First name:	Surname:

Current School:

SHREWSBURY SCHOOL

SIXTH FORM ENTRANCE EXAMINATION 2016

MATHEMATICS

(1 Hour 15 Minutes)

Instructions to candidates:

Answer all questions, writing your answers in the spaces provided.

The number of marks for each question is shown in square brackets: [ ].

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

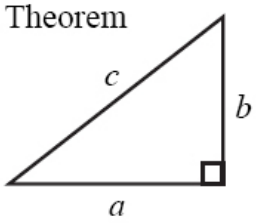
Section B is intended to be more considerably more difficult, and is mainly targeted at candidates who are aiming for an academic scholarship on the strength of their mathematics, or who are hoping to take Further Mathematics at A-Level.

You are expected to use a calculator in this examination.

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

IGCSE MATHEMATICS 4400
FORMULA SHEET – HIGHER TIER

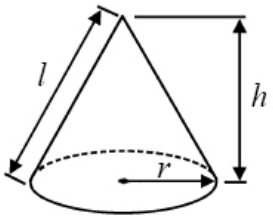
Pythagoras' Theorem



$a^2 + b^2 = c^2$

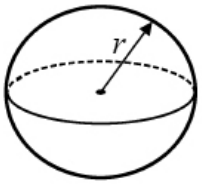
Volume of cone = $\frac{1}{3}\pi r^2 h$

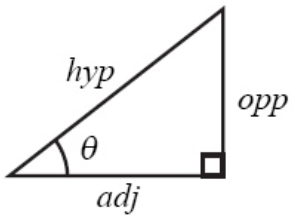
Curved surface area of cone = $\pi r l$



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

Surface area of sphere = $4\pi r^2$





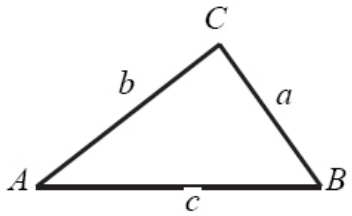
adj = hyp × cos θ
opp = hyp × sin θ
opp = adj × tan θ

or $\sin\theta = \frac{\text{opp}}{\text{hyp}}$

$\cos\theta = \frac{\text{adj}}{\text{hyp}}$

$\tan\theta = \frac{\text{opp}}{\text{adj}}$

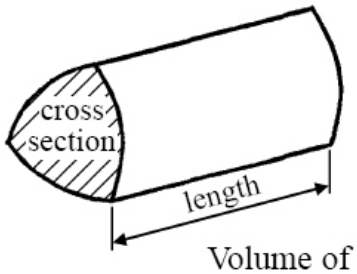
In any triangle ABC



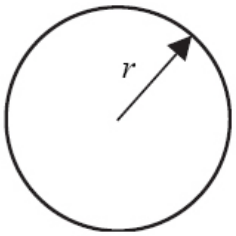
Sine rule $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

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

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



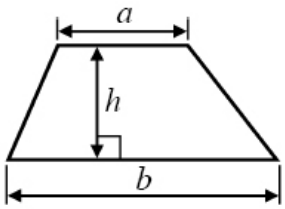
Volume of prism = area of cross section × length

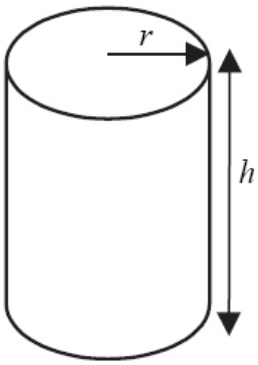


Circumference of circle = $2\pi r$

Area of circle = πr^2

Area of a trapezium = $\frac{1}{2}(a + b)h$





Volume of cylinder = $\pi r^2 h$

Curved surface area of cylinder = $2\pi rh$

The Quadratic Equation
The solutions of $ax^2 + bx + c = 0$ where $a \neq 0$, are given by

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Section A (60 marks)

Answer all questions in this section.

1) Expand the following, simplifying where appropriate:

a) $6(2f + 3g) - 2(4f - g)$

_____ [2]

b) $(3v + 2)(v + 7)$

_____ [2]

Factorise the following:

c) $9cd^2 - 15c^2d$

_____ [2]

d) $x^2 - 5x - 36$

_____ [2]

2) You must **not** use a calculator in this question. Full working **must** be shown.

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

i) $4\frac{1}{3} + 3\frac{5}{7}$

_____ [3]

ii) $4\frac{1}{3} \div 3\frac{5}{7}$

_____ [3]

b) Without using a calculator, determine which of these numbers is larger:

$\frac{\sqrt{7}}{4}$ or $\frac{1}{\sqrt{2}}$?

_____ [2]

3) a) During the battle of Hoth, the rebels lost 80% of their 85 snow-speeders. How many snow-speeders did they have left afterwards?

_____ [2]

b) After collecting his reward for a successful mission, Boba Fett's savings increased by 24%. If he had 59,520 credits after the mission, how much money did he have beforehand?

_____ [2]

c) Lando Calrissian bought a B-Wing Fighter for 720,000 credits and later sold it for only 675,000 credits.

What was the percentage decrease in the value of the B-Wing Fighter?

_____ [3]

4) A large tin contains 15 snacks altogether: 7 cupcakes and 8 chocolate biscuits. Scooby Doo eats one of these snacks at random. He then eats a second snack at random.

a) What is the probability that the first snack is a cupcake?

_____ [1]

b) What is the probability that Scooby Doo eats two snacks of the same type?

_____ [3]

5) For a pendulum of fixed length, the gravitational field strength g is **inversely** proportional to the **square** of the time period T. When $T = 3$ seconds, $g = 10$ ms^{-2}.

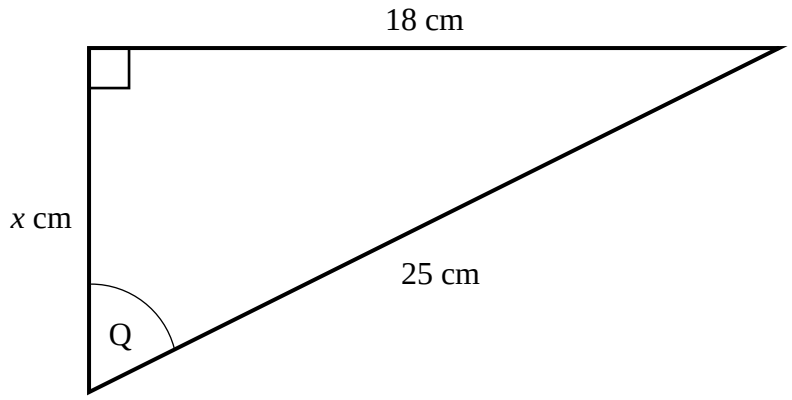
a) Find a formula for g in terms of T.

_____ [3]

b) Calculate the time period when the same pendulum is in a gravitational field strength of 1.6 ms^{-2}.

_____ [3]

6)



The diagram shows a right-angled triangle.

a) Assuming the lengths shown are exact, calculate angle Q to 3 significant figures.

_____ [2]

b) Given instead that the lengths are only correct to the nearest cm, calculate the lower bound ("smallest value") of the length x.

Give your answer to 4 decimal places.

_____ [3]

7) Rearrange the following formulae to make *y* the subject:

a) $4x - 6y = 7$

_____ [2]

b) $x = \dfrac{3}{y+5}$

_____ [3]

c) $M = 4\sqrt{y^3 - 5}$

_____ [3]

d) $W = \dfrac{y+6}{y-4}$

_____ [3]

8) Solve the following equations:

a) $7x - 9 = 2x + 6$

_____ [2]

b) $\frac{4x}{x+5} = \frac{3}{7}$

_____ [3]

c) $2x^2 + 7x + 5 = 0$

_____ [3]

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

_____ [3]

Section B (20 marks)

This section is intended to be more considerably more difficult, and is 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) A regular pack of 52 playing cards is shuffled, and all the cards are dealt out one by one.

a) What is the probability that the Jack of Hearts appears before the Queen of Hearts?

_____ [1]

b) Calculate the probability that the Jack appears before the Queen in all four suits.

_____ [2]

c) Calculate the probability that all four Jacks appear before the first Queen appears.

_____ [3]

B2) a) Expand and simplify $4(n-3)+17$.

_____ [1]

b) Determine all the integer values of *n* such that $\frac{4n+5}{n-3}$ is also an integer.

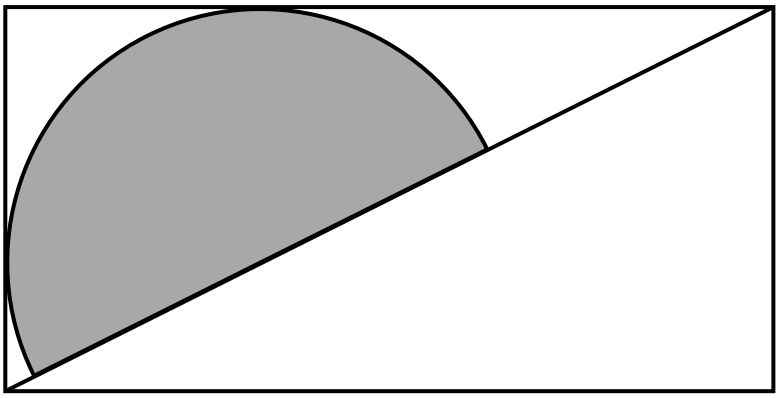
[An integer is a whole number; it can be positive, negative, or zero.]

_____ [6]

Please turn over for the final question.

B3) The diagram below shows a rectangle with sides in the ratio $2 : 1$.

A semi-circle is drawn such that the diameter lies along a diagonal of the rectangle, with the curved edge touching two sides of the rectangle.



Find the exact proportion of the rectangle which is occupied by the semi-circle.

_____ [7]

+++++ END +++++