Upper and Lower Bounds - Worksheet

Skill

Group A - Finding upper and lower bounds

Find the upper and lower bounds of the rounded values.

1) 12 to the nearest integer

2) 8.7 to one decimal place

3) 300 to the nearest 100

4) 300 to the nearest 10

5) 5000 to 1 significant figure

6) 5000 to 2 significant figure

7) 1.78 to 3 significant figures

8) 0.030 to 3 decimal places

9) 4670 to the nearest integer

10) 4670 to the nearest 10

11) 0.62 to 2 significant figures

12) 60.0 to one decimal place

Group B - Bound calculations involving addition or multiplication

If $A = 7$ the the nearest integer, $B = 3.2$ to 2 significant figures, $C = 40$ to the nearest 10 and $D = 12.39$ to 2 decimal places. Find the upper and lower bounds of the calculations.

1) $A + B$

2) $A + C$

3) $B + D$

4) AB

5) BD

6) CB

7) $2A$

8) $2(B + C)$

9) $2B + 3D$

10) A^2

11) B^3

12) ABD

Group C - Bound calculations involving subtraction or division

If $P = 20$ to the nearest integer, $Q = 100$ to the nearest hundred, $R = 5.2$ to 1 decimal place and $S = 320$ to 2 significant figures. Find the upper and lower bounds of the calculations.

1) $S - Q$

2) $Q - P$

3) $P - R$

4) $\frac{Q}{P}$

5) $\frac{P}{Q}$

6) $\frac{S}{P}$

7) $\frac{R}{S}$

8) $P - 2R$

9) $4Q - S$

10) $S - P - Q$

11) $\frac{QP}{S}$

12) $\frac{P}{RQ}$

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Upper and Lower Bounds - Worksheet

Applied

1) A rectangle has a length of $7.2cm$ and a width of $4.8cm$. Both measurements are to the nearest millimetre.

(a) Find the upper and lower bounds of the perimeter of the rectangle.

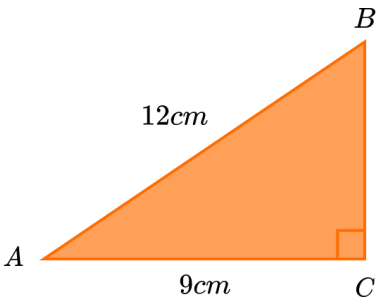
(b) Find the upper and lower bounds of the area of the rectangle.

2) A circular pond has a diameter of $5.36m$ to the nearest centimetre.

(a) Find the upper bound of the circumference of the pond. Give your answer to 3decimal places.

(b) Find the lower bound of the area of the pond.
Give your answer to 3 decimal places.

3) The diagram shows the right-angled triangle ABC where $AB = 12cm$ and $AC = 9cm$. Both measurements have been rounded to the nearest centimetre.



(a) Find the lower bound for the length BC.

(b) Find the error interval for the angle BAC.

Upper and Lower Bounds - Worksheet

4) Using the formula $P = \frac{F}{A}$.

(a) Find the upper bound of P if $F = 45.72$ to 2 d.p and $A = 5.8$ to 1 d.p.

(b) If $F = 5.21$ to 2 d.p and $P = 1.67$ to 2 d.p. By considering bounds, find the value of A to a suitable degree of accuracy.

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Upper and Lower Bounds - Exam Questions

1) $E = mgh$
$m = 4$ correct to the nearest integer.
$g = 9.81$ correct to 3 significant figures.
$h = 2.4$ correct to 1 decimal place.

(a) Find the lower bound for E.

.....
(2)

(b) Find the upper bound for E.

.....
(2)
(4 marks)

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2) A rectangular field has a length of 260 metres to 2 significant figures and a width of 145 metres to the nearest metre.

(a) Find the lower bound of the area of the field.

.....
(2)

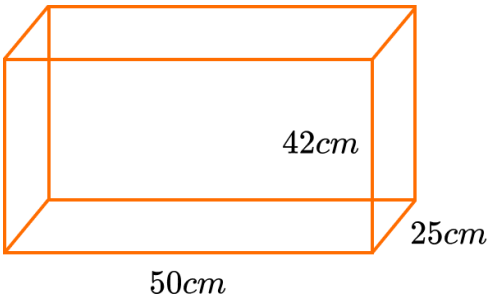
(b) Find the upper bound of the perimeter of the field.

.....
(2)
(4 marks)

Upper and Lower Bounds - Exam Questions

3) A container in the shape of a cuboid is to be filled with soil. The cuboid is $50cm$ by $42cm$ by $25cm$, where the measurements are correct to the nearest cm.

The container will be filled using a jug that can hold $2500ml$ to the nearest $100\ ml$.



What is the minimum number of full jugs that may be required to fill the container?

.....

(5 marks)

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4) $K = \sqrt{\frac{M}{H}}$

$M = 8.42$ to 3 significant figures
$H = 2.64$ to 3 significant figures.

By considering bounds, work out the value of K to a suitable degree of accuracy, justifying your answer.

.....

(5 marks)

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Upper and Lower Bounds - Answers

	Question	Answer
	Skill Questions	
Group A	Find the upper and lower bounds of the rounded values. **1)** 12 to the nearest integer **2)** 8.7 to one decimal place **3)** 300 to the nearest 100 **4)** 300 to the nearest 10 **5)** 5000 to 1 significant figure **6)** 5000 to 2 significant figure **7)** 1.78 to 3 significant figures **8)** 0.030 to 3 decimal places **9)** 4670 to the nearest integer **10)** 4670 to the nearest 10 **11)** 0.62 to 2 significant figures **12)** 60.0 to one decimal place	 **1)** UB $= 12.5$, LB $= 11.5$ **2)** UB $= 8.75$, LB $= 8.65$ **3)** UB $= 350$, LB $= 250$ **4)** UB $= 305$, LB $= 295$ **5)** UB $= 5500$, LB $= 4500$ **6)** UB $= 5050$, LB $= 4950$ **7)** UB $= 1.785$, LB $= 1.775$ **8)** UB $= 0.0305$, LB $= 0.0295$ **9)** UB $= 4670.5$, LB $= 4669.5$ **10)** UB $= 4675$, LB $= 4665$ **11)** UB $= 0.625$, LB $= 0.615$ **12)** UB $= 60.05$, LB $= 59.95$
Group B	If $A = 7$ the the nearest integer, $B = 3.2$ to 2 significant figures, $C = 40$ to the nearest 10 and $D = 12.39$ to 2 decimal places. Find the upper and lower bounds of the calculations. **1)** $A + B$ **2)** $A + C$ **3)** $B + D$ **4)** AB **5)** BD **6)** CB **7)** $2A$ **8)** $2(B + C)$ **9)** $2B + 3D$	$UB_A = 7.5$, $LB_A = 6.5$ $UB_B = 3.25$, $LB_B = 3.15$ $UB_C = 45$, $LB_C = 35$ $UB_D = 12.395$, $LB_D = 12.385$ **1)** UB $= 10.75$, LB $= 9.65$ **2)** UB $= 52.5$, LB $= 41.5$ **3)** UB $= 15.645$, LB $= 15.535$ **4)** UB $= 24.375$, LB $= 20.475$ **5)** UB $= 40.28375$, LB $= 39.01275$ **6)** UB $= 146.25$, LB $= 110.25$ **7)** UB $= 15$, LB $= 13$ **8)** UB $= 96.5$, LB $= 76.3$ **9)** UB $= 43.685$, LB $= 43.455$

Upper and Lower Bounds - Answers

Group B contd	**10)** A^2 **11)** B^3 **12)** ABD	**10)** UB $= 56.25$, LB $= 42.25$ **11)** UB $= 34.328125$, LB $= 31.255875$ **12)** UB $= 302.128125$, LB $= 253.582875$
Group C	If $P = 20$ to the nearest integer, $Q = 100$ to the nearest hundred, $R = 5.2$ to 1 decimal place and $S = 320$ to 2 significant figures. Find the upper and lower bounds of the calculations. **1)** $S - Q$ **2)** $Q - P$ **3)** $P - R$ **4)** $\frac{Q}{P}$ **5)** $\frac{P}{Q}$ **6)** $\frac{S}{P}$ **7)** $\frac{R}{S}$ **8)** $P - 2R$ **9)** $4Q - S$ **10)** $S - P - Q$ **11)** $\frac{QP}{S}$ **12)** $\frac{P}{RQ}$	$UB_P = 20.5$, $LB_P = 19.5$ $UB_Q = 150$, $LB_Q = 50$ $UB_R = 5.25$, $LB_R = 5.15$ $UB_S = 325$, $LB_S = 315$ **1)** UB $= 275$, LB $= 165$ **2)** UB $= 130.5$, LB $= 29.5$ **3)** UB $= 15.35$, LB $= 14.25$ **4)** UB $= 7.6923$, LB $= 2.4390$ **5)** UB $= 0.41$, LB $= 0.13$ **6)** UB $= 16.\dot{6}$, LB $= 15.366$ **7)** UB $= 0.01\dot{6}$, LB $= 0.0158$ **8)** UB $= 10.2$, LB $= 9$ **9)** UB $= 285$, LB $= -125$ **10)** UB $= 255.5$, LB $= 144.5$ **11)** UB $= 9.7619$, LB $= 3$ **12)** UB $= 0.0796$, LB $= 0.0248$

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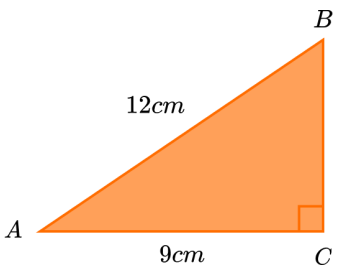
Upper and Lower Bounds - Answers

	Question	Answer
	Applied Questions	
1)	A rectangle has a length of $7.2\ cm$ and a width of $4.8\ cm$. Both measurements are to the nearest millimetre. **a)** Find the upper and lower bounds of the perimeter of the rectangle. **b)** Find the upper and lower bounds of the area of the rectangle.	**a)** UB $= 24.2\ cm$ LB $= 23.8\ cm$ **b)** UB $= 35.1625\ cm^2$ LB $= 33.9625\ cm^2$
2)	A circular pond has a diameter of $5.36\ m$ to the nearest centimetre. **a)** Find the upper bound of the circumference of the pond. Give your answer to 3 decimal places. **b)** Find the lower bound of the area of the pond. Give your answer to 3 decimal places.	**a)** $16.855\ cm$ **b)** $22.522\ cm^2$
3)	The diagram shows the right-angled triangle ABC where $AB = 12\ cm$ and $AC = 9\ cm$. Both measurements have been rounded to the nearest centimetre.  **a)** Find the lower bound for the length BC. **b)** Find the error interval for the angle BAC.	**a)** $6.481\ cm$ **b)** $34.301° \leq BAC < 47.156°$

Upper and Lower Bounds - Answers

4)	Using the formula $P = \frac{F}{A}$	
	a) Find the upper bound of P if $F = 45.72$ to 2 d.p and $A = 5.8$ to 1 d.p.	**a)** $45.725 \div 5.75 = 7.9521...$
	b) If $F = 5.21$ to 2 d.p and $P = 1.67$ to 2 d.p. By considering bounds, find the value of A to a suitable degree of accuracy.	**b)** UB $= 3.1321...$ LB $= 3.1074...$ A $= 3.1$ to 1 d.p

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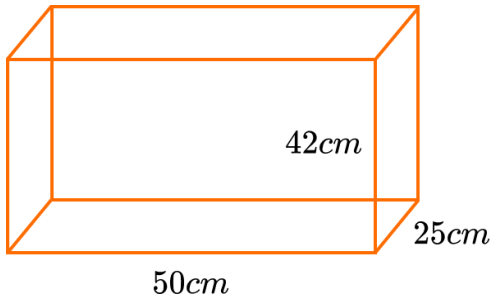
Upper and Lower Bounds - Mark Scheme

	Question	Answer	
	Exam Questions		
1)	$E = mgh$ $m = 4$ correct to the nearest integer. $g = 9.81$ correct to 3 significant figures. $h = 2.4$ correct to 1 decimal place.		
(a)	Find the lower bound for E.	**(a)** 3.5 or 9.805 or 2.35 80.646125	**(1)** **(1)**
(b)	Find the upper bound for E.	**(b)** 4.5 or 9.815 or 2.45 108.210375	**(1)** **(1)**
2)	A rectangular field has a length of 260 metres to 2 significant figures and a width of 145 metres to the nearest metre.		
(a)	Find the lower bound of the area of the field.	**(a)** 255 or 144.5 36847.5 m^2	**(1)** **(1)**
(b)	Find the upper bound of the perimeter of the field.	**(b)** 265 or 145.5 821 m	**(1)** **(1)**

Upper and Lower Bounds - Mark Scheme

3)	A container in the shape of a cuboid is to be filled with soil. The cuboid is 50 cm by 42 cm by 25 cm, where the measurements are correct to the nearest cm. The container will be filled using a jug that can hold 2500 ml to the nearest 100 ml.  What is the minimum number of full jugs that may be required to fill the container?	49.5 or 41.5 or 24.5 LB (volume) $49.5 \times 41.5 \times 24.5$ $(= 50329.125)$ 2550 $\frac{49.5 \times 41.5 \times 24.5}{2550} (= 19.7369\ldots)$ 20 jugs	**(1)** **(1)** **(1)** **(1)** **(1)**
4)	$K = \sqrt{\frac{M}{H}}$ $M = 8.42$ to 3 significant figures $H = 2.64$ to 3 significant figures. By considering bounds, work out the value of K to a suitable degree of accuracy, justifying your answer.	8.425 or 8.415 or 2.645 or 2.635 seen $\sqrt{\frac{8.425}{2.635}}$ or $\sqrt{\frac{8.415}{2.645}}$ $1.788111\ldots$ or 1.78366 $K = 1.8$ Both LB and UB round to 1.8 to 2 sf	**(1)** **(1)** **(1)** **(1)** **(1)**

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