

# ELECTRICAL MATHEMATICS

## TEST 5 – TRIAL TEST/ASSIGNMENT

### Notes:

- Test covers trigonometric functions, logarithms and exponentials, complex numbers and vectors.
- The actual test will be closed book, with calculator and ruler required.
- It is **ESSENTIAL** to show working/steps, where asked, otherwise **no marks** can be given.

1. Given that  $\pi$  radians =  $180^\circ$ , express:

1.1  $55^\circ$  in radians

1.2  $\frac{2}{3}\pi$  radians as degrees

1.3  $45^\circ$  in radians (expressed **in terms of  $\pi$** )

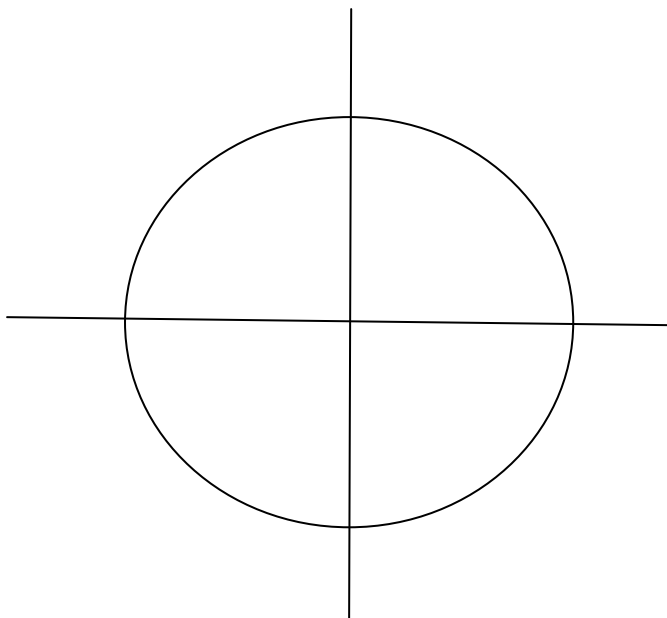
1.4 1.7 radians as degrees

2. Use your calculator to determine the trigonometric ratios of the following, giving answers to 3 significant figures:

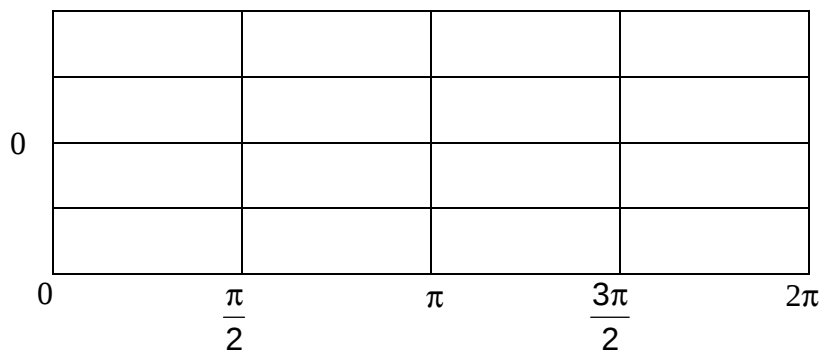
|                                                       |  |
|-------------------------------------------------------|--|
| 2.1 $\tan 21^\circ$                                   |  |
| 2.2 $\cos 225^\circ$                                  |  |
| 2.3 $\sin \frac{3\pi}{4} \text{ rad}$                 |  |
| 2.4 $\cos \left( \frac{4}{3} \pi \text{ rad} \right)$ |  |
| 2.5 $\tan(-21^\circ)$                                 |  |

3. Given that  $\sin 40^\circ = 0.6428$ , use the unit circle (NOT calculator) to determine:

|     |                  |  |
|-----|------------------|--|
| 3.1 | $\sin 140^\circ$ |  |
| 3.2 | $\sin 220^\circ$ |  |
| 3.3 | $\sin 320^\circ$ |  |



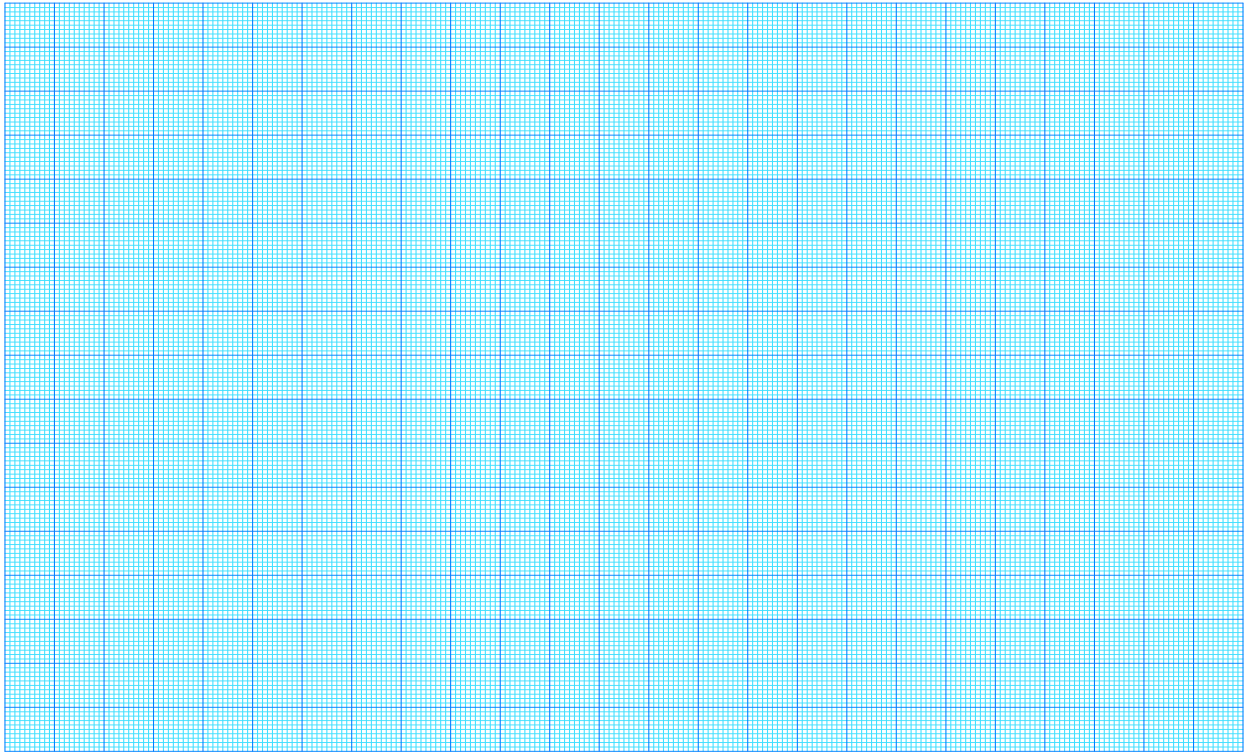
4. Sketch the graph of  $y = \sin \theta$  for  $0 \leq \theta \leq 2\pi$



5. State the amplitude of the following functions:

|     |                         |  |
|-----|-------------------------|--|
| 5.1 | $y = 4 \sin 4\theta$    |  |
| 5.2 | $y = 0.4 \cos 12\theta$ |  |

6. Illustrate the main difference between a sine wave and a cosine wave using a graph.



7. Convert the following:

7.1  $2 - j5$  to polar form

7.2  $3 \angle 60^\circ$  to rectangular form

8. Express the following as indicated:

8.1  $\log_3 27 = 3$  in exponential form

8.2  $\log_2 \frac{1}{4} = -2$  in exponential form

8.3  $10^m = n$  in logarithmic form

8.4  $8^{-\frac{2}{3}} = \frac{1}{4}$  in logarithmic form

9. Evaluate:

9.1  $\log_3 81$

9.2  $\log_e 8.5$

9.3  $\log_n n$

9.4  $\log_5 5^2$

10. Solve the following exponential equations:

10.1  $4^x = 8$

10.2  $\frac{1}{4^a} = 8$

10.3  $9 = 27^{2-x}$

10.4  $3^{2k-5} = 1$

11. Make the variable in the brackets the subject of the formula in the following:

11.1  $a = b^n \quad (n)$

$$11.2 \quad y = \log_{10} x \quad (x)$$

$$11.3 \quad \log_2 \left( \frac{a}{b} \right) = n \quad (a)$$

$$11.4 \quad Q = Q_0 e^{kt} \quad (t)$$

12. The power gain of an amplifier, in decibels, is given by  $G = 10 \log_{10} \frac{P_o}{P_i}$ , where  $P_i$  is the input power and  $P_o$  is the output power.

12.1 Make  $P_o$  the subject of the formula.

- 12.2 Hence find the output power from an amplifier having a 45dB gain and an input signal power of 10 mW (answer correct to 2 significant figures)
13. A robot arm needs to move 400 mm on the x-axis and 300 mm on the y-axis. Sketch these displacement vectors and the resultant displacement vector. Calculate the magnitude AND direction (angle) of the resultant displacement vector.

----- **END OF TRIAL TEST/ASSIGNMENT - *Check your work!*** -----