

## 2013 UQ/QAMT Problem Solving Competition - Year 9 & 10 Paper

*All questions have equal value. Non-CAS calculators may be used.*

### Question 1

My internet connection is slow. The more files I download at once the slower it gets. At 1:00 pm I started downloading the three files simultaneously. At that point the time remaining to complete the downloads were given as 10, 8 and 4 minutes. At what time will the downloads all be finished?

### Question 2

If the number  $x = 111 \dots 1$  consists of 2013 digits which are all equal to 1, what are the 3 middle digits of  $x^2$ ?

### Question 3

A cone has radius 1, height 6. A cube just fits inside the cone, with the bottom of the cube level with the bottom of the cone. What is the volume of the cube?

### Question 4

The factorial,  $n!$ , of a non-negative integer  $n$  is defined by

$$n! = n \times (n - 1) \times (n - 2) \times \dots \times 1,$$

with  $0! = 1$ . How many triples  $a, b, c$  of non-negative integers are there such that

$$(a!)(b!) = a! + b! + c! ?$$

### Question 5

Suppose we have six equally spaced points on a circle of radius 1 unit. We connect one point to each of the other five with straight lines, as in the diagram. What is the product of the lengths of all these lines?

