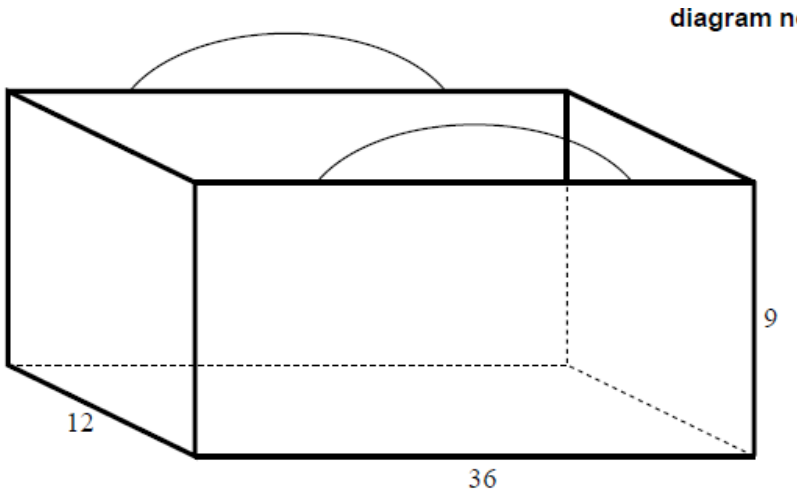
Optimization *[18 marks]*

Haruka has an eco-friendly bag in the shape of a cuboid with width 12 cm, length 36 cm and height of 9 cm. The bag is made from five rectangular pieces of cloth and is open at the top.

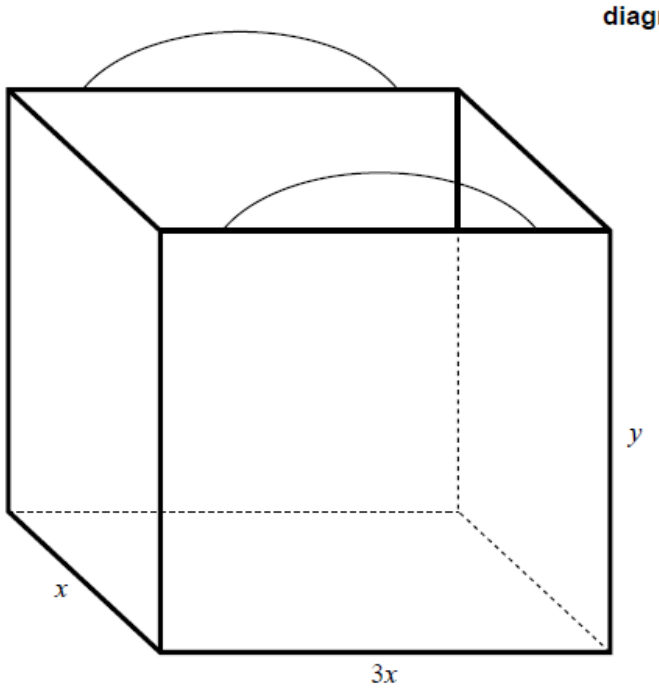


1a. Calculate the area of cloth, in cm^2, needed to make Haruka's bag. *[2 marks]*

1b. Calculate the volume, in cm^3, of the bag. *[2 marks]*

Nanako decides to make her own eco-friendly bag in the shape of a cuboid such that the surface area is minimized.

The width of Nanako's bag is x cm, its length is three times its width and its height is y cm.



The volume of Nanako's bag is 3888 cm^3.

1c. Use this value to write down, and simplify, the equation in x and y for the volume of Nanako's bag. *[2 marks]*

1d. Write down and simplify an expression in x and y for the area of cloth, A, used to make Nanako's bag. *[2 marks]*

1e. Use your answers to parts (c) and (d) to show that $A = 3x^2 + \frac{10368}{x}$. *[2 marks]*

1f. Find $\frac{\mathrm{d}A}{\mathrm{d}x}$. *[3 marks]*

1g. Use your answer to part (f) to show that the width of Nanako's bag is 12 cm. *[3 marks]*

1h. The cloth used to make Nanako's bag costs 4 Japanese Yen (JPY) per cm^2. *[2 marks]*

Find the cost of the cloth used to make Nanako's bag.