# Push The Pace #4

You have thirty-five minutes to answer seven examination questions

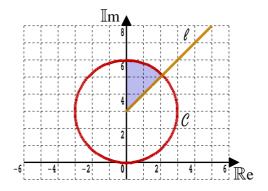
Marks Available: 40 (+ 14 bonus)

**Further A-Level Pure Mathematics** 

**Push The Pace Revision Papers** 

#### **Question 1**

Further A-Level Examination Question from June 2013, Paper 1, Q6 (OCR)



The Argand diagram shows a half-line  $\ell$  and a circle  $\mathcal{C}$ .

The circle has centre 3i and passes through the origin.

(i) Write down, in complex number form, the equations of  $\ell$  and  $\ell$ .

[4 marks]

(ii) Write down inequalities that define the region shaded. (The shaded region includes the boundaries)

Further A-Level Examination Question from June 2019, Paper 1, Q7 (MEI)

A curve has cartesian equation  $(x^2 + y^2)^2 = 2c^2xy$ , where c is a positive constant.

(a) Show that the polar equation of the curve is  $r^2 = c^2 \sin 2\theta$ 

[ 2 marks ]

(**b**) Sketch the curves  $r = c\sqrt{\sin 2\theta}$  and  $r = -c\sqrt{\sin 2\theta}$  for  $0 \le \theta \le \frac{\pi}{2}$ 

[ 3 marks ]

(c) Find the area of the region enclosed by one of the loops in part (b).

Advanced Higher Examination Question from May 2019, Q2, (SQA)

Matrix **A** is defined by  $\mathbf{A} = \begin{pmatrix} 2 & 1 & 4 \\ -3 & p & 2 \\ -1 & -2 & 5 \end{pmatrix}$  where  $p \in \mathbb{R}$ 

(a) Given that the determinant of A is 3, find the value of p

[3 marks]

Matrix **B** is defined by  $\mathbf{B} = \begin{pmatrix} 0 & 1 \\ q & 3 \\ 4 & 0 \end{pmatrix}$  where  $q \in \mathbb{R}$ 

**(b)** Find **AB** 

[2 marks]

(c) Explain why **AB** does not have an inverse.

[ 1 mark ]

Further AS-Level Examination Question from May 2019, Q10 (WJEC) The quadratic equation,

$$px^2 + qx + r = 0$$

has roots  $\alpha$  and  $\beta$ , where p, q, r are non-zero constants.

(a) A cubic equation is formed with roots  $\alpha$ ,  $\beta$ ,  $\alpha + \beta$ Find the cubic equation with coefficients expressed in terms of p, q, r.

[ 6 marks ]

(**b**) Another quadratic equation  $px^2 - qx - r = 0$  has roots  $2\alpha$  and  $\gamma$ . Show that  $\beta = -2\gamma$ 

Further A-Level Specimen Examination Question from 2017, Paper 1, Q11 (AQA)

(a) Prove that 
$$\frac{\sinh \theta}{1 + \cosh \theta} + \frac{1 + \cosh \theta}{\sinh \theta} = 2 \coth \theta$$

[4 marks]

(**b**) Solve 
$$\frac{\sinh \theta}{1 + \cosh \theta} + \frac{1 + \cosh \theta}{\sinh \theta} = 4$$

Give your answer in an exact form.

Further A-Level Examination Question from June 2015, Paper FP1, Q3 (WJEC) The complex number z satisfies the equation,

$$2z - iz^* = \frac{2 + i}{1 - i}$$
 where  $z^*$  denotes the complex conjugate of  $z$ 

Express z in the form a + bi where a and b are rational numbers to be found.

Further A-Level Examination Question from June 2010, Paper FP2, Q8 (Edexcel)

(a) Find the value of  $\lambda$  for which  $y = \lambda x \sin 5x$  is a particular integral of the differential equation,

$$\frac{d^2y}{dx^2} + 25y = 3\cos 5x$$

## [ 4 bonus marks ]

(**b**) Using your answer to part (a), find the general solution of the differential equation,

$$\frac{d^2y}{dx^2} + 25y = 3\cos 5x$$

Given that at $x = 0$ , $y = 0$	and $\frac{dy}{dx} = 5$
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(c) find the particular solution of this differential equation, giving your solution in the form y = f(x)

## [ 5 bonus marks ]

(**d**) Sketch the curve with equation y = f(x) for  $0 \le x \le \pi$ 

## [ 2 bonus marks ]