!
Distance is the journey,

and Displacement is just the change in position!

Physics is easy when we understand it step by step!



EXAMPLE:

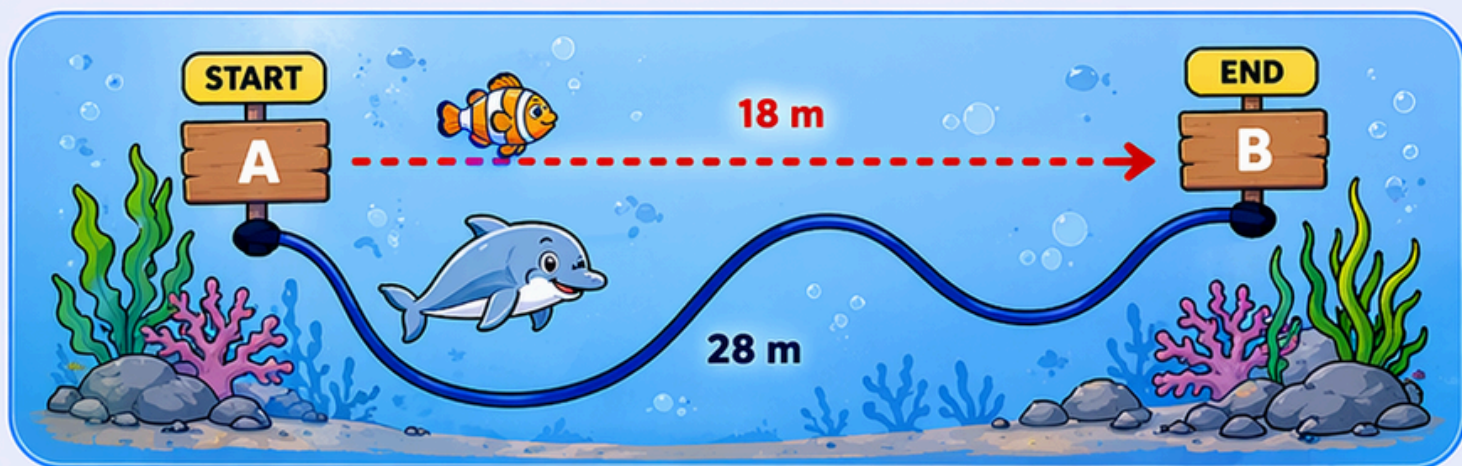
DISTANCE VS DISPLACEMENT

Let's look at a real-life example to understand better!

SCENARIO:

A dolphin and a fish travel from point A to point B. They take the paths shown below.

LET'S SOLVE IT!



DISTANCE (d)

TOTAL PATH travelled



The dolphin swam along the curved path.
So, Distance = 28 m

DISPLACEMENT (s)

SHORTEST STRAIGHT PATH + DIRECTION



The fish swam in a straight line from A to B.
So, Displacement = 18 m to the EAST



SOLUTION:



From A to B:
Distance travelled = 28 m (dolphin)
Displacement travelled = 18 m to the EAST (fish)



REMEMBER!

Distance cannot be negative and distance travelled never decreases.



LET'S
LEARN!

SPEED (v)

How Fast an Object Moves!

Speed tells us
HOW FAST
something moves!

WHAT IS SPEED?

Speed is a measure of **how fast**
an object moves.

It tells us how quickly its position
changes with time.



FORMULA

$$v = \frac{s}{t}$$

where:

v = Speed (m/s or km/h)

s = Total distance travelled (m or km)

t = Total time taken (s or h)

QUICK NOTES!



Speed does not tell us
the direction, only
how fast an object
moves.



If the speed stays the
same throughout the
journey, it is called
UNIFORM SPEED.



Even if an object
changes direction,
its speed can still be
the same as long as its
magnitude does not
change.

KEY DIFFERENCE

ASPECT	SPEED (v)	VELOCITY
WHAT IT TELLS US	How fast an object moves.	How fast and in what direction an object moves.
MAGNITUDE	Only has magnitude (size).	Has magnitude and direction .

LET'S
LEARN!

SPEED (v)

HOW FAST AN OBJECT MOVES!

Speed tells us
HOW FAST
something moves!

EXAMPLE

A car travels a total distance of **120 km** in **2 hours**.
Find its average speed.



Using the formula:

$$v = \frac{s}{t}$$

$$v = \frac{120 \text{ km}}{2 \text{ hours}}$$

$$v = 60 \text{ km/h}$$

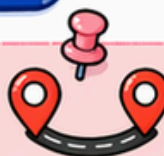
So, the average speed of the car is

60 km/h.

QUICK NOTES!



Speed does not tell us the direction, only **how fast** an object moves.



If the speed is the same throughout the journey, the motion is said to be **UNIFORM SPEED**.



Even if an object changes direction, its speed can still be the same as long as its **magnitude** does not change.

KEY DIFFERENCE!

ASPECT	SPEED (v)	VELOCITY
WHAT IT TELLS US	How fast an object moves.	How fast and in what direction an object moves.
MAGNITUDE	Only has magnitude (size).	Has magnitude and direction .

VELOCITY (v)

HOW FAST AND IN WHICH DIRECTION?

1. WHAT IS VELOCITY?

Velocity is the **rate of displacement change**.

It tells us how fast something moves **AND** in which direction!

A VECTOR QUANTITY
It has Magnitude and Direction!

THE RATE OF
DISPLACEMENT
CHANGE

UNIT:
m/s
(metres per second)

VELOCITY



Think:

Speed is how fast...

Velocity is **how fast + direction!**

2. FORMULA

1 AVERAGE VELOCITY

$$v = \frac{s}{t}$$

v = velocity (m/s)

s = displacement (m)

t = time (s)

EXAMPLE:

You travel 100 m in 5 s.

$$v = \frac{100}{5} = 20 \text{ m/s}$$

2 VELOCITY WITH ACCELERATION

$$v = u + at$$

v = final velocity (m/s)

u = initial velocity (m/s)

a = acceleration (m/s²)

t = time (s)



**KEY
POINTS!**

★ Velocity = **Speed + Direction**

★ It is a **VECTOR** quantity.

★ Unit = **m/s**

★ Formula: $v = \frac{s}{t}$ and $v = u + at$



LET'S
LEARN!

VELOCITY (v)

RATE OF DISPLACEMENT CHANGE!

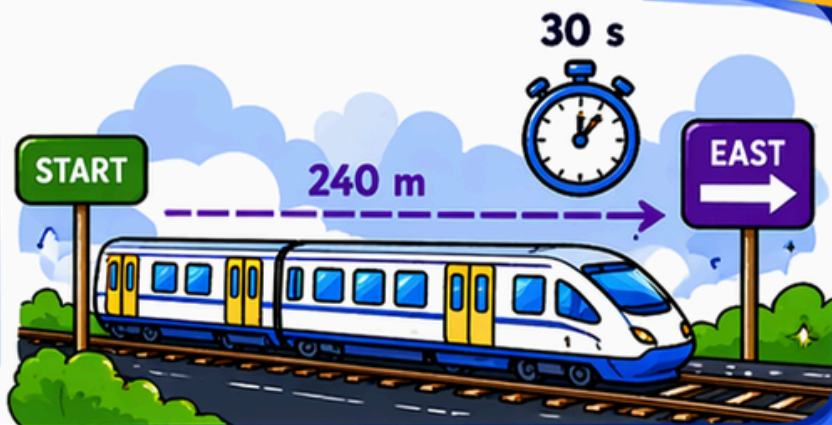
Velocity tells us
HOW FAST
and in **WHICH**
DIRECTION we move!



EXAMPLE

A train travels **240 metres**
to the east in **30 seconds**.

What is its average velocity?



1. PICK THE FORMULA!

We use:

$$v = \frac{s}{t}$$

v = velocity (m/s)

s = displacement (m)

t = time (s)

2. PUT IN THE VALUES!

$$v = \frac{240 \text{ m}}{30 \text{ s}}$$

3. CALCULATE + UNITS!

$$v = 8 \text{ m/s}$$

The train's average
velocity is **8 metres**
per second to the **East**.

QUICK NOTE!



Velocity has
MAGNITUDE
(how fast) AND
DIRECTION (where
it's going)!



If the direction
changes, velocity
changes!



If speed is the same
all the time and
direction doesn't
change, the velocity
is **UNIFORM**.

KEY POINT!

- Velocity tells us **HOW FAST** and in **WHICH DIRECTION**.
- Formula: $v = \frac{s}{t}$
- Always include **UNITS!** (m/s)

Physics Talk: ACCELERATION (a) AND DECELERATION (a)

POLITEKNIK
MALAYSIA

SULTAN MIZAN ZAINAL ABIDIN

JABATAN MATEMATIK, SAINS & KOMPUTER

Okay everyone, before we go home, let's learn **ACCELERATION (a) AND DECELERATION (a)**!

Alright! What are we learning today?

Let's start with **ACCELERATION (a)**. It means the rate of change of velocity. When something speeds up, its velocity increases.

Example: A car moves from 10 m/s to 20 m/s. It is accelerating.



So, acceleration means speeding up?

Exactly! And acceleration is **POSITIVE (+)** because the velocity is increasing.

Now, **DECELERATION (a)** is when something slows down. The rate of decrease in speed. The velocity decreases.

Example: A car moves from 20 m/s to 10 m/s. It is decelerating.



So, deceleration means slowing down?

Yes! And deceleration is **NEGATIVE (-)** because the velocity is decreasing.

Ohh... now I get it! Acceleration speeds things up (positive), and deceleration slows things down (negative)!

Physics can be simple and fun when we learn together!

Let's pack up, eat more cookies, and keep learning! 😊



ACCELERATION (a) AND DECELERATION (a)

Let's
Learn!

★ **ACCELERATION (a)**
is **speeding up**.
Velocity increases.

★ **DECELERATION (a)**
is **slowing down**.
Velocity decreases.

It's
Easy!

ACCELERATION: SPEEDING UP!

The car moves from slowing motion to increase the speed and acquired with time taken.

$t_1 = 2.0 \text{ s}$



10 km/h

$t_2 = 4.0 \text{ s}$



20 km/h

$t_3 = 6.0 \text{ s}$



40 km/h

$t_4 = 8.0 \text{ s}$



100 km/h



KEY IDEA

Acceleration makes the **speed get bigger** as **time increases**.



DECELERATION MOTION

LET'S LEARN!

Slowing Down with Time!

The car slows down... speed gets smaller as time passes. That's **DECELERATION!**

The car moves from **increasing motion** to **slow the speeding** and acquired with time taken.

$t_1 = 2.0 \text{ s}$

$t_2 = 4.0 \text{ s}$

$t_3 = 6.0 \text{ s}$

$t_4 = 8.0 \text{ s}$



QUICK NOTES!

4 **Zero acceleration** occurs if an object moving at a constants velocity, that is, the magnitude and direction of its velocity remain unchanged – is **not accelerating**.



5 **Constant acceleration** occurs if velocity increases at the **uniform rate**.



WHAT IS ACCELERATION?

the rate of change of velocity over time

vector quantity:
has **magnitude & direction**

unit = m s^{-2}

LET'S LEARN!

ACCELERATION & DECELERATION

MAKING SPEED CHANGE!

Acceleration makes you **SPEED UP!**
Deceleration (or slowing down) makes you **SLOW DOWN!**



EXAMPLE

A bike starts from **rest** and speeds up to **12 m/s** in **6 seconds**.

- What is its **acceleration**?
- Then it **slows down** to **stop** in **4 seconds**. What is its **deceleration**?

START



$u = 0 \text{ m/s}$
at rest

SPEEDING UP!



$v = 12 \text{ m/s}$
after 6 s

STOP



$v = 0 \text{ m/s}$
after 4 s

1. PICK THE FORMULA!

Use:

$$a = \frac{v - u}{t}$$

a = acceleration (m/s^2)
 u = initial velocity (m/s)
 v = final velocity (m/s)
 t = time (s)

2. PUT IN THE VALUES!

- a) **Acceleration**

$$\begin{aligned} a &= \frac{12 - 0}{6} \\ &= \frac{12}{6} \\ &= 2 \text{ m/s}^2 \end{aligned}$$

- b) **Deceleration**

$$\begin{aligned} a &= \frac{0 - 12}{4} \\ &= \frac{-12}{4} \\ &= -3 \text{ m/s}^2 \end{aligned}$$

3. CALCULATE + UNITS!

- a) The bike accelerates at

2 m/s²

It speeds **up** by **2 metres per second** every second!

- b) The bike decelerates at

-3 m/s²

It **slows down** by **3 metres per second** every second!

QUICK NOTES!



Positive acceleration (+) means **SPEEDING UP**.



Negative acceleration (-) means **SLOWING DOWN** or **DECELERATION**.



When the final velocity is **0 m/s**, the object has **STOPPED**.

KEY POINT!

- Acceleration **changes how fast** you are moving.
- Deceleration is acceleration in the opposite direction – it makes you slow down!
- Formula: $a = \frac{v - u}{t}$
- Always include **UNITS!** (m/s^2)



PHYSICS TALK!

UNIFORM & NON-UNIFORM MOTION



Motion can change. Let's see how!

Hi everyone!
Today we'll
learn about
motion!

Okay! What
is motion?

Motion is when
something changes
its position.

There are two types:
UNIFORM and
NON-UNIFORM MOTION.

Let's find
out together!

1 UNIFORM VELOCITY

Same speed, same direction!



The speed
doesn't change!

Exactly! That means
ZERO ACCELERATION.

2 UNIFORM ACCELERATION

Speeding up at a constant rate!

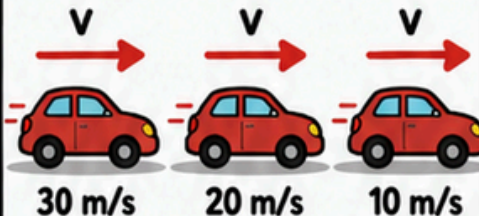


The speed gets
bigger every second!

Yes! That's
ACCELERATION.

3 UNIFORM DECELERATION

Slowing down at a constant rate!



Now it's getting
slower...

Right! That's
DECELERATION.

So...

Speeding up means
ACCELERATION!

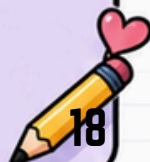
And slowing down
means **DECELERATION**!

If the speed stays
the same, that's
UNIFORM VELOCITY!

Physics is really fun
when we learn
together!

REMEMBER!

- **Uniform** = Same Speed
- **Non-Uniform** = Changing Speed
- Speeding Up = **Acceleration**
- Slowing Down = **Deceleration**



Let's keep learning
and be curious!



MOTION GRAPH

SEE THE MOTION. UNDERSTAND IT BETTER!

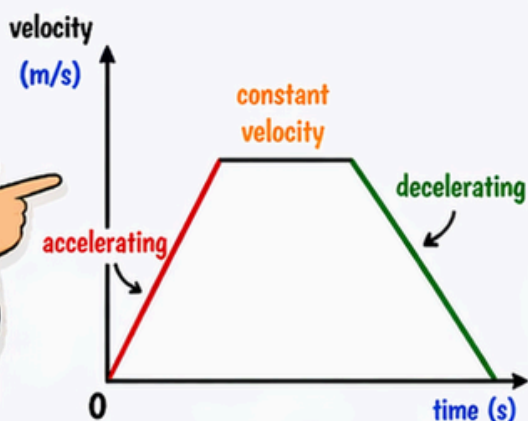
LET'S LEARN!

Motion graphs can tell us how far a body has travelled, how fast it is moving, and all the **speed changes** that happen.

Graphs are like **STORYTELLERS** for **MOTION**!

VELOCITY - TIME GRAPH

Shows how fast an object is moving and how its speed changes with time.



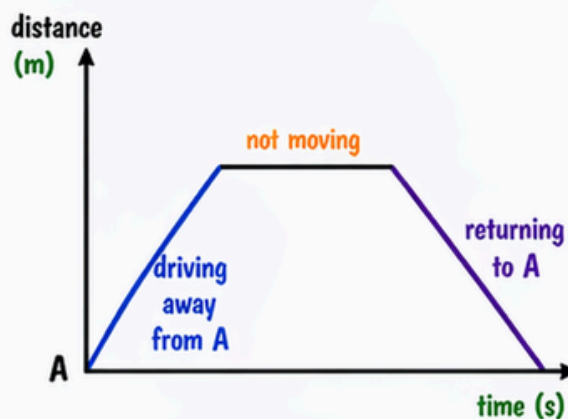
WHAT DOES IT MEAN?

- ★ Line going up = **Speeding up**
- ★ Horizontal line = Moving at **constant speed**
- ★ Line going down = **Slowing down**



DISTANCE - TIME GRAPH

Shows how far an object has travelled as time passes.



WHAT DOES IT MEAN?

- ★ Line going up = **Moving away** from the starting point
- ★ Horizontal line = **Not moving**
- ★ Line going down = **Moving back** towards the starting point



QUICK REMINDERS!

Steeper line means **greater speed** or **moving faster!**



Flat line means the object is **not moving.**



PHYSICS TALK!

GRAPHS OF LINEAR MOTION

Let's learn with Zootopia!

a. CONSTANT VELOCITY

I'm cruising at the **same speed**! I don't speed up or slow down.

So... acceleration is **ZERO**!

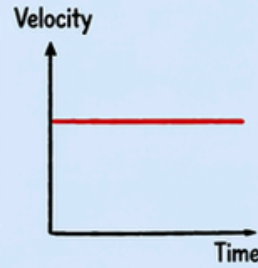
CONSTANT VELOCITY means velocity is the same. So, **acceleration is ZERO**.

Distance vs. Time



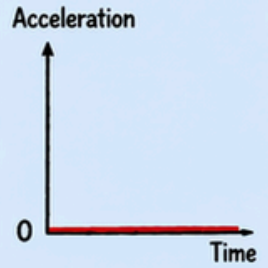
Distance increases evenly with time.

Velocity vs. Time



Velocity stays the same.

Acceleration vs. Time



Acceleration is **zero**.

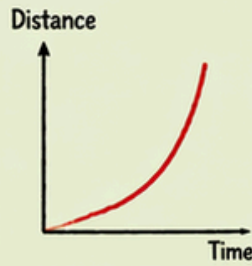
b. POSITIVE CONSTANT ACCELERATION

I'm speeding up! I'm getting **FASTER** every second!

Yup! Acceleration is **POSITIVE**!

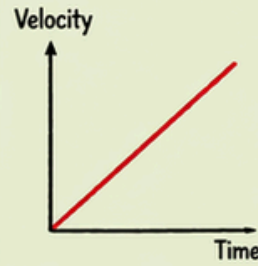
POSITIVE ACCELERATION means speeding up at a constant rate. Acceleration is **POSITIVE**.

Distance vs. Time



Distance increases faster and faster.

Velocity vs. Time



Velocity increases linearly.

Acceleration vs. Time



Acceleration is constant and **positive**.

c. NEGATIVE CONSTANT ACCELERATION

Uh-oh... I'm **slowing down**! My speed keeps decreasing.

Right! Acceleration is **NEGATIVE**!

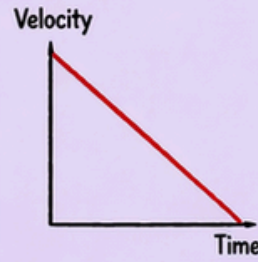
NEGATIVE ACCELERATION means slowing down at a constant rate. Acceleration is **NEGATIVE**.

Distance vs. Time



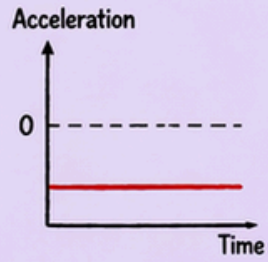
Distance increases but more slowly.

Velocity vs. Time



Velocity decreases linearly.

Acceleration vs. Time



Acceleration is constant and **negative**.

REMEMBER!

- ★ Straight line on a graph = Constant change
- ★ Upward curve or upward sloping line = Speeding up (**Positive Acceleration**)
- ★ Downward curve or downward sloping line = Slowing down (**Negative Acceleration**)
- ★ Horizontal line on acceleration graph = **Zero Acceleration**

Now graphs make sense! You've got this!

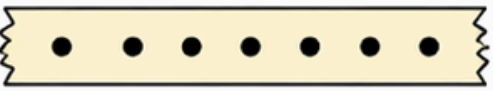
Physics is **PAWS-itively awesome**!

LET'S
LEARN!

TICKER-TAPE CHART

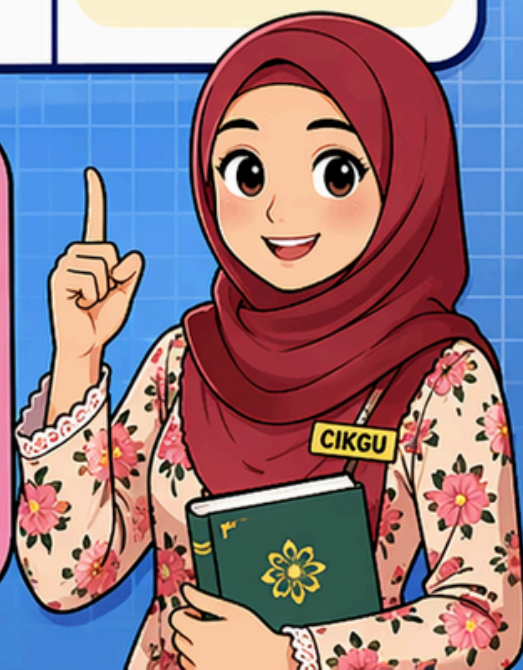
Dots That Tell a Story!

Small dots...
Big ideas!
Understand motion
with just dots!

TICKER-TAPE CHART	CHARACTERISTICS	INFERENCE
(a) CONSTANT VELOCITY Direction of motion 	Tick length is CONSTANT. The spacing between dots is the same.	The object moves with constant or uniform velocity.
(b) UNIFORM ACCELERATION Direction of motion 	Tick length INCREASES uniformly. The spacing between dots gets bigger.	The object is accelerating uniformly. It is speeding up.
(c) UNIFORM DECELERATION Direction of motion 	Tick length DECREASES uniformly. The spacing between dots gets smaller.	The object is decelerating uniformly. It is slowing down.

QUICK REMEMBER!

- ★ Same spacing = **Same speed**
- ★ Spacing gets bigger = **Speeding up**
- ★ Spacing gets smaller = **Slowing down**



YOU GOT THIS!

EXERCISE

LET'S TEST WHAT YOU KNOW!

FILL IN THE TABLE
and show what
you've learned!

1

FILL IN THE TABLE

State the difference between the following:

Speed	Velocity
Distance	Displacement
Acceleration	Deceleration

2

SHORT ANSWER QUESTIONS

- Give one real-life example of acceleration.

- Give one real-life example of deceleration.

- Why is displacement a vector quantity but distance is not?

- A runner completes one round of a 400 m track and ends where he started. What is his displacement?

- A car travels 100 km east and then 60 km west. What is the total distance travelled?

- A cyclist moves with a constant velocity. Is the cyclist accelerating? Explain your answer.

3

DECIDE: TRUE OR FALSE?

Write **TRUE** or **FALSE** for each statement.

- Speed includes direction. ☐
- Velocity is a vector quantity. ☐
- Acceleration is always speeding up. ☐
- Deceleration means slowing down. ☐
- Distance can never be zero. ☐
- If velocity changes, the object must be accelerating. ☐
- The unit of acceleration is m/s. ☐

4

FILL IN THE BLANKS

- Speed tells us how _____ an object moves.
- Velocity tells us how fast and _____ an object moves.
- Acceleration is a change in _____.
- Deceleration is acceleration in the _____ direction (it slows you down).

SPEED

VELOCITY

REMEMBER!

- Speed = **HOW FAST**
- Velocity = **HOW FAST + WHICH DIRECTION.**
- Distance = **HOW FAR YOU TRAVEL**
- Displacement = **HOW FAR AND IN WHAT DIRECTION.**
- Acceleration = **SPEEDING UP**
- Deceleration = **SLOWING DOWN.**

EXERCISE

YOU GOT THIS!

LET'S SOLVE IT!

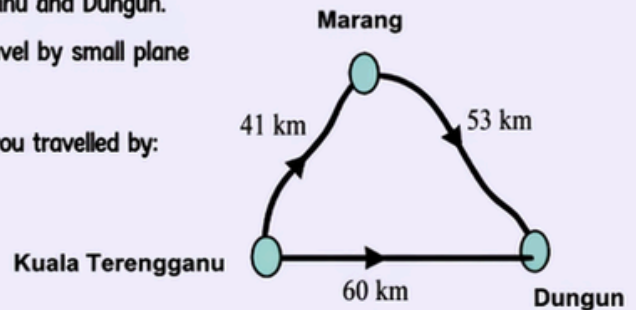
Show your workings
and don't forget
your **UNITS**!

2

The following diagram shows the location of Kuala Terengganu and Dungun. You can travel by car using existing road via Marang or travel by small plane along straight path.

Calculate how far it is from Kuala Terengganu to Dungun if you travelled by:

- The car
- The plane



a. The car

Answer: _____

b. The plane

Answer: _____

3

A car at certain time moves at 30 kmh^{-1} , it has constant deceleration of 0.7 ms^{-2} . Then its velocity decreases until 10 kmh^{-1} .

Find decreasing time of the velocity for the car.

Answer: _____

REMEMBER!

- Always write down what you **KNOW**.
- Show your **CALCULATIONS** clearly.
- Always include **UNITS** in your answer!

YOU GOT THIS!

EXERCISE

LET'S SOLVE IT!

Read carefully,
Think smart,
Answer with
confidence!

4

A school bus accelerates with an acceleration of 4 m s^{-2} after picking up some students at a bus stop.

Calculate:

- a) Velocity of the bus after 5 s
- b) Distance travelled by the bus after 5 s



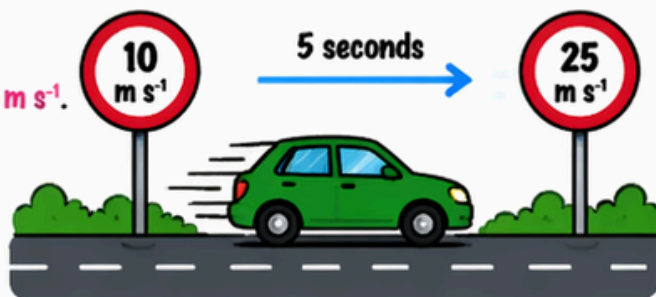
Answers: 20 m s^{-1} , 50 m

5

A car is travelling along a straight road at 10 m s^{-1} .

It accelerates uniformly for 5 s until it is moving at 25 m s^{-1} .

What is the acceleration?



Answer: 3 m s^{-2}

REMEMBER!



Always write down your **UNITS**.



Show your **steps** clearly.



Acceleration means a **change in velocity**.



EXERCISE

YOU GOT THIS!

LET'S SOLVE IT!

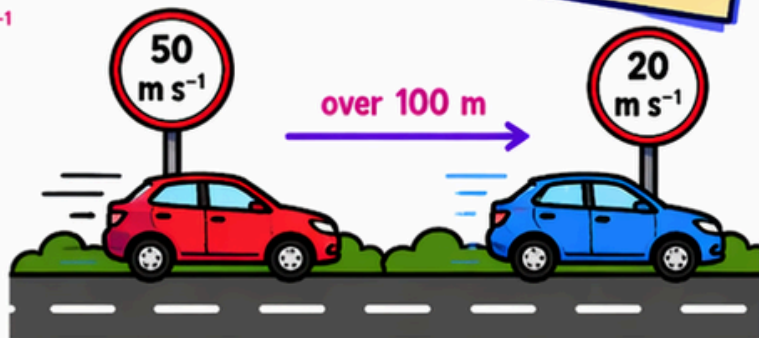
Read carefully,
Think smart,
Answer with
confidence!

6

The speed of a car travelling along a straight road decreases uniformly from 50 m s^{-1} to 20 m s^{-1} over 100 m .

Calculate:

- Deceleration of the car
- Time taken for the speed to decrease from 50 m s^{-1} to 20 m s^{-1}



a)

b)

7

An airplane travelling at 150 m s^{-1} is accelerated uniformly at 25 m s^{-2} .

- What is the airplane's speed after 15 s ?
- What distance has it travelled at the point of the time?



a)

b)

REMEMBER!



Always write your **UNITS**.



Show your **steps** clearly.



Acceleration is a **change in velocity**.

YOU GOT THIS!

EXERCISE

LET'S SOLVE IT!

Read carefully,
Think smart,
Answer with
confidence!

8

An aeroplane flies from Kuala Terengganu to Kuala Lumpur, which is located 300 km east of Kuala Terengganu. Upon reaching Kuala Lumpur, the aeroplane then flies to Sandakan, which is located 400 km north. The total time of flight is 4 hours.

Calculate:

- The speed of the aeroplane
- The velocity of the aeroplane



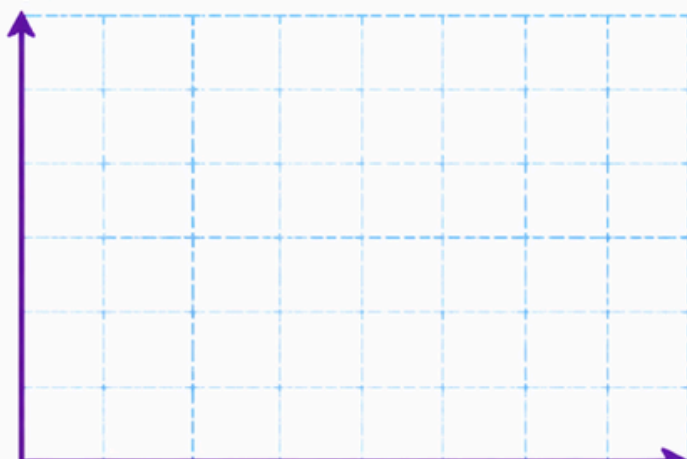
Answer: 175 kmh^{-1} , 125 kmh^{-1}

9

A car starts from rest and accelerates at a constant acceleration of 5 ms^{-2} for 10 s. The car then travels at a constant velocity for 15 s. The brakes are then applied and the car stops in 5 s.

- Sketch a velocity-time graph for the whole journey of the car.

Velocity (m s^{-1})



Time (s)

- Calculate the maximum velocity attained by the car.

Answer: _____

- Calculate the total distance travelled.

Answer: _____

REMEMBER!



Always write your **UNITS**.



Show your **steps** clearly.



Make neat and clear **graphs**.



YOU GOT THIS!

EXERCISE

LET'S SOLVE IT!

Read carefully,
Think smart,
Answer with
confidence!

10

Fakhira travelling at a velocity of 120 kmh^{-1} notices a sheep in the middle of the road 85 m in front of her.

On seeing the sheep, she instantly applies the brakes and is able to bring the car to a stop after 8 s.

Calculate:

- What is the deceleration of the car
- Calculate the distance travelled by the car from the time the driver applies the brakes until it comes to stop
- Is she able to avoid knocking the sheep



a)

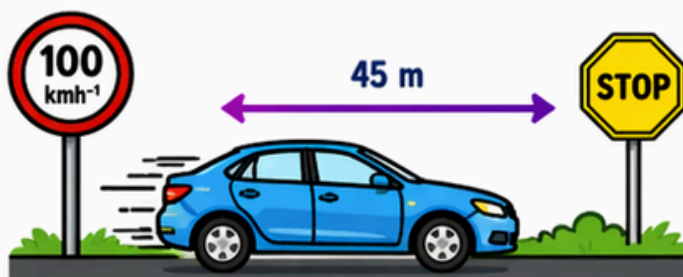
b)

c)

11

A car can be brake from 100 kmh^{-1} along 45 m. Find

- Time for the car to stop
- The deceleration of the car



a)

b)

REMEMBER!



Always write your **UNITS**.



Show your **steps** clearly.



Deceleration means **slowing down**.



YOU GOT THIS!

EXERCISE

LET'S SOLVE IT!

Read carefully,
Think smart,
Answer with
confidence!

12

A car starts from rest and reaches at destination at **8 minutes** with velocity of **72 kmh^{-1}** , calculate :

- The acceleration of the car in ms^{-2}
- The distance travelled in km



a)

b)

13

A car starts from rest and accelerates at a constant acceleration of **2 ms^{-2}** for **5 seconds**. The car then travels at a constant velocity for **9 seconds**. The brake is then applied and the car stops in **6 seconds**.

- Plot a velocity-time graph for the whole journey
- What is the maximum velocity attained by the car
- From the graph plotted, determine the total distance travelled

Velocity (m s^{-1})



Time (s)

b) Maximum velocity :

_____ m s^{-1}

c) Total distance travelled :

_____ m

REMEMBER!



Always write your **UNITS**.

Show your **steps** clearly.

The area under a velocity-time graph gives the **distance** travelled.



YOU GOT THIS!

EXERCISE

LET'S SOLVE IT!

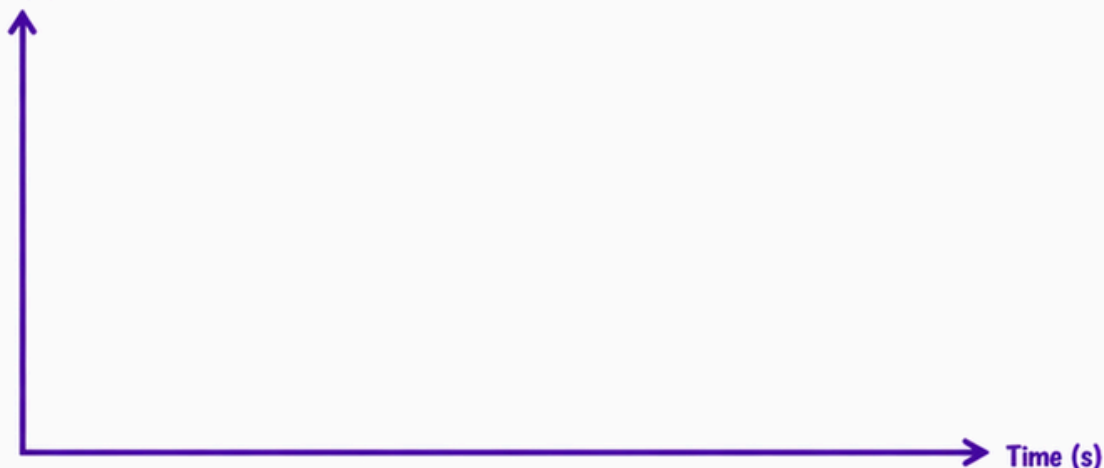
Read carefully,
Think smart,
Answer with
confidence!

14

A car starts from rest and accelerates with constant acceleration of 6 m s^{-2} until it reaches a velocity of 60 m s^{-1} after 10 s . The velocity of the car then reduces uniformly to 10 m s^{-1} in 5 s . Finally, the car accelerates uniformly to a velocity of 50 m s^{-1} in 10 s .

Draw the velocity-time graph for the whole journey of the car.

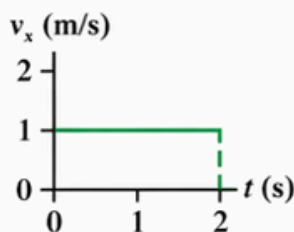
Velocity (m s^{-1})



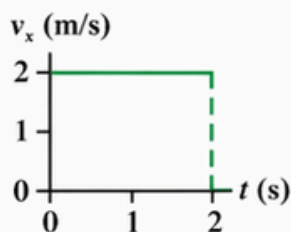
15

Four objects move with the velocity versus time graphs shown.

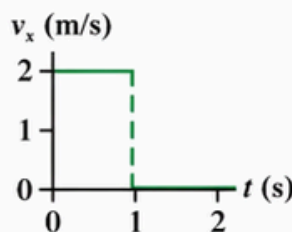
Which object has the largest displacement between $t = 0 \text{ s}$ and $t = 2 \text{ s}$?



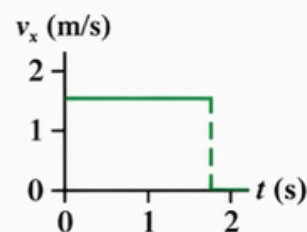
A.



B.



C.



D.

Object with the largest displacement: _____

REMEMBER!

- Label your axes clearly.
- For velocity-time graphs, the area under the graph gives the displacement.
- Read the question carefully before you start.

YOU GOT THIS!

EXERCISE

LET'S SOLVE IT!

Read carefully,
Think smart,
Answer with
confidence!

16

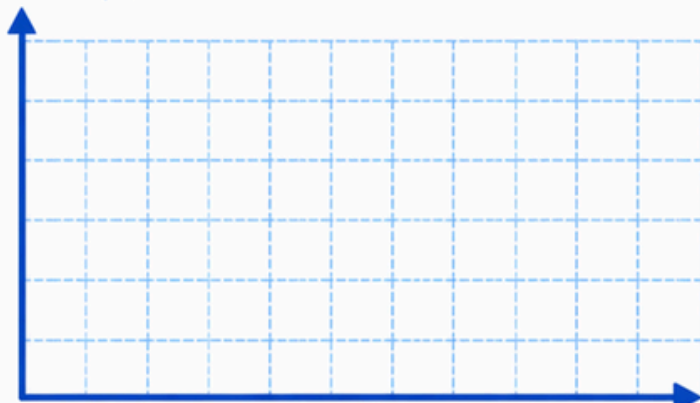
A lorry moves from a stationary state, undergoes uniform acceleration for 200 m in 5 s. After 5 s, the lorry moves at a constant velocity for half a minute. The lorry then stops in 10 s. Based on the given situation

Calculate:

- Sketch the velocity-time graph
- Calculate the velocity of the lorry for the first 5 s
- Calculate the deceleration of the lorry
- Calculate the displacement of the lorry



a) Velocity (m s^{-1})



Time (s)

b) Velocity for the first 5 s :

_____ m s^{-1}

c) Deceleration of the lorry :

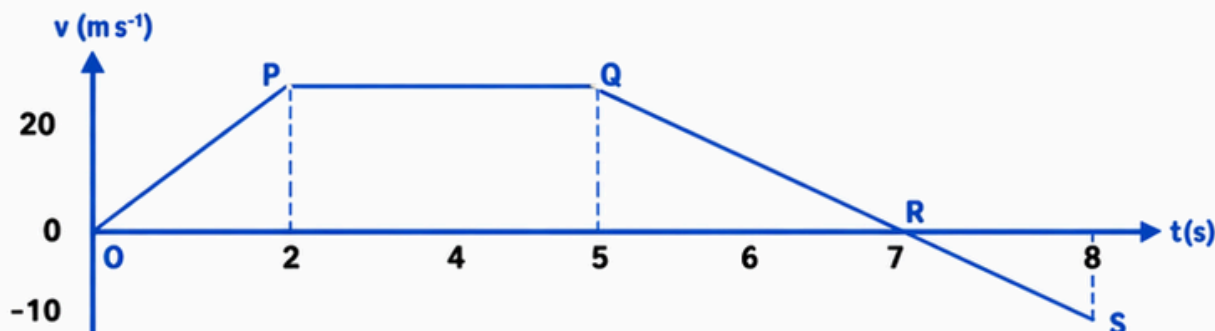
_____ m s^{-2}

d) Displacement of the lorry :

_____ m

17

Following the graph shown, calculate acceleration over OP, QR and RS at the given graph below.



Acceleration over OP :

_____ m s^{-2}

Acceleration over QR :

_____ m s^{-2}

Acceleration over RS :

_____ m s^{-2}

REMEMBER!



Label your axes clearly.



Show your steps neatly.



Acceleration is the **change in velocity** per second.



YOU GOT THIS!

EXERCISE

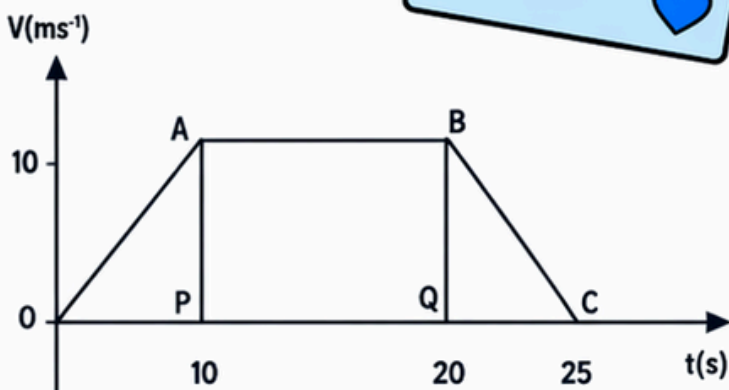
LET'S SOLVE IT!

Read carefully,
Think smart,
Answer with
confidence!

18

Diagram below shown velocity versus time graph for a toy car

- Mark with 'X' on the diagram above, shown a car with uniform deceleration
- Based on the diagram, calculate
 - The acceleration of a car
 - Distance made by a car in 20 s



a) Mark 'X' on the graph above.

b) Calculate:

i) Acceleration of a car :

_____ m s^{-2}

ii) Distance made by a car in 20 s :

_____ m

19

A space rocket is launched and it accelerated uniformly to rest at a rate to 160 ms^{-1} in 0.075 minutes. Calculate how far the rocket travelled within that time.

Distance travelled = _____ m

REMEMBER!

- Label your axes clearly.
- Acceleration is the change in velocity per second.
- The area under a velocity-time graph gives the distance travelled.

YOU GOT THIS!

EXERCISE

LET'S SOLVE IT!

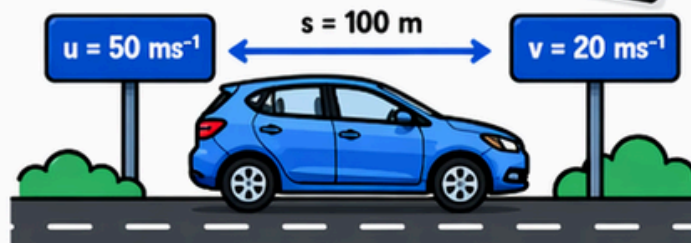
Read carefully,
Think smart,
Answer with
confidence!

20

A speed of a car travelling along a straight road decreases uniformly from 50 ms^{-1} to 20 ms^{-1} over 100 m .

Calculate

- The retardation of the car (retardation is equivalent to deceleration)
- Time taken for the speed to decrease from 50 ms^{-1} to 20 ms^{-1}



a) Retardation of the car:

_____ ms^{-2}

b) Time taken:

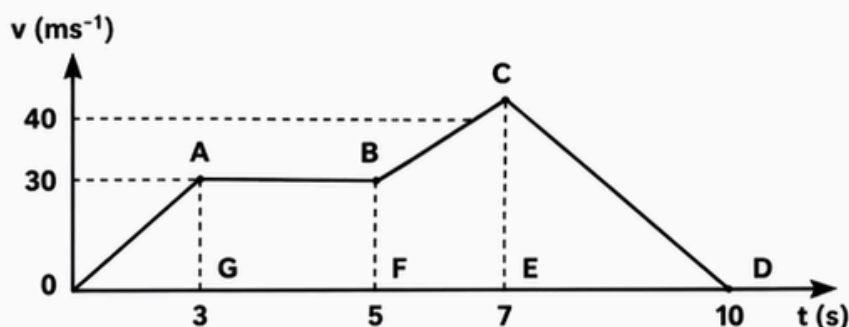
_____ s

21

A figure below shows the velocity-time graph for the motion of an object.

Calculate

- Acceleration of the car in the first 3 s
- Deceleration of the car before it stops
- Total distance travelled
- Average velocity of the car



a) Acceleration in the first 3 s :

_____ ms^{-2}

b) Deceleration before it stops:

_____ ms^{-2}

c) Total distance travelled:

_____ m

d) Average velocity of the car:

_____ ms^{-1}

REMEMBER!



Always write your **UNITS**.

Label your graphs clearly.

The area under a velocity-time graph gives the **total distance** travelled.





Scan to watch
the explanation
video for
*Distance and
Displacement.*

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video for
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Non-Linear Motion.*

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“

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