## Dr Oliver Mathematics Applied Mathematics: Mechanics or Statistics Section B 2015 Paper 1 hour

The total number of marks available is 32. You must write down all the stages in your working.

1. Given that

 $y = e^{5x} \tan 2x,$ 

- find  $\frac{\mathrm{d}y}{\mathrm{d}x}$ .
- 2. (a) Given matrix

$$\mathbf{A} = \begin{pmatrix} 3 & -5 \\ 1 & -1 \end{pmatrix},$$

find  $\mathbf{A}^2$  and show that the inverse of  $\mathbf{A}^2$  exists.

(b) Hence, or otherwise, find matrix **B** such that

$$\mathbf{A}^2 \mathbf{B} = \left(\begin{array}{cc} 4 & 6\\ 2 & -2 \end{array}\right)$$

3. A curve is defined by

$$y = \frac{\sin x}{2 - \cos x} \text{ for } 0 \le x \le \pi.$$

Find the exact values of the coordinates of the stationary point of this curve.

4. (a) Express

 $\log_a 2 + \log_a 4 + \log_a 8$  $p \log_a 2,$ 

in the form

where p is a constant.

(b) Hence evaluate

$$\sum_{r=1}^{100} \log_a 2^r$$

 $q \log_a 2,$ 

giving your answer in the form

where q is a constant.

(1)

(3)

(5)

(3)

(2)

(3)

5. Find the general solution, in the form y = f(x), of the differential equation

$$\frac{1}{\cos x}\frac{\mathrm{d}y}{\mathrm{d}x} + y\tan x = \tan x, \ 0 < x < \pi.$$

6. (a) Express

 $\frac{1}{1-y^2}$ 

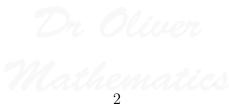
in partial fractions.

(b) Use the substitution  $u = \sqrt{1-x}$  to obtain

 $\int \frac{1}{x\sqrt{1-x}} \,\mathrm{d}x, \, 0 < x < 1.$ 







(6)

(3)

(6)