

Appendix 4. Original modeling task by group 4

1. Read the following dialogue and answer the questions. [30 points]

Susan: It looks like I just bought a new one, but the sunscreen is running out!
Hosung: So do I. Let's buy a new sunscreen today.
Naree: Oh! There is a Two Plus One event over there.
Susan, Hosung: Where...? Shall we buy it together?




The three stopped by a drug store and bought sunscreen for a Two Plus One event.

Naree: Let's calculate how long we can use the sunscreen this time.
Susan: What to consider first...?
...

The following are the face shapes of Hosung, Naree, and Susan. Suppose the midpoint of the segment between the top of the forehead and the bottom of the chin is point O. Then, the distance from the top of the forehead to point O and the distance from the bottom of the chin to point O are both r .

(Note: $1\text{ ml} = 1\text{ cm}^3$)

(Note: Please assume that the surface of the face is flat, ignoring all the curvature.)

		
Hosung (Round shape: Circle)	Naree (Angular: Half-circle + Quadrilateral)	Susan (Egg shape: Half-circle + Quadratic curve)

(1) Find an expression for the area of the face shape of Hosung, Naree, and Susan in terms of r and explain the process. [10 points]

(2) When the sunscreen's volume is 30 ml, write an expression for the maximum number of times that each person can apply the sunscreen on their faces. In doing so, use the symbol '[]' and the variables t and r and explain the solution process. [10 points]

Note that t represents the thickness of the sunscreen layer and $[x]$ represents the greatest integer less than or equal to x .

(3) Use the following conditions and assume that they apply the sunscreen on their faces once per day. Explain who will be able to use the sunscreen the longest time. (Note: Assume $\pi = 3$ in your calculation.) [10 points]

Conditions: The thickness of the sunscreen layer is 0.005 cm on Hosung, 0.003 cm on Naree, and 0.004 cm on Susan. Assume r is 9 cm.