(a) Let $f(x) = 3\cos(2x) + 5$ for $x \in R$ and let $g(x) = 4f(3x)$.

The function g can be written in the form $g(x) = 12\cos(bx) + c$.

(a) The range of f is $q \leq f(x) \leq r$. Find q and r. (3 marks)

(b) Find the range of g. (2 marks)

(c) Find the value of b and c. (3 marks)

(d) Find the period of g. (2 marks)

Mark scheme:

(a) Correct working with the amplitude and vertical translation. (M1)

$2 \leq f(x) \leq 8$ (A1)(A1)

(b) $8 \leq g(x) \leq 32$ (A1)(A1)

(c) $g(x) = 4\big(3\cos\big(2(3x)\big) + 5\big)$ (M1)

$g(x) = 12\cos(6x) + 20$

$b = 6$ and $c = 20$ (A1)(A1)

(d) $\frac{2\pi}{b} = \frac{2\pi}{6} = \frac{\pi}{3}$ (M1)(A1)