Approximations: Upper and Lower Bounds

Part A

Each of the following numbers has been rounded as shown. Write down in the form $A \leq x < B$ the range of values in which the unrounded value must lie.

1) 3.8 (1dp)	2) 4.26 (2dp)	3) 0.004 (3dp)
4) 3.70 (2dp)	5) 1340 (3sf)	6) 34.7 (3sf)
7) 2700 (2sf)	8) 0.058 (2sf)	9) 4.3 (2sf)
10) 4.30 (3sf)	11) 8500 (nearest whole no)	12) 8500 (nearest 10)
13) 8500 (nearest 100)	14) 7800 (2sf)	15) 7800 (3sf)

Part B

1) The radius and height of a cylinder are given as:
r = 4.6cm (to 1dp) h = 120cm (to 2sf)
Find the maximum and minimum possible volumes of the cylinder.

2) In the specification of a ball-bearing, the radius is given as 3.2cm $\pm$ 0.03cm. Find the minimum permissible volume of the ball-bearing.

3) The rate (R cm/sec) at which the water level in a barrel is rising can be calculated using the formula $R = \frac{a-b}{t}$

Measurements have been made and the following figures given:
a = 130cm)
b = 68cm) all to the nearest whole number
t = 20 secs)
Find the greatest possible value for R based on these figures.

4) The speed of an object in an experiment is to be calculated using the formula $S = \frac{D}{T}$. D has been measured as 24cm (to the nearest cm), and T as 1.6 secs (to 1dp).
(a) Calculate the speed using the actual values given.
(b) Calculate the maximum and minimum possible speeds taking into account the degree of accuracy of the measurements.
(c) Hence find the maximum possible ERROR in the speed.
(d) Express this error as a percentage of the answer to (a).

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