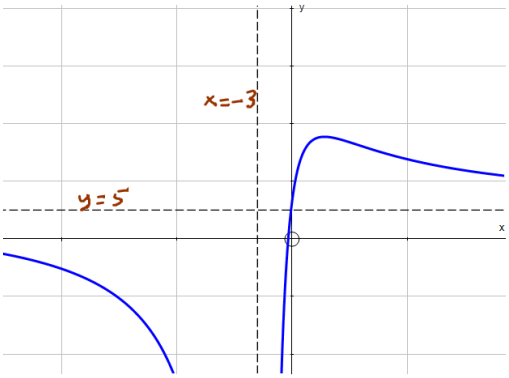
Edexcel AS Mathematics Graphs and transformations

Section 2: Transformations of graphs

Exercise level 3 (Extension)

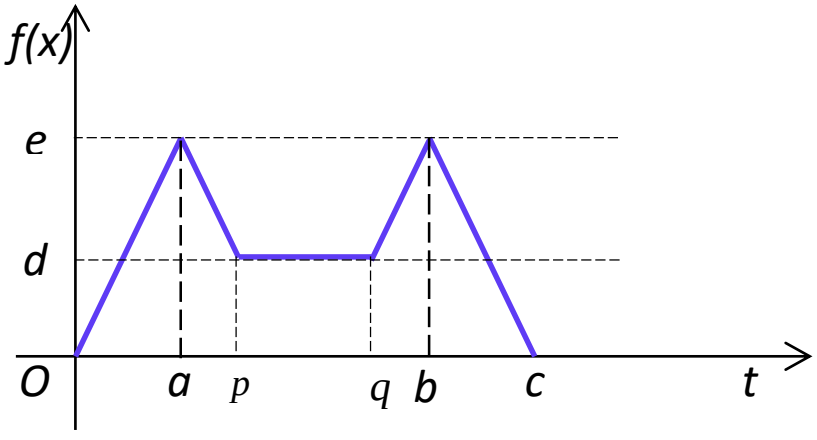
Do not use a graphical calculator or graphing software for this exercise.

1. The diagram shows the graph of $y = \mathrm{f}(x)$, and the lines x = -3 and y = 5 which are asymptotes.
Sketch the following curves, and in each case sketch and label the asymptotes.
(i) $y = \mathrm{f}(x) + 3$
(ii) $y = 2\mathrm{f}(x)$
(iii) $y = -\mathrm{f}(x) - 2$
(iv) $y = 2\mathrm{f}(x - 3)$
(v) $y = \mathrm{f}(\frac{1}{2}x - 3)$



2. (i) Sketch the graphs of $y = \mathrm{p}(x)$ and $y = \mathrm{q}(x)$ where
$\mathrm{p}(x) = x^3$ and $\mathrm{q}(x) = x^2 + 4$
and find the coordinates of their intersection.
(ii) Write the expression $\mathrm{f}(x) = x^3 - 9x^2 + 27x - 30$ in the form $(x - a)^3 + b$ and hence sketch the graph $y = \mathrm{f}(x)$.
(iii) Write the expression $\mathrm{g}(x) = x^2 - 6x + 10$ in the form $(x - c)^2 + d$ and hence sketch the graph $y = \mathrm{g}(x)$.
(iv) Explain how your solutions in parts (ii) and (iii) enable you to write down the intersection of the graphs $y = \mathrm{f}(x)$ and $y = \mathrm{g}(x)$ without needing to solve the two equations simultaneously.

3. The function $y = \mathrm{f}(x)$ below is a repeated signal generated in a laboratory experiment:



(a) The experimenter wishes to change the characteristics of the signal.
Write in terms of f(x) an equation for the signal if
(i) she wishes to multiply the amplitude ('height') of the signal by3.
(ii) she wishes the 'zero time' of the signal to occur at the middle of the "dip".
(iii) she wishes the signal to recur twice as quickly (double the frequency).

(iv) she wishes to increase the amplitude of the signal by a constant value k.

(v) she wishes to combine all four changes into a new signal.

(b) Sketch a graph of the new signal in part (v), showing 2 complete cycles beginning at time $t = 0$, carefully labelling the values of the important points of one cycle.