## 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) 3sin 2x = 1 c) tan (2x – 1) = 5 d) sin (3 – x) +4 = 5

e) 2 – cos 5x = 3 f) 2 – cos 5x = 7 g) 0.1tan (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 using cos (45- 30) and an appropriate trig identity.   
Write these values in terms of

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

c) Show that: sin 3x + cos 3x = 4 cos 2x  
 sin x cos x

d) Prove the identity: sec (a/2) + cosec (a/2) = 2[sin(a/2) + cos (a/2)]/sin a

e) Solve the equation: 2cos2 x – sin x - 1 = 0 (0 x < 2)

f) Solve the equation: sin 2x +sin x = 0 (- x < )