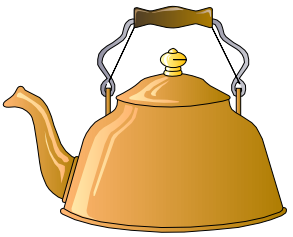
SAMPLE INVESTIGATION

EFFICIENCY RATIOS

An efficiency ratio is the ratio of surface area to volume of a shape.

e.g.: A particular rectangular prism has a surface area of 88 cm^2 and a volume of 48 cm^3. Its efficiency ratio is 88 ÷ 48 and is expressed as a percentage i.e. 183%.

Efficiency ratios are important in biology with the study of heat loss of animals, and in physics with heat loss and gain of containers.



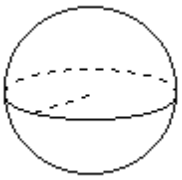
* Using the formulae given at the end of this page examine the efficiency ratios for various spheres, cubes, cones and cylinders.

* Look at which shape is the most efficient (i.e. has the LOWEST ratio).

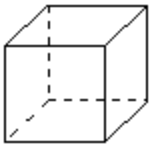
* Look at how increasing the radius of a sphere or length of a cube affects its efficiency ratio.

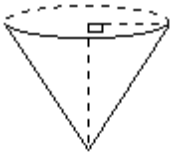
* Look at how different shaped cones and cylinders have different efficiency ratios.

$V(sphere) = \frac{4}{3}\pi r^3$ $SA(sphere) = 4\pi r^2$



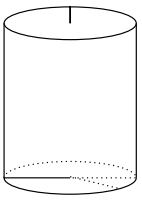
$V(cube) = l^3$ $SA(cube) = 6l^2$





$V(cone) = \frac{1}{3}\pi r^2 h$ $SA(cone) = \pi rs + \pi r^2$ *where s is slant height*

$V(cylinder) = \pi r^2 h$ $SA(cylinder) = 2\pi rh + 2\pi r^2$



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ASSESSMENT TASK

EFFICIENCY RATIOS

The formulae you require for this assessment are printed here:

$V(sphere) = \frac{4}{3}\pi r^3$ $SA(sphere) = 4\pi r^2$ $V(cube) = l^3$ $SA(cube) = 6l^2$

$V(cone) = \frac{1}{3}\pi r^2 h$ $SA(cone) = \pi rs + \pi r^2$ *where s is slant height*

$V(cylinder) = \pi r^2 h$ $SA(cylinder) = 2\pi rh + 2\pi r^2$

1. Calculate the efficiency ratios for;

(a) A sphere of radius 3 cm _____% (4 marks)

(b) A cube of edge length 7 cm _____% (4 marks)

(c) A cone with height and radius both 4 cm _____% (4 marks)

(d) A cylinder with height and radius both 5cm _____% (4 marks)

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2. (a) If you are trying to find **the most efficient shape** for a vacuum flask to keep your coffee hot, which of the four shapes would you choose: sphere, cube, cone, cylinder; rank them in order from the least efficient to the most efficient. (Do NOT rely on the values in question 1).

_____,_____,_____,_____

(4 marks)

(b) The answer for question 2(a) can not be found from the results of question 1. Explain why not and how an answer could be found.

_____

_____

_____.(2 marks)

3. As the radius of a sphere increases what happens to its efficiency ratio ?

_____. (2 marks)

4. The efficiency ratio for a cube is always $\frac{6}{l}$.

Use the formulae to show why this is true. (3 marks)

5. A rodent with cylindrical body shape loses most of its heat from its body. Will a rodent with body length 10cm and radius approximately 5cm be more heat efficient than one with a length of 5cm and radius of approximately 10cm? Show working to justify your answer. (3 marks)

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