RADLEY COLLEGE
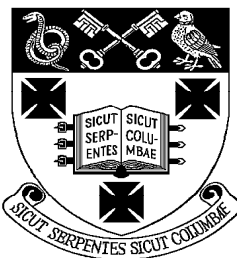## Entrance Scholarships

MATHEMATICS I

Tuesday 22nd February 2005
Time allowed 90 minutes

*You may try the questions in any order and
are not expected to complete them all.*

Show all working.

1. (No calculating aids are to be used in this question)
    a) Work out exactly

    i) 4.91×30.8

    ii) $436.58 \div 8.3$

    b) Give the answers to the following as fractions in their simplest form

    i) $\dfrac{31}{36} - \dfrac{5}{12}$

    ii) $6\dfrac{2}{9} \div 6\dfrac{2}{5}$

    iii) $\left(3\dfrac{1}{2} + 2\dfrac{2}{7}\right) \times 1\dfrac{5}{9}$

    c) Give the answers to the following in standard form.

    i) $\left(4 \times 10^{-4}\right) + \left(8 \times 10^{-5}\right)$

    ii) $\left(8 \times 10^{-5}\right) \times \left(3 \times 10^{8}\right)$

    iii) $\left(6.4 \times 10^{5}\right) \div \left(8 \times 10^{-9}\right)$

2. (No calculating aids are to be used in this question)

Work out as simply as possible

a) $873^2 - 673^2$

b) $(67 \times 91) + (76 \times 67) - 67^2$

c) $(73 \times 16) - (76 \times 27) + (57 \times 73) + (27 \times 49)$

d) $\dfrac{671^2 + (29 \times 671)}{67.1 \times 35}$

3. a) Multiply out and simplify

i) $(2x - 3y)^2$

ii) $(4x^2 - 6xy + 9y^2)(2x + 3y)$

b) Factorise fully

i) $21xy^2 + 28x^3y$

ii) $20x^2 - 45y^2$

iii) $x^2 + 4x - 21$

c) Simplify

i) $\dfrac{ab - ac}{b^2 - c^2}$

ii) $\dfrac{x^3}{y} \div x^2 y^3$

4. Solve each of these equations for x

a) $\dfrac{3x + 2}{5} + \dfrac{x - 2}{4} = 5$

b) $4x^2 - 8x = 0$

c) $\dfrac{64}{x + 3} - 3 = \dfrac{40}{x + 3}$

d) $(2x + 3)(x + 2) - 2x^2 = 55$

5. Rearrange each of the following formulae to make x the subject

a) $a = bx + c$

b) $\dfrac{a}{x-b} = \dfrac{c}{x+d}$

c) $\sqrt{x+a} = b$

6. a) The summit of Cairn Gorm is 1244 metres above sea level, whereas the summit of Ben Macdui is 1309 metres above sea level. From a map, the horizontal distance between these two mountains is 5500 metres. Standing at the top of Cairn Gorm, at what angle above the horizontal do I have to look to see the top of Ben Macdui?

1244m

Cairn Gorm

Ben Macdui

1309m

5500m
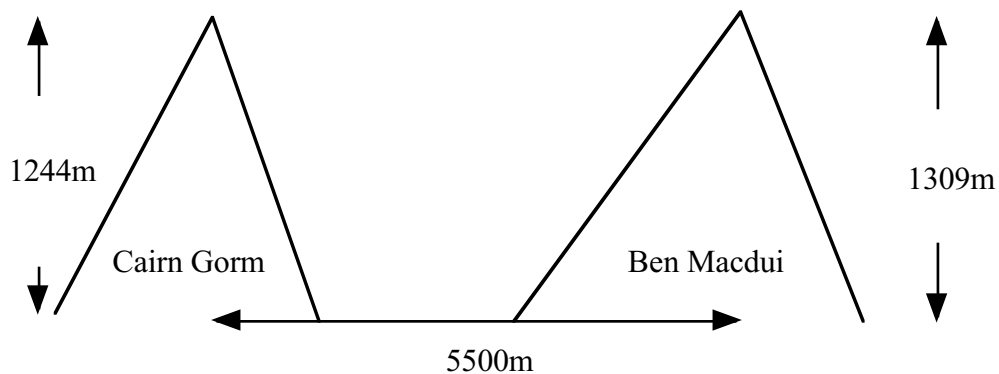
b) A ptarmigan flies 1600 metres East from Cairn Gorm then 1200 metres North. At the same time a golden eagle flies directly from Cairn Gorm to the point the ptarmigan has reached. How far has the golden eagle flown?

c) A skier loses 200 metres altitude in skiing down a straight ski-run on Cairn Gorm of length 700 metres. What angle is this ski run to the horizontal?

d) On a different ski run, the slope is $19.5°$ to the horizontal. How far along the slope does a skier ski in descending 200 metres?

7. Matthew Matics has been designing a wine rack for his cellar. The bottles are to be stored in rows with each row directly above the row below. In his first design, he finds that he completes a certain number of rows but has 10 bottles of wine left over. So in a second design he makes the rows 5 bottles longer and discovers that with one fewer row, he is 5 bottles short of filling the rack. Supposing that his first design had x bottles in each row, and there were y rows, write down an equation on the basis of this information and show that it simplfies to $5y - x = 20$.

He tries a third design with 5 fewer bottles in each row than the first design and finds that with two rows more, he has 5 bottles left over. Write down a second equation using this information.

Solve these two equations to find x and y and then work out how many bottles of wine there are altogether in Matthew's cellar.

8. In arithmetic modulo 4, the answers to a calculation are given as the remainder when the answer is divided by 4. So for example, $2 + 3 = 1 \pmod 4$.
Copy and complete the following table for addition modulo 4:-

+	0	1	2	3
0				
1				
2				
3			1	

Use the table to solve the equation $3 + x = 2 \pmod 4$

Copy and complete the following table for multiplication modulo 4:-

×	0	1	2	3
0				
1			2	
2				
3		3		

Use the tables to solve the following equations:-
a) $3x = 2 \pmod 4$
b) $x^2 = 1 \pmod 4$
c) $2x + 3 = 1 \pmod 4$