

**1S2 (Timoney) sample for part 2**  
of 1S1/1S2 christmas test

The instructions will say to do 3 questions from this part. They will also state:

Log tables are available from the invigilators, if required.

Non-programmable calculators are permitted for this examination,—please indicate the make and model of your calculator on each answer book used.

1. Use Gauss-Jordan elimination to describe all solutions of the following system of linear equations:

$$\begin{array}{rrcrcl} 5x_1 & - & x_2 & - & x_3 & - & 8x_4 & = & 5 \\ 15x_1 & + & 2x_2 & + & 3x_3 & + & 5x_4 & = & 10 \\ 10x_1 & - & 2x_2 & + & 4x_3 & + & 2x_4 & = & 8 \end{array}$$

2. (a) For  $\mathbf{v} = -3\mathbf{i} + 7\mathbf{j} + 2\mathbf{k}$  and  $\mathbf{w} = 6\mathbf{i} - 3\mathbf{j} + 5\mathbf{k}$ , calculate  $\|5\mathbf{v} - \mathbf{w}\|$  and the projection  $\text{proj}_{\mathbf{w}}(\mathbf{v})$  of  $\mathbf{v}$  along the direction of  $\mathbf{w}$ .  
(b) Find both the parametric and cartesian equations for the line in space which passes through the point  $(1, 2, 3)$  and is perpendicular to the plane

$$5x - 6y + z = 4.$$

3. (a) Let  $\mathbf{x} = (2, 1, -3, 5, 2)$  and  $\mathbf{y} = (3, 0, 3, -4, -2)$  (in  $\mathbb{R}^5$ ). Compute the cosine of the angle between  $\mathbf{x}$  and  $\mathbf{y}$ .

- (b) For

$$a = \begin{bmatrix} 2 & -1 & 3 \\ 4 & 0 & -2 \\ 3 & 1 & 5 \\ -4 & 3 & 2 \end{bmatrix}, b = \begin{bmatrix} 2 & -2 & 1 & 4 \\ 4 & -5 & 2 & 3 \\ 5 & 7 & 1 & 4 \end{bmatrix}, c = \begin{bmatrix} \frac{1}{2} & 3 \\ 2 & -1 \\ 4 & -2 \\ 1 & 0 \end{bmatrix}$$

compute  $ab$ ,  $ba$  and  $bc$ .

4. (a) What output would be produced by the following Mathematica instruction, and what does it mean?

`FactorInteger[36]`

- (b) Write a Mathematica instruction to factor  $3x^2 + 2x - 1$ .

- (c) Write a Mathematica instruction to graph  $y = \sin(x^2 + 1)$  for  $x$  in the range  $-3 \leq x \leq 3$ .

- (d) What does the following Mathematica instruction mean?

`Solve[x^2 + 4 y x - 5 y^2 == 0, x]`

Work out mathematically, in as much detail as you can, what the result will be (and give reasons).

(e) The following shows a portion of a spreadsheet.

	A	B	C	D
1	23			
2	19			
3	13			
4	10			
5	-5			
6				
7				
8				
9				
10				
11				

If you type into cell **B3** the keystrokes  $=2 * A4 + 1$  and return, what will then show in cell **B3**? If you then copy from cell **B3** and paste into cell **B4**, what will show in cell **B4** afterwards?

*For those who still have a tutorial this week, you can ask about these questions during your tutorial.*

Richard M. Timoney