SHREWSBURY SCHOOL

SIXTH FORM ENTRANCE EXAMINATION 2010

MATHEMATICS
(1 Hour 15 Minutes)

Instructions to candidates:

Answer all questions, writing your answers on lined or squared paper.
Do <u>not</u> write your answers directly on this question paper.

Section A contains questions of a GCSE nature. Attempt this section first, but do not spend too long on any particular question.

Section B is intended to be more considerably more difficult, and is mainly targeted at candidates who are aiming for an academic scholarship on the strength of their mathematics, or who are hoping to take Further Mathematics at A-Level.

You are expected to use a calculator in this examination.

Relevant working must be shown in order to gain high marks.

Formulae

Quadratic Formula

If $\quad ax^2 + bx + c = 0 \quad$ then $\quad x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Sine Rule

$$\frac{a}{\sin A} = \frac{b}{\sin B}$$

Cosine Rule

$$a^2 = b^2 + c^2 - 2bc \cos A$$

$$\cos A = \frac{b^2 + c^2 - a^2}{2bc}$$

Volume of Sphere

$$V = \frac{4}{3}\pi r^3$$

Surface Area of Sphere

$$S = 4\pi r^2$$

Section A (65 marks)

Answer all questions in this section.

1) Expand the following, simplifying where appropriate:

   a) $2(3a + 5b) + 3(a + 4b)$

   b) $(x + 4)(x - 2)$

   Factorise the following:

   c) $10x - 15$

   d) $x^2 + 4x + 3$

   [2, 2, 1, 2 marks]

2) a)   Hector scores 70% in a chemistry exam. If the total number of marks on the exam was 90, what score out of 90 did Hector get?

   b)   A car was bought for £12,000 and sold a few years later for £8,499. What was the percentage loss in the value of the car?

   c)   A waterproof sponge is on sale for £1.75 having already been reduced in price by 65%. What was the original price of the sponge?

   [2, 2, 2 marks]

3) You must **not** use a calculator in this question. Full working must be shown to obtain any marks.

   a)   Calculate the following, giving your answers as fractions in their simplest form:

   i) $5\frac{4}{7} - 4\frac{2}{3}$

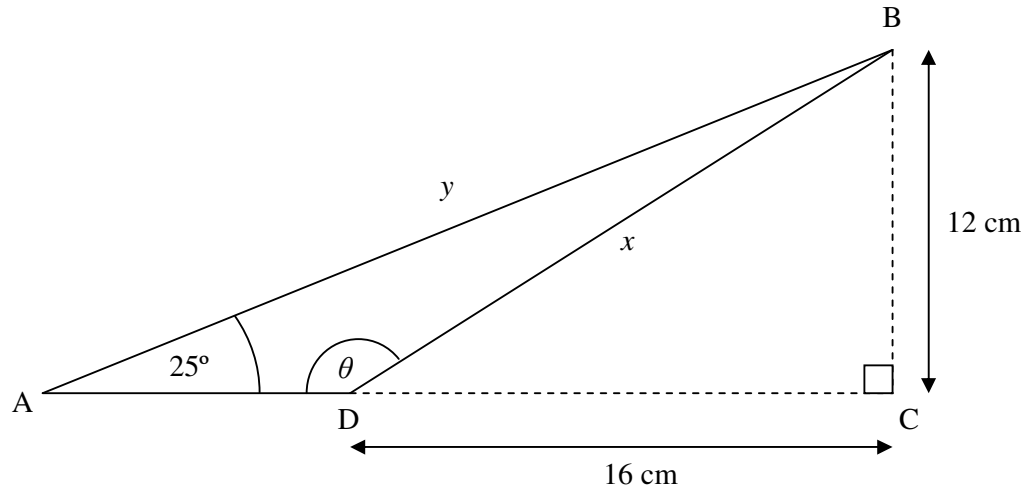   ii) $5\frac{4}{7} \times 4\frac{2}{3}$

   b)   Explain fully which of these numbers is bigger: $5\sqrt{7}$ and $4\sqrt{11}$. Show relevant working and remember **not** to use a calculator.

   c)   Expand and simplify this expression: $(7 + \sqrt{5})(4 - 3\sqrt{5})$.
   (Leave square roots in your answer.)

   [2, 3, 3, 3 marks]

Please turn over.

4)

a)   By considering triangle BCD, calculate the value of *x*.

b)   By considering triangle ABC, calculate the value of *y* to 3 significant figures.

c)   Calculate the value of θ to 3 significant figures.

[2, 2, 3 marks]

5)   An ingot of gold in the shape of a cuboid measures 15 cm by 30 cm by 8 cm. The ingot is melted down, and reformed into many golden marbles.

a)   Assuming each marble is a perfect sphere of radius 2 cm, how many complete marbles can be formed?

b)   What percentage of the original ingot will be wasted? Give your answer to 3 significant figures.

[4, 3 marks]

6)   a)   Expand and simplify $(2t - 9)^2$

b)   Factorise $16a^2 - 25b^2$

[3, 2 marks]

7) Rearrange the following formulae to make t the subject:

a) $2t + 3u = 5$

b) $x = \dfrac{5t}{6} + k$

c) $y = 2 + \sqrt{t - 1}$

d) $z = \dfrac{t - a}{t + a}$

[2, 3, 3, 3 marks]

8) Solve the following equations:

a) $6x + 5 = 4x + 13$

b) $\dfrac{5x + 7}{3x - 1} = 2$

c) $4x^2 - 3x - 22 = 0$

d) $\sqrt{x} + \sqrt{4x} + \sqrt{9x} = 60$

[2, 3, 3, 3 marks]

Section B (20 marks)

This section is intended to be more considerably more difficult, and is mainly targeted at candidates who are aiming for an academic scholarship on the strength of their mathematics, or who are hoping to take Further Mathematics at A-Level.

Only attempt these harder questions if you have done and checked as much of section A as you can.

B1) Express $\left(\sqrt{2}\right)^{\sqrt{2}}$ in the form $2^{2^{n}}$ for a suitable value of *n*.

[5 marks]

B2) 12 identical tennis balls are to be given to Ben, Han and Luke.

This can be done in many ways. For example, Ben might get all 12 balls. Or perhaps Ben gets 2 and Han and Luke each get 5.
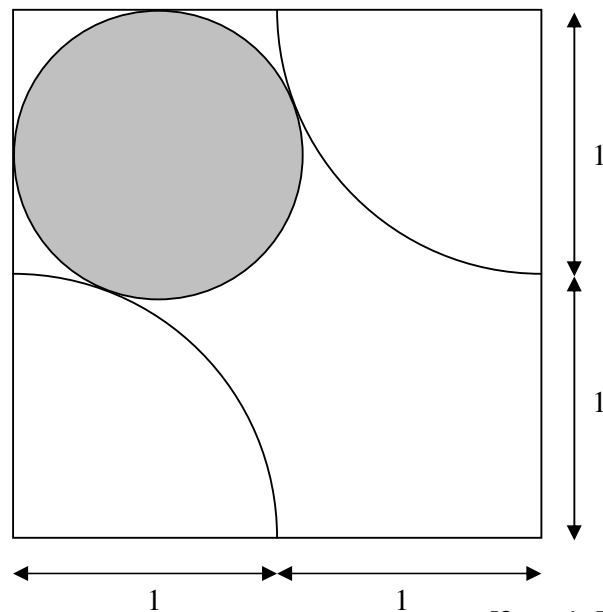
How many ways are there altogether of giving out the 12 tennis balls?

[7 marks]

B3) Two quarter-circles, each of radius 1 unit, are drawn inside opposite corners of a square of side 2 units, as shown.

The shaded circle is the largest possible circle which will fit between the quarter-circles and the edges of the square.

Calculate the exact area of the shaded circle, giving your answer in the form $\left(a - b\sqrt{c}\right)\pi$ for suitable values of *a, b, c*.

[8 marks]

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