13	12 c	A cup of coffee with an initial temperature of 80°C is placed in a room with a constant temperature of 22°C. The temperature, T°C, of the coffee after t minutes is given by $T = A + Be^{-kt}$, where A, B and k are positive constants. The temperature of the coffee drops to 60°C after 10 minutes. How long does it take for the temperature of the coffee to drop to 40°C? Give your answer to the nearest minute.	3

State Mean: **2.41/3**

Subs $t = \infty$ and $T = 22$ in $T = A + Be^{-kt}$

$22 = A + 0$

$A = 22$

Subs $t = 0$ and $T = 80$ in $T = 22 + Be^{-kt}$

$80 = 22 + Be^{0}$

$B = 80 - 22$

$= 58$

$\therefore T = 22 + 58e^{-kt}$

Subs $t = 10$ and $T = 60$ in $T = 22 + 58e^{-kt}$

$60 = 22 + 58e^{-k(10)}$

$58e^{-10k} = 38$

$-10k = \dfrac{38}{58}$

$k = \dfrac{\log_e \frac{38}{58}}{-10}$

$= 0.042285685 \ldots$

Subs $T = 40$ in $T = 22 + 58e^{-kt}$:

$40 = 22 + 58e^{-kt}$

$58e^{-kt} = 18$

$e^{-kt} = \dfrac{18}{58}$

$-kt = \log_e \dfrac{18}{58}$

$t = \dfrac{\log_e \frac{18}{58}}{-k}$

$= 27.67062306 \ldots$

$= 28$ (nearest whole)

$\therefore$ about 28 minutes

* These solutions have been provided by *projectmaths* and are not supplied or endorsed by the Board of Studies

Board of Studies: Notes from the Marking Centre

Most candidates gained full marks for this part.

Common problems were:

- not identifying correct A and B values
- as a result of having incorrect A and B values, the subsequent log equation involved the log of a negative number, which was ignored
- truncating the k-value, leading to a less accurate answer.

Source: http://www.boardofstudies.nsw.edu.au/hsc_exams/