

# PROTOTYPE EXAMINATION

## Mathematics

First Year of Secondary Cycle Two  
(Secondary III)

### Part I

Context

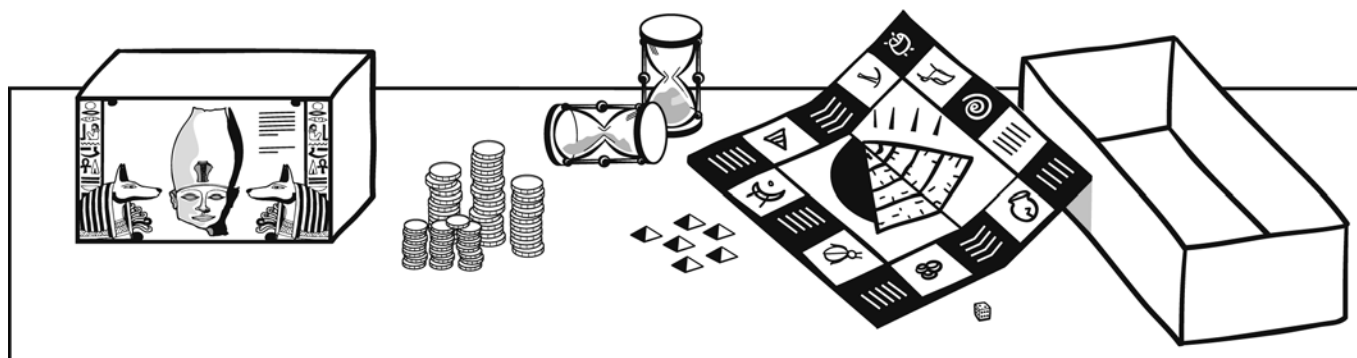
**2009**

Time: 3 hours

## THE GREAT PYRAMID GAME

Located in Giza, Egypt, the Great Pyramid of Giza, also known as the Pyramid of Cheops, was built at the request of the pharaoh, Cheops, who wanted it to house his tomb. Standing more than 145 m high, it was constructed over a 20-year period beginning around 2530 years before Jesus Christ. The Greeks regarded this famous monument as one of the Seven Wonders of the World.

A company wants to create a board game in which the players pretend they are archaeologists doing research on the site of the Great Pyramid. The game consists of a storage box and its lid, a game board, 2 hourglasses, a die, 50 tokens representing various discoveries and 6 game pieces.



**Before producing the game, you must determine the length of the sides of the base of the game pieces.**

Below you will find the information needed to do your calculations.

### TOTAL WEIGHT OF THE GAME

- ♦ The total weight of the game includes the weight of the storage box and lid, the game board, the 2 hourglasses, the die, the 50 tokens and the 6 game pieces.
- ♦ The company has determined that consumers find lightweight games less appealing. The total weight of the game box, its contents and the lid must be greater than the 3rd quartile of the weights of the 13 comparable games produced by this company. The weights, in grams, of these 13 games are given below.

1700 1716 1716 1754 1802 1802 1850 1875 1912 1912 1920 1925 1925

- ♦ To facilitate handling, this company produces games that weigh a maximum of 1925 g.

### THE STORAGE BOX AND GAME BOARD

- ♦ The same type of plastic-coated cardboard is used to make the game board, the box and its lid. This cardboard weighs  $2 \text{ g per cm}^3$ .
- ♦ The storage box and its lid weigh a total of 1150 g.
- ♦ The game board is a square-based right prism measuring 32 cm by 32 cm by 0.2 cm. The board is folded into two congruent parts so it can be easily stored in the box.

## THE TWO HOURGLASSES

- ◆ The two hourglasses are used to measure the time that players are allotted for answering the different questions. One hourglass can measure 60 seconds and the other, 90 seconds. The two hourglasses are congruent and contain the same type of sand. However, the quantity of sand in each hourglass differs according to the amount of time it can measure.
- ◆ The total weight of an hourglass includes the weight of the hourglass itself as well as the weight of the sand it holds. The table of values on the right shows the total weight of different hourglasses according to the amount of time to be measured.



Time to be measured (s)	Total weight of the hourglass (g)
30	47
45	57.5
120	110
180	152

## THE DIE, TOKENS AND GAME PIECES

The die, tokens and game pieces are made of acrylic. The weight of  $1 \text{ cm}^3$  of acrylic is 1.2 g.

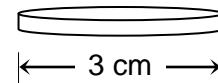
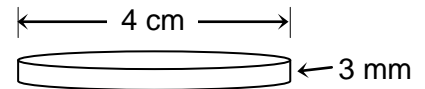
### THE DIE

- ◆ The die is an acrylic cube with each edge measuring 1.5 cm.



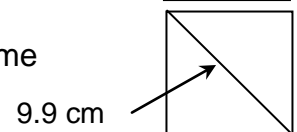
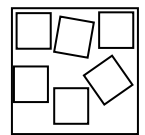
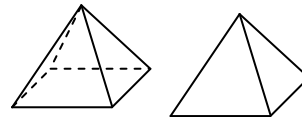
### THE TOKENS

- ◆ The 50 tokens representing the discoveries of archaeologists are right circular cylinders.
- ◆ The tokens are similar and come in two different sizes. The game has 30 big tokens and 20 small tokens.
- ◆ The diameter of a big token is 4 cm. Its height is 3 mm.
- ◆ The diameter of a small token is 3 cm.



### THE GAME PIECES

- ◆ The 6 game pieces are congruent.
- ◆ Each game piece is a right pyramid with a square base.
- ◆ The value of the ratio  $\frac{\text{Height of a game piece}}{\text{Length of one side of the base of a game piece}}$  must be equal to 1.1.
- ◆ It must be possible to place all 6 game pieces on one game board space without stacking them, meaning that each piece must be able to stand on its base within the boundaries of the game board space.
- ◆ Each space on the game board is a square. The diagonal of each game board space is 9.9 cm long.



**You must now determine the length of the sides of the base of the game pieces, taking into account the restrictions related to the weight of the game and to the dimensions of the game pieces.**

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