16+ ENTRANCE EXAMINATION

For entry in
September 2016

Mathematics
Time: 1 hour

Candidates Name: ......................................................

Instructions to Candidates

- 60 Marks
- Time allowed 1 Hour
- Calculators are allowed
- Write all answers, including your workings, in this booklet
You may use the following formulae:

**Volume of prism** = area of cross section \( \times \) length

Volume of sphere = \( \frac{4}{3} \pi r^3 \)

Surface area of sphere = \( 4\pi r^2 \)

Volume of cone = \( \frac{1}{3} \pi r^2 h \)

Curved surface area of cone = \( \pi rl \)

In any triangle \( ABC \)

Sine Rule \( \frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C} \)

Cosine Rule \( a^2 = b^2 + c^2 - 2bc \cos A \)

Area of triangle = \( \frac{1}{2} ab \sin C \)

**The Quadratic Equation**

The solutions of \( ax^2 + bx + c = 0 \) where \( a \neq 0 \), are given by \( x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \)
1) a) Expand and simplify

\[ 5(2x - 1) - 3(2x - 5) \]

b) Factorise fully

\[ 36x^3y^2 + 45x^2y \]

c) Factorise \( x^2 - 10x + 21 \)

d) Factorise \( 30x^2 - 19x - 5 \)

(Total 7 marks)
2) Simplify

a) \( \left( \frac{2}{x^3} \right)^{-3/2} \)

b) \( (64a^6)^{1/2} \)

c) \( \frac{a^3}{b^3} \div \frac{a^{-1}}{b^2} \)

d) \( (\frac{27c^3}{d^3})^{-\frac{1}{3}} \)
3) Freddie cycles to work every day.
   a. Yesterday, his journey home from work took 50% longer than usual. By what percentage was his average speed slower than normal?

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   (3)

   b. By what percentage would he have to increase his speed in order to reduce the journey time by 20%?

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   (2)

4) A has coordinates (40,60)
   B has coordinates (0,20)

   A straight line passes through the points A and B
   The point P lies on this straight line.
   The x coordinate of P is 0.5

   Find the y coordinate of P

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   (2)
5) A rectangular block of wood with face ABCD leans against a vertical wall, as shown in the diagram below. AB = 8 cm, BC = 5 cm and angle $\angle BAE = 28^\circ$.

Find the vertical height of C above the ground. (Total 4 marks)
6) Write the following as single fractions:

a. \( \frac{3}{a} + \frac{2}{3a} + \frac{2}{3} \)

b. \( \frac{a}{b} + \frac{3}{a} - \frac{2}{3ab} \)

c. \( \frac{1}{x} + \frac{1}{x-1} - \frac{1}{x^2} \)
7)

Two straight lines are shown.

$B$ is the midpoint of $AC$.

$TB : BS = 2 : 3$

Work out the coordinates of $T$. 

Not drawn accurately
8) \((3 + \sqrt{a})(4 + \sqrt{a}) = 17 + k\sqrt{a}\)

Find the value of \(a\) and the value of \(k\)

9) The line \(l_1\) has equation \(y = 3x + 2\) and the line \(l_2\) has equation \(3x + 2y - 8 = 0\).

(a) Find the gradient of the line \(l_2\).

(b) Find the coordinates of \(P\).
10) Make a the subject of the formula:

\[ p = \sqrt{\frac{n^2 + a}{n + a}} \]
11) The following diagram shows a sloping roof. The surface ABCD is a rectangle. The angle ADE is 55°. The vertical height, AF, of the roof is 3 m and the length DC is 7 m.

(a) Calculate AD.

(b) Calculate the length of the diagonal DB.
12) Solve the simultaneous equations

\[ x + y = 2 \]
\[ x^2 + 2y = 12. \]