Graphs of Trigonometric Functions *and*

Using graphs to find solutions to Trigonometric Equations

These are questions given to students in a tutorial on trigonometric functions where trigonometric functions have been discussed in a lecture. Students are first year engineering students, many of whom do not have mathematics at Advanced level.

The class of 50 students is divided into groups of 4 who are asked to work together in a computer room to explore the mathematics in the questions. They are to use the computer software GeoGebra.

Task 1

As a group, use GeoGebra to explore the following trigonometric functions. You will need to enter parameters a, b, c, d as sliders before using them in functions.

bsin(ax+c); bsin(ax) + c; bcos(ax+c)+d; btan(ax+c); btan(ax+c) + d;

You need to be clear as to how varying a, b, c and d affects the basic function sin, cos or tan.

As a result of the above exploration, you should now have a good understanding of these functions and you should be able to sketch by hand such a function if asked to do so in a test or exam.

Task 2

Work with members of your group on the following and discuss what you find.

For the equations below, solve the equation analytically using the inverse sin, cos or tan and your calculator. Then draw a suitable graph and use it to find a solution or solutions to the equation (do this for different domains where the relevant graph is one-one). See if your findings from the two methods agree.

a) $\sin 2x = 0.5$

(Hint – draw graphs of y=sin 2x and y=0.5 and inspect point(s) of intersection.)

b) $3\sin 2x = 1$ c) $\tan (2x - 1) = 5$ d) $\sin (3 - x) + 4 = 5$

e) $2 - \cos 5x = 3$ f) $2 - \cos 5x = 7$ g) $0.1\tan (0.1x) = -3$

Task 3

Work on the following questions related to trigonometric expressions and equations: you can find the trig identities in HELM 4 and in the yellow book.

a) Find $\cos 15^\circ$ using $\cos (45^\circ - 30^\circ)$ and an appropriate trig identity.

Write these values in terms of π

b) Use trig identities to show that: $[\sin (a - b)]/[\sin a \sin b] = \cot b - \cot a$

c) Show that: $\frac{\sin 3x}{\sin x} + \frac{\cos 3x}{\cos x} = 4 \cos 2x$

d) Prove the identity: $\sec (a/2) + \operatorname{cosec} (a/2) = 2[\sin(a/2) + \cos (a/2)]/\sin a$

e) Solve the equation: $2\cos^2 x - \sin x - 1 = 0 \qquad (0 \leqslant x < 2\pi)$

f) Solve the equation: $\sin 2x + \sin x = 0 \qquad (-\pi \leqslant x < \pi)$