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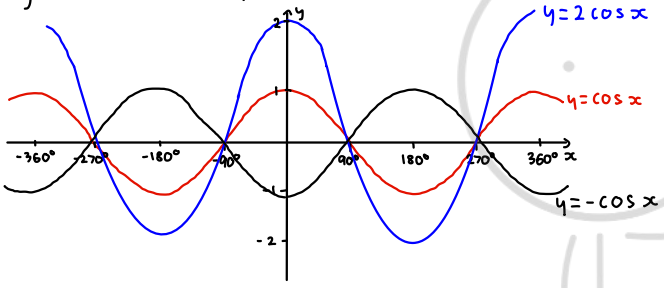
9.6 Transforming trigonometric graphs

1. a) $y = \cos x$

$y = 2\cos x \longrightarrow$ stretch by 2 in vertical direction

$y = -\cos x \longrightarrow$ reflection of $y = \cos x$ in x-axis



b) i) $y = 2\cos x$

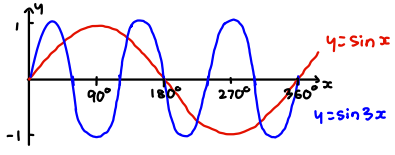
↳ Stretch by scale factor 2 parallel to the y axis

ii) $y = -\cos x$

↳ reflection in the x-axis

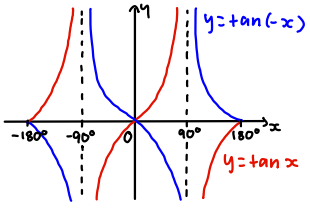
2. a) $y = \sin x$

$y = \sin 3x \longrightarrow$ stretch by $\frac{1}{3}$ in horizontal direction



b) $y = \tan x$

$y = \tan(-x) \longrightarrow$ reflection of $\tan x$ in y-axis



c) i) $y = \sin x$ onto $y = \sin 3x$

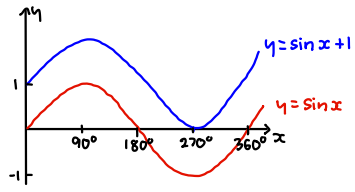
↳ stretch by scale factor $\frac{1}{3}$ parallel to the x-axis

ii) $y = \tan x$ onto $y = \tan(-x)$

↳ reflection in the y-axis

3. a) $y = \sin x$

$y = \sin x + 1 \longrightarrow$ translate by vector $\begin{pmatrix} 0 \\ 1 \end{pmatrix}$

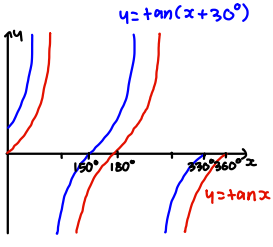


b) $y = \sin x$ onto $y = \sin x + 1$

↳ translation by $\begin{pmatrix} 0 \\ 1 \end{pmatrix}$

4. a) $y = \tan x$

$y = \tan(x + 30°) \longrightarrow$ translate by vector $\begin{pmatrix} -a \\ 0 \end{pmatrix}$

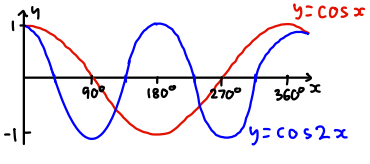


b) $y = \tan x$ onto $y = \tan(x + 30°)$

↳ translation by vector $\begin{pmatrix} -30° \\ 0 \end{pmatrix}$

5. a) $y = \cos x$

$y = \cos 2x \longrightarrow$ stretch by $\frac{1}{2}$ in horizontal direction



b) $y = \cos x$ onto $y = \cos 2x$

↳ stretch by scale factor $\frac{1}{2}$ parallel to the x-axis

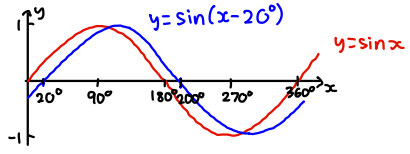
c) $y = \cos 2x$ repeats after 180° so period = 180°

d) Stretch by scale factor $\frac{1}{2}$ in horizontal direction

∴ Roots of graph = 45°, 135°, 225°, 315°

6. a) $y = \sin x$

$y = \sin(x - 20°) \longrightarrow$ translate by vector $\begin{pmatrix} 20° \\ 0 \end{pmatrix}$



b) $y = \sin x$ onto $y = \sin(x - 20)°$

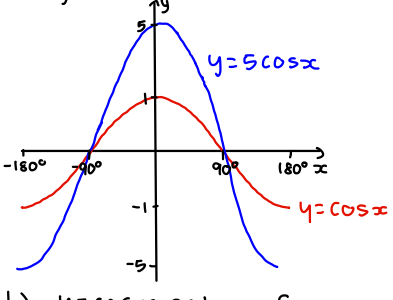
↳ translation by vector $\begin{pmatrix} 20° \\ 0 \end{pmatrix}$

c) i) when $\sin(x - 20°) = 1$, $x = 110°$ $(90° + 20)°$

ii) when $\sin(x - 20°) = -1$, $x = 290°$ $(270° + 20)°$

7. a) $y = \cos x$

$y = 5\cos x \longrightarrow$ stretch by 5 in vertical direction



b) $y = \cos x$ onto $y = 5\cos x$

↳ stretch by scale factor 5 parallel to the y-axis

c) stretch by scale factor 5 parallel to the y-axis

∴ max. value = 5

min. value = −5

d) $5\cos x = k$

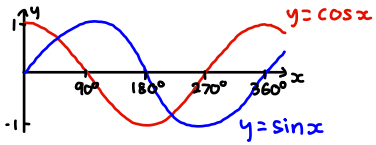
$x = \theta$

Using symmetry:

$x = -\theta$

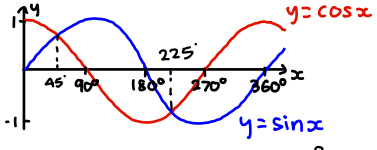
8.

a) $y = \sin x$
$y = \cos x$



b) 2 points of intersections
$\therefore$ 2 solutions

c) Points of intersections



$x = 45°$ and $x = 225°$

d) i) $\sin x = \cos(x + k)$
$y = \cos(x - 90°)$ overlays $y = \sin x$
$\therefore k = -90°$

ii) $\cos x = \sin(x + k)$
$y = \sin(x + 90°)$ overlays $y = \cos x$
$\therefore k = 90°$