Year 1 | Travel Graphs

Standard Units | Definitions

- *Displacement* measures how far an object is from its *starting position*.
  - This *includes direction* (it is a *vector* quantity).
- *Distance* measures *how far* an object has travelled *in total*.
  - *Distance* is the *magnitude* of displacement.
- The *velocity* of an object is the *rate of change* of *displacement*.
  - This *includes direction* (it is a *vector* quantity).
  - *Speed* is the *magnitude* of velocity.

Standard Units of Measurement

Variable	Quantity	SI Units
s or x	Displacement	m
u or v	Velocity	ms^{-1}
a	Acceleration	ms^{-2}
t	Time	s

Displacement-Time Graphs | Key Facts

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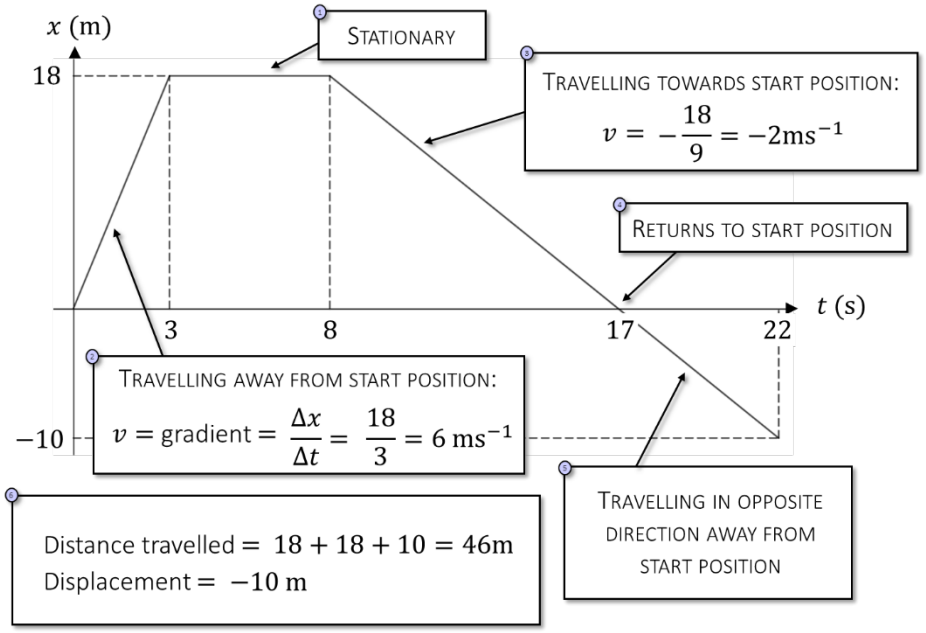
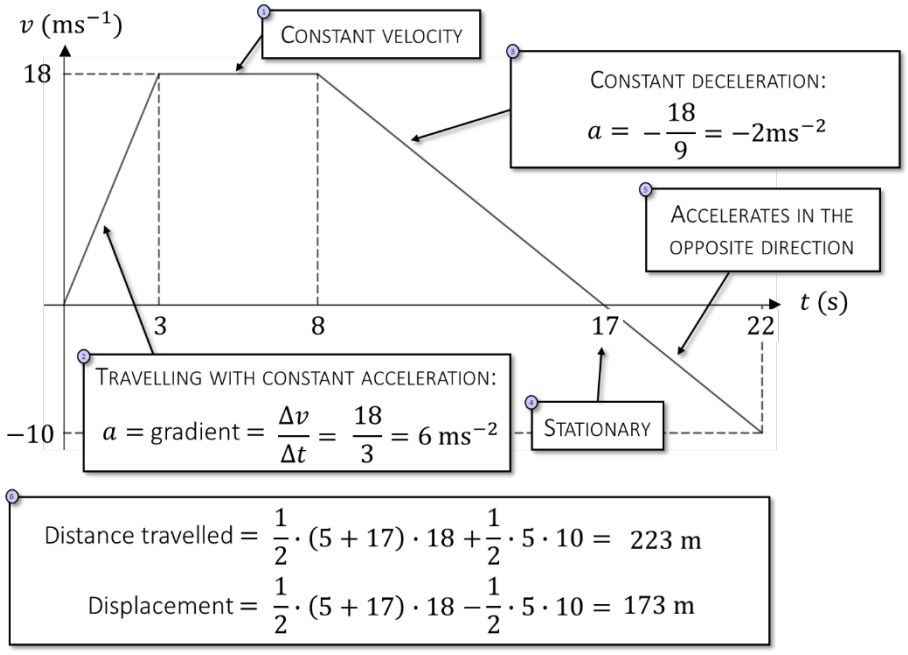
$$\text{Average Velocity: } v_{av} = \frac{\text{Final Displacement} - \text{Initial Displacememt}}{\text{Time Taken}} \qquad \text{Average Speed: } |v| = \frac{\text{Total Distance}}{\text{Total Time}}$$

- *Velocity* is given by the *gradient*.
- A *horizontal line* represents a *stationary object*.



Velocity-Time Graphs | Key Facts

- *Acceleration* is given by the *gradient*.
- A *horizontal line* represents a *constant velocity*.
- *Displacement* is given by *area under the curve*.



DISPLACEMENT-TIME GRAPHS | PROBLEM 1

A man travels $480\ \text{m}$ along a straight road. He runs for the first $300\ \text{m}$ at $4\ \text{ms}^{-1}$, and then walks the remaining $180\ \text{m}$ at $1.5\ \text{ms}^{-1}$. The man's displacement from his starting point after t seconds is x metres.

(a) Sketch the (t, x) graph for the man's journey.

(b) A woman jogs the same $480\ \text{m}$ route at a constant speed, starting and finishing at the same instant as the man. Draw a second line on the (t, x) graph to represent the woman's journey.

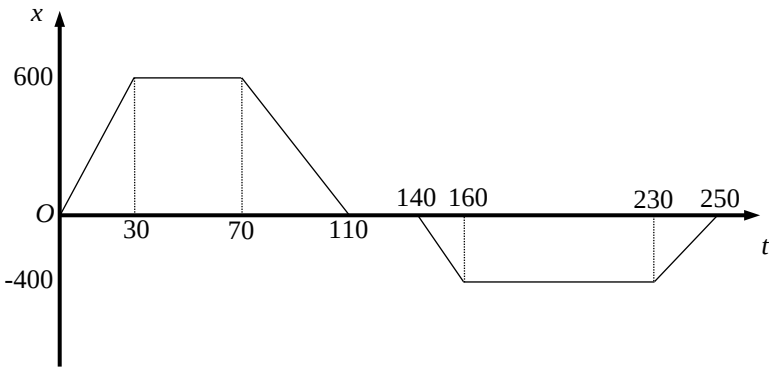
DISPLACEMENT-TIME GRAPHS | PROBLEM 2

A lorry at a recycling plant leaves its base, O, travels East to collect the goods it will recycle and then returns to the base. After waiting for instructions the lorry then travels West to deliver the goods for recycling. At time t seconds the displacement of the lorry from O is $x\ \text{m}$. Sketch the (t, x) graph for the man's journey.

(a) State the total distance travelled by the lorry during the interval $0 \leq t \leq 250$

(b) Calculate the speed of the lorry during the interval $70 \leq t \leq 110$

(c) Calculate the velocity of the lorry during the interval $140 \leq t \leq 160$

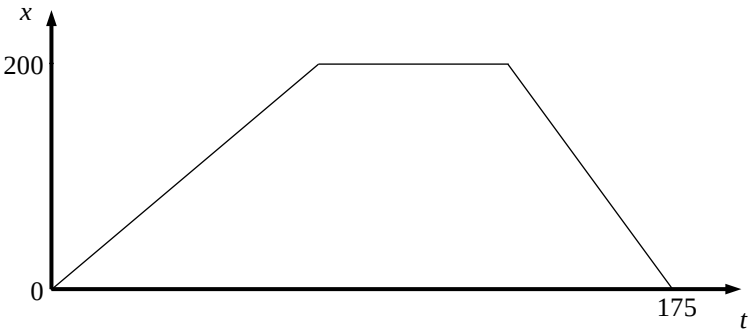


DISPLACEMENT-TIME GRAPHS | PROBLEM 3

A woman lives $200\ \text{m}$ from the post office. One day she runs to the post office at a constant velocity, arriving after 80 seconds. She stays in the post office for a while and then runs back to her house at $4\ \text{ms}^{-1}$. The (t, x) graph for her motion is shown below.

(a) What is the woman's velocity when she runs to the post office?

(b) How long did the woman stay in the post office?



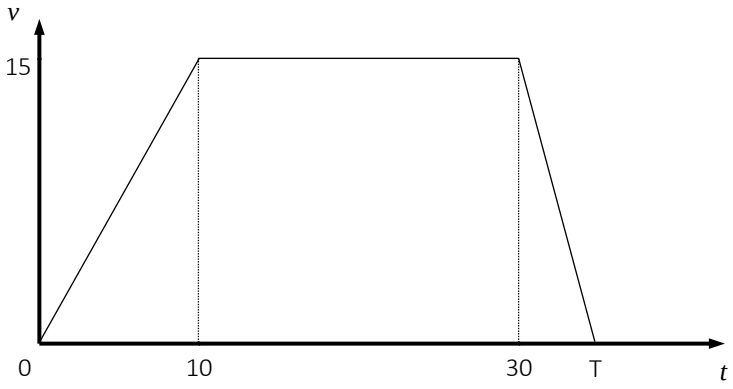
VELOCITY-TIME GRAPHS | PROBLEM 1

The (t, v) graph below represents the journey of a car travelling from one junction to another.

(a) Find the acceleration of the car during the interval $0 \leq t \leq 10$

(b) (i) Given that the car decelerates at $3\ \text{ms}^{-2}$ for $t > 30$, find the value of T.

(b) (ii) Hence find the total distance the car travelled from one junction to the other.



VELOCITY-TIME GRAPHS | PROBLEM 2

A man walks from his home to a cycle shop at $2\ \text{ms}^{-1}$.
He buys a cycle and then he cycles back home.

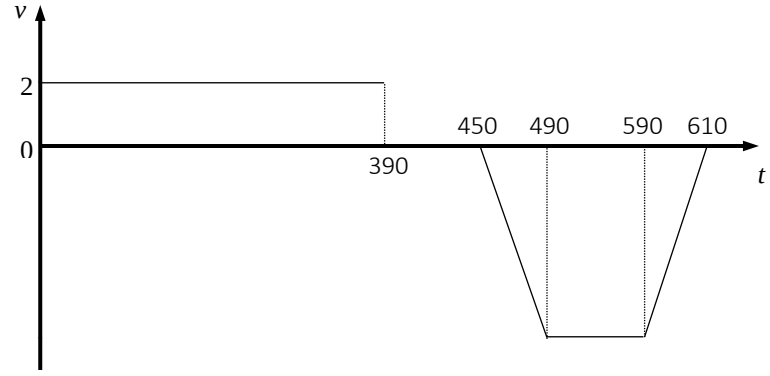
The (t, v) graph for his motion is shown below.

(a) Calculate the maximum speed the man reaches on the cycle.

(b) Find the magnitude of the acceleration of the man during the period $450 \leq t \leq 490$

(c) Find the speed of the man at the instant when $t = 480$

(d) Find the deceleration of the man during the period $590 \leq t \leq 610$



VELOCITY-TIME GRAPHS | PROBLEM 3

A car is being assessed by the distance it can cover in in a fixed amount of time. The car is initially at rest and then accelerates uniformly until it reaches its top speed. The car maintains its top speed for 17 seconds and then comes to rest with constant deceleration. The car travels in a straight line and is in motion for a total of 30 seconds.

(a) Sketch the (t, v) graph for the car's motion on the axes below.

(b) The car came to rest $658\ \text{m}$ from its starting point. Calculate the maximum speed of the car during its motion.

(c) Given that the car's acceleration was $3.5\ \text{ms}^{-2}$, calculate its deceleration.