## Differentiation \& Functions (Q 6, 7 \& 8, Paper 1)

## Lesson No. 11: Linear Graphs

## 2007

6 (b) A cold object is placed in a warm room.
Its temperature $C$ degrees after time $t$ minutes is shown in the following graph.

(i) After what time interval is the temperature of the object 0 degrees?
(ii) What is the rise in temperature of the object in the first 10 minutes?
(iii) The relationship between the temperature $C$ and the time $t$ is given by

$$
C=\frac{1}{2}(t+k) .
$$

Find the value of $k$.

## Solution

## 6 (b) (i)

Look at the graph. After 0 minutes the temperature is -3 degrees.
After 6 minutes the temperature reaches 0 degrees.
Ans: 6 minutes


## 6 (b) (ii)

Look at the graph. After 0 minutes the temperature is -3 degrees.
After 10 minutes the temperature is 2 degrees.
Therefore, the change in temperature in the first 10 minutes is $2-(-3)=5$ degrees.

## 6 (b) (iii)

From the graph you can see that $C=2$ degrees when $t=10$ minutes.
$C=\frac{1}{2}(t+k)$
$\Rightarrow 2=\frac{1}{2}(10+k)$
$\Rightarrow 4=10+k$
$\Rightarrow k=-6$

## 2006

6 (b) The temperature, $C$, in degrees Celsius, of a liquid in an insulated container is related to time $t$, in hours, by

$$
C=86-6 t .
$$

(i) Draw the straight line graph of this relation, putting $t$ on the horizontal axis, for $0 \leq t \leq 8$.
(ii) Use your graph to estimate the temperature when $t=5.5$ hours.
(iii) Use your graph to estimate the time it takes for the temperature to fall from 80 degrees to 60 degrees.

## Solution

6 (b) (i)
C $=86-6 t$
As these graphs are straight lines, you only need to plot the first and last points in the domain.

| $t$ | 0 | 8 |
| :---: | :---: | :---: |
| 86 | 86 | 86 |
| $-6 t$ | 0 | -48 |
| $C$ | 50 | 10 |

OR $\quad t=0: C=86-6(0)=86-0=86$
$t=8: C=86-6(8)=86-48=34$

The two end points of your straight line are $(0,86)$ and $(8,34)$.


## 6 (b) (ii)

Go to 5.5 hours on the horizontal axis. Go straight up until you meet the straight line graph and then go out to the vertical axis. Read off the temperature.
Ans: $C=53$ degrees

## 6 (b) (iii)

Draw lines from 80 degrees and 60 degrees on the vertical axis to the graph of the straight line and go straight down to the horizontal axis. Measure the time between both points.
Ans: $t=4.3$ hours -1 hour $=3.3$ hours

## 1998

6 (b) The speed, $v$, in metres per second of an engine moving along a track is related to time, $t$, in seconds by

$$
v=\frac{1}{3}(2 t+5) .
$$

(i) Draw the straight line graph of this relation, putting $t$ on the horizontal axis, for $0 \leq t \leq 8$.
(ii) Use your graph to estimate the speed when $t=2.5$ seconds.
(iii) Use your graph to estimate the time at which the speed reaches 6 metres per second.

## Solution

6 (b) (i)
As these graphs are straight lines, you only need to plot the first and last points in the domain.
$t=0: v=\frac{1}{3}(2 t+5)=\frac{1}{3}(2(0)+5)=\frac{1}{3}(5)=\frac{5}{3} \Rightarrow\left(0, \frac{5}{3}\right)$ is a point on the line.
$t=8: v=\frac{1}{3}(2 t+5)=\frac{1}{3}(2(8)+5)=\frac{1}{3}(21)=7 \Rightarrow(8,7)$ is a point on the line.


## 6 (b) (ii)

Start at 2.5 s along the horizontal axis and go straight up till you meet the graph.
Now go straight across to the vertical axis and read off the speed $v$.
$\therefore v=3.3 \mathrm{~m} / \mathrm{s}$


Cont...

## 6 (b) (iii)

Start at $6 \mathrm{~m} / \mathrm{s}$ along the vertical axis and go straight across till you meet the graph. Now go straight down to the horizontal axis and read off the time $t$.
$\therefore t=6.5 \mathrm{~s}$


