

INVESTIGATION # 18

## ICE CREAMS

For this investigation you will need to use these two formulae:

$$\text{Volume (sphere)} = \frac{4}{3} \pi r^3$$

$$\text{Volume (cone)} = \frac{1}{3} \pi r^2 h$$

An ice-cream manufacturer has asked you to design the perfect ice-cream **cone**. The only stipulation is the *legal confectionary guidelines* which state that;

*" the radius of the top of the cone and the perpendicular height of the cone must equal a total of 6cm "*

1. What sizes are possible for the radius and perpendicular height?
2. What volume results from each of these sizes?
3. Draw a graph of all possible radii and their corresponding volumes.
4. What are the dimensions that maximise the volume?
5. If ice-cream is placed in the cone so that it fills the cone and forms a hemisphere above the cone, what is the volume of ice cream in total?
6. Examine what happens if the legal confectionary guidelines change the total from 6cm?

## ASSESSMENT TASK

### ICE CREAMS

For this assessment task you will need to use these two formulae:

$$\text{Volume (sphere)} = \frac{4}{3} \pi r^3$$

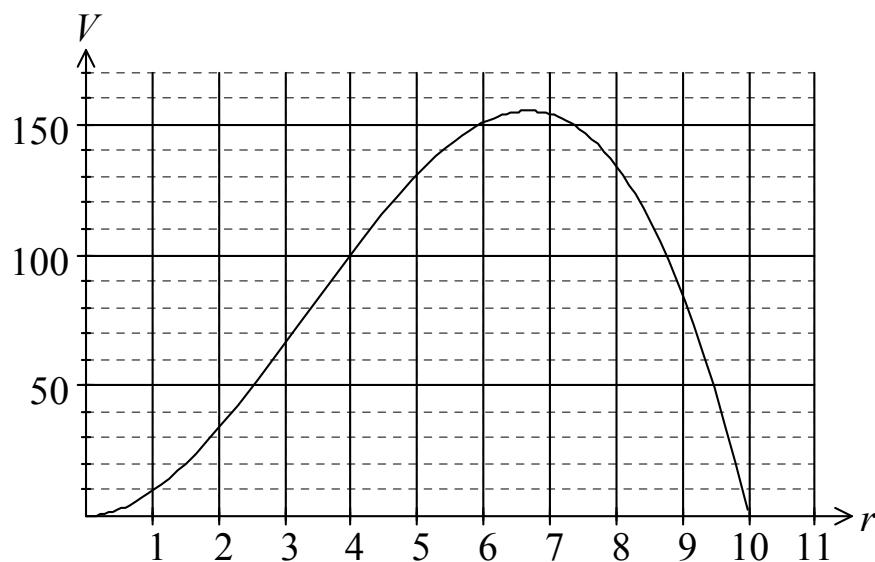
$$\text{Volume (cone)} = \frac{1}{3} \pi r^2 h$$

NOTE: The volume of the hemisphere is only applicable to question 4. In all other questions only the cone is filled.

An ice-cream manufacturer has asked you to design the perfect ice-cream **cone**. The only stipulation is the *legal confectionary guidelines*.

1. List 4 possible sizes for the radius and perpendicular height if the guidelines state *"the radius of the top of the cone and the perpendicular height of the cone must equal a total of 9cm"*.
2. Draw a graph of all possible radii and their corresponding volumes under these guidelines.
3. What are the dimensions that maximise the volume under these guidelines?
4. If ice-cream is placed in the cone with the dimensions found in question 3 so that it fills the cone and forms a hemisphere above the cone, what is the total volume of ice cream.

5. The graph below represents the radius and volume for guidelines which state that the total must be 10cm.



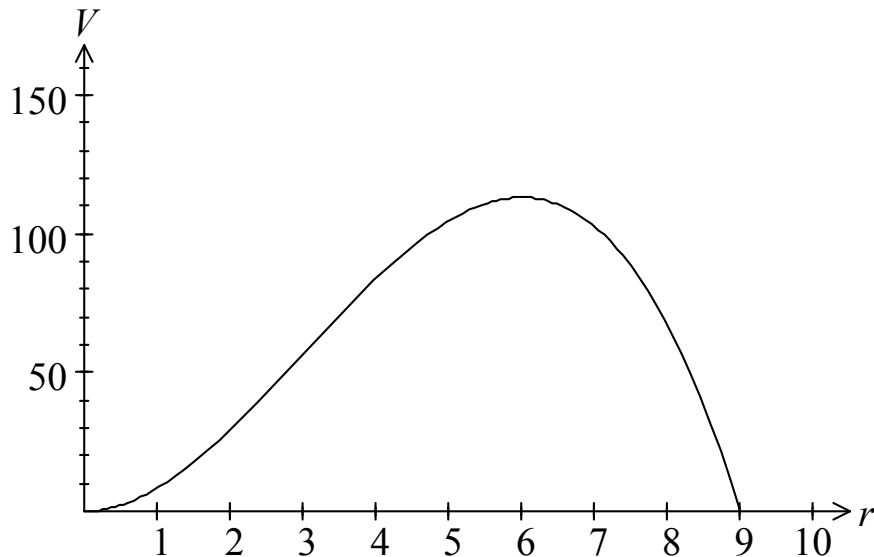
Use this graph to find the dimensions that would maximise the volume in the cone.

6. What dimensions would maximise the volume if the guidelines stated that a total of 20cm was appropriate.

SOLUTIONS and POSSIBLE MARKING GUIDE to ASSESSMENT TASK

Q1. Any 4 pairs of numbers,  $r, h$  where  $r + h = 9\text{cm}$ . 4 marks

Q2. Graph 6 marks



Q3.  $R = 6\text{cm}$ ,  $h = 3\text{cm}$  4 marks

Q4. 
$$V = \frac{1}{3} \cdot \pi \cdot (6^2) \cdot 3 + \frac{1}{2} \cdot \frac{4}{3} \cdot \pi \cdot (6^3)$$

$$= 113.1 + 452.4$$

$$= 565.5 \text{ cm}^3 \quad 8 \text{ marks}$$

Q5.  $r = 6\frac{2}{3}$   $h = 3\frac{1}{3}$  4 marks

or  $r = 6.5, 6.6, 6.7$   $h = 3.5, 3.4, 3.3$  2 marks

or  $r = 7$   $h = 3$  1 mark

Q6.  $r = 13\frac{1}{3}$   $h = 6\frac{2}{3}$  4 marks

TOTAL MARKS = 30