# Sixth Form Scholarship Examination

# Mathematics

# Specimen

**Your Name…………………………………………..**

**Your Current School………………………………….**

**Time allowed: 1 hour 30 minutes**

**Instructions:**

- **Calculators are NOT allowed.**
- **Answer all questions in the spaces provided. Except question 8 which should be done on a sheet of named graph paper and inserted into this booklet at the end**
- **Any extra sheets should be clearly labeled with your name and the question number and inserted into this booklet at the end**
- **Show all your working, credit can be given for this**
- **Marks for each question are given in brackets e.g. [2]**

1. Write $0.0\dot{3}4\dot{1}$ as a fraction with integer numerator and denominator.

2. $\dfrac{2}{3}$ of the rectangle below is unshaded. What is the value of $x$?
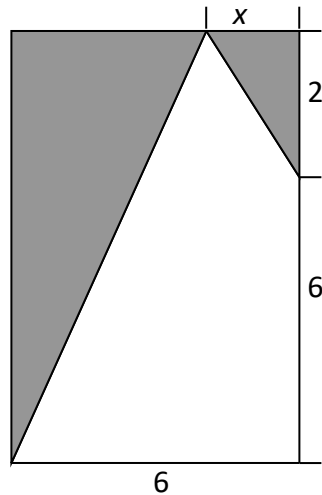
3. Solve the equation $3x^2 - 14x - 5 = 0$.

[3]

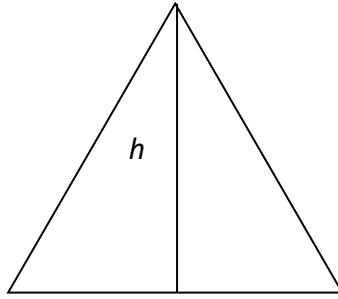4. Make *r* the subject of the following formulae:

a) $x = \dfrac{pr + v}{r - s}$

[2]

b) $\dfrac{1}{a} + \dfrac{1}{b} = \dfrac{1}{r}$

[2]

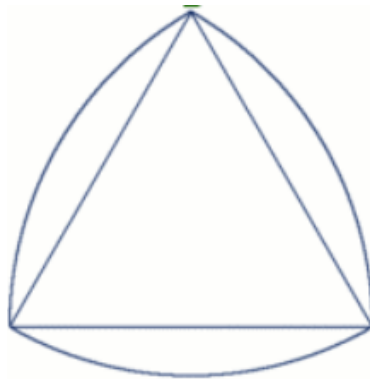5. This is an equilateral triangle with side length 2



a) Find, as an exact square root, the height marked $h$

[1]

b) Calculate the area of the equilateral triangle. Again, give your answer as an exact square root.

[1]

c) 3 circular arcs are drawn from each vertex of the equilateral triangle to form the shape below:



Calculate the area of this shape, leave your answer in terms of $\pi$ and exact square roots.

[3]

6. a) Simplify as far as possible:

$$\frac{x+2}{x^2+5x+6}$$

[2]

b)

    i.    Factorise $x^2-1$

[1]

    ii.   Hence write the following as a single fraction in its simplest terms

$$\frac{x+3}{x^2-1}-\frac{1}{x+1}$$

[3]

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7. A quadratic graph has the equation $y = a(x - b)^2 + c$. It passes through (0,9) and has its vertex at (2,1). Calculate the values *a,b* and *c*. *Hint: you should start by sketching the curve.*

[3]

8. On the sheet of graph paper attached, sketch, on the same axes the graphs of :

a) $y = \cos x°$

[1]

b) $y = \cos 2x°$

[2]

c) $y = 3\cos x°$

[1]

You should label each graph clearly and use a scale of -360° to 360°

9. Bag A contains 2 black and 3 red discs. Bag B contains 3 black and 1 red disc. In an experiment, a bag is chosen at random and then a disc is pulled out of the bag, also at random.

    a. Calculate the probability that the disc is red.

[2]

    b. Given that the disc is red, find the probability that it came from bag A (Hint, imagine repeating the experiment 1000 times and then consider the distribution of outcomes)

[3]

10. Prove algebraically that the square of any odd number is always odd.

[3]

11. What is the last digit of $3^{2014}$ ? Explain your answer fully.

[2]

**Total: 40 Marks**