These questions are designed to test your ability to analyse a problem and to express yourself clearly and accurately. The following suggestions are made for your guidance:

1. Great weight will be attached by the examiners to the method of presentation of a solution. Candidates should state as clearly as they can the reasoning by which they arrived at their results. In addition, more credit will be given for an elegant than for a clumsy solution.

2. The seven questions are not of equal length or difficulty. Generally, the later questions are more difficult than the earlier questions.

3. It may be necessary to spend considerable time on a problem before any real progress is made.

4. You may need to do considerable rough work but you should then write out your final solution neatly, stating your arguments carefully.

5. Credit will be given for partial solutions; however a good answer to one question will normally gain you more credit than sketchy attempts at several questions.

Textbooks, electronic calculators and computers are NOT allowed. Otherwise normal examination conditions apply.
(1) Bob, Rob and Tony are employed to load bricks on a truck. It takes 60 minutes for Rob and Bob to load one truck, while it takes 90 minutes for Rob and Tony to load one truck, and 72 minutes for Bob and Tony to load one truck. How long would it take all three men working together to load one truck if they work at their usual rate, and who is the slowest worker?

(2) The digits of Phil’s bill have accidentally been reversed. He has been overcharged by an amount that uses the same digits as the correct price. If he spent a whole number of dollars less than $1000, what is the correct price?

(3) A right-angled triangle has hypotenuse of length 7 and perimeter of length 16. What is the area of the triangle?

(4) In the following figure, the two squares have a common centre point. Find the area of the shaded region between the two squares.

(5) A circular floor of diameter 32 metres is spinning at a rate of one revolution per 16 seconds. Alex walks on the floor at a constant speed of 3m/s. What is the shortest time it can take Alex to walk between two opposite points adjacent to the circular floor?

(6) Find all positive integer solutions \((p, q, n)\) of 
\[ p^{n+1} + 2011 = q^{n+1}. \]

(7) The numbers \(2^1 = 2\), \(2^5 = 32\) and \(2^9 = 512\) have the property that they are powers of 2 ending in 1s and 2s. Does there exist a power of 2 whose last 10 digits consists only of 1s and 2s?