## Alpine Skiing Pythagoras Answers

Calculate the missing length for each slalom, giving your answer correct to 3 significant figures. What is the total distance covered by the skier, assuming they take the shortest route possible between each slalom?
$a=\sqrt{\left(3^{2}+20^{2}\right)}$
$b=\sqrt{\left(9^{2}+23^{2}\right)}$
$c=\sqrt{\left(19^{2}-18^{2}\right)}$
$d=\sqrt{\left(25^{2}-8^{2}\right)}$
$a=20.2 \mathrm{~m}$
$b=\mathbf{2 4 . 7} \mathrm{m}$
$c=6.08 \mathrm{~m}$
$d=23.7 \mathrm{~m}$
$e=\sqrt{\left(30^{2}-5^{2}\right)}$
$e=29.6 \mathrm{~m}$
$2 f^{2}=17^{2}$
$f=\sqrt{\frac{17^{2}}{2}}$
$g=\sqrt{\left(4^{2}+0.5^{2}\right)}$
$f=12.0 \mathrm{~m}$
$g=4.03 \mathrm{~m}$

Total distance $=\mathbf{2 0 . 2} \mathbf{m}+\mathbf{2 4 . 7} \mathbf{m}+19 \mathrm{~m}+25 \mathrm{~m}+30 \mathrm{~m}+17 \mathrm{~m}+4.03 \mathrm{~m}$
Total distance $=139.93 \mathrm{~m}$ (or 139.95 m if the individual answers were not rounded)

## Extension:

Construct a scale diagram of the ski slope, using a scale of $1 \mathrm{~cm}=2 \mathrm{~m}$.
Students will need to use a compass, protractor and ruler to accurately construct each triangle. The measurements for each triangle become:

| First slalom: | Second slalom: | Third slalom: | Fourth slalom: |
| :--- | :--- | :--- | :--- |
| $3 \mathrm{~m}=1.5 \mathrm{~cm}$ | $9 \mathrm{~m}=4.5 \mathrm{~cm}$ | $19 \mathrm{~m}=9.5 \mathrm{~cm}$ | $25 \mathrm{~m}=12.5 \mathrm{~cm}$ |
| $20 \mathrm{~m}=10 \mathrm{~cm}$ | $23 \mathrm{~m}=11.5 \mathrm{~cm}$ | $18 \mathrm{~m}=9 \mathrm{~cm}$ | $8 \mathrm{~m}=4 \mathrm{~cm}$ |
| $20.2 \mathrm{~m}=10.1 \mathrm{~cm}$ | $24.7 \mathrm{~m}=12.35 \mathrm{~cm}$ | $6.08 \mathrm{~m}=3.04 \mathrm{~cm}$ | $23.7 \mathrm{~m}=11.85 \mathrm{~cm}$ |
|  |  |  |  |
| Fifth slalom: | Sixth slalom: | Finish: |  |
| $30 \mathrm{~m}=15 \mathrm{~cm}$ | $17 \mathrm{~m}=8.5 \mathrm{~cm}$ | $4 \mathrm{~m}=2 \mathrm{~cm}$ |  |
| $5 \mathrm{~m}=2.5 \mathrm{~cm}$ | $12.0 \mathrm{~m}=6 \mathrm{~cm}$ | $0.5 \mathrm{~m}=0.25 \mathrm{~cm}$ |  |
| $29.6 \mathrm{~m}=14.8 \mathrm{~cm}$ |  | $4.03 \mathrm{~m}=2.02 \mathrm{~cm}$ (to 3s.f.) |  |

## Alpine Skiing Pythagoras

## Instructions:

Below is the plan view of the alpine ski slope (not drawn to scale). Calculate the missing length on each slalom, giving your answers correct to 3 significant figures. What is the total distance covered by the skier, assuming they take the shortest route possible between each slalom?


Total distance $=$ $\qquad$

## Extension:

Construct a scale diagram of the ski slope, using a scale of $1 \mathrm{~cm}=2 \mathrm{~m}$.

## Alpine Skiing Trigonometry Answers

Calculate the missing angle or length for each slalom, giving your answers correct to 3 significant figures.
$a=\tan ^{-1}\left(\frac{5}{17}\right)$
$b=\tan ^{-1}\left(\frac{18}{11.4}\right)$
$c=\frac{15.2}{\tan 70}$
$a=16.4^{\circ}$
$b=57.7^{\circ}$
$c=5.53 \mathrm{~m}$
$d=21 \times \sin 35$
$e=\sin ^{-1}\left(\frac{2.4}{24}\right)$
$f=\frac{4}{\cos 70}$
$d=12.0 \mathrm{~m}$
$e=5.74^{\circ}$
$f=11.7 \mathrm{~m}$

## Extension:

Construct a scale diagram of the ski slope, using a scale of $1 \mathrm{~cm}=2 \mathrm{~m}$.
Angles remain the same but the measurements change as follows:

First slalom:
$5 \mathrm{~m}=2.5 \mathrm{~cm}$
$17 \mathrm{~m}=8.5 \mathrm{~m}$

Fourth slalom:
$21 \mathrm{~m}=10.5 \mathrm{~cm}$
$12.0 \mathrm{~m}=6 \mathrm{~cm}$

Second slalom:
$11.4 \mathrm{~m}=5.7 \mathrm{~cm}$
$18 \mathrm{~m}=9 \mathrm{~cm}$

Fifth slalom:
$24 \mathrm{~m}=12 \mathrm{~cm}$
$2.4 \mathrm{~m}=1.2 \mathrm{~cm}$

Third slalom:
$15.2 \mathrm{~m}=7.6 \mathrm{~cm}$
$5.53 \mathrm{~m}=2.77 \mathrm{~cm}$ (3s.f.)

Finish:
$4 \mathrm{~m}=2 \mathrm{~cm}$
$11.7 \mathrm{~m}=5.85 \mathrm{~cm}$

## Alpine Skiing Trigonometry

## Instructions:

Below is the plan view of the alpine ski slope (not drawn to scale). Calculate the missing angle or length for each slalom, giving your answers correct to 3 significant figures.

$a=\square d=$
$b=$
$\qquad$

$$
e=
$$

$\qquad$
$c=$ $\qquad$ $f=$ $\qquad$

## Extension:

Construct a scale diagram of the ski slope, using a scale of $1 \mathrm{~cm}=2 \mathrm{~m}$.

## Speed Skating Events Answers

## Instructions:

You are given two values out of speed, distance or time from several different speed skating events. Calculate the missing values. Give the time and speed to 1 decimal place and the distance to the nearest 100 m .

## Men's Events Results

| Name | Country | Distance $\mathbf{( m )}$ | Time | Average Speed (m/s) |
| :--- | :--- | :--- | :--- | :--- |
| Michel | Netherlands | 500 m | 34.7 seconds | $\mathbf{1 4 . 4}$ |
| Jan | Netherlands | 500 m | $\mathbf{3 5 . 2}$ seconds | 14.2 |
| Zbigniew | Poland | $\mathbf{1 5 0 0 m}$ | 105 seconds | 14.3 |
| Sven | Netherlands | 5000 m | 6 minutes 10.8 seconds <br> $=\mathbf{3 7 0 . 8}$ seconds | $\mathbf{1 3 . 5}$ |
| Jorrit | Netherlands | $\mathbf{1 0 0 0 0 m}$ | 12 minutes 44.5 seconds <br> $=\mathbf{7 6 4 . 5}$ seconds | 13.1 |

## Women's Events Results

| Name | Country | Distance (km) | Time | Average Speed (m/s) |
| :--- | :--- | :--- | :--- | :--- |
| Martina | Czech Republic | $3=\mathbf{3 0 0 0 m}$ | 4 minutes 2.0 seconds <br> $=\mathbf{2 4 2}$ seconds | $\mathbf{1 2 . 4}$ |
| Olga | Russia | $3=\mathbf{3 0 0 0 m}$ | $\mathbf{2 4 3 . 9}$ seconds | 12.3 |
| Sang | Korea | $\mathbf{0 . 5}=\mathbf{5 0 0 m}$ | 35.45 seconds | 14.1 |
| Ireen | Netherlands | $5=\mathbf{5 0 0 0 m}$ | $\mathbf{4 1 3 . 2}$ seconds | 12.1 |
| Hong | China | $\mathbf{1 = 1 0 0 0 m}$ | 1 minute 14.1 seconds <br> $=\mathbf{7 4 . 1}$ seconds | 13.5 |

## Extension:

The world record time for the 500 m in 1994 was 35.76 seconds. Which competitors achieved a greater average speed in their event in the table?

This is an average speed of $500 \div 35.76=14.0 \mathrm{~m} / \mathrm{s}$ (to $3 \mathrm{~s} . \mathrm{f}$.).
The competitors who beat this average speed were Michel, Jan, Zbigniew and Sang.

What is the percentage improvement in time from the world record holder in 1994 to the fastest competitor in the table?

The fastest competitor in the table was Michel who completed the 500 m in 34.7 seconds. To calculate the percentage improvement, we complete the following calculations:
35.76 - $34.7=1.06$
$\frac{1.06}{35.76}=0.0296=2.96 \%$ (to 3s.f.)

## Speed Skating Events

## Instructions:

You are given two values out of speed, distance or time from several different speed skating events. Calculate the missing values. Give the time and speed to 1 decimal place and the distance to the nearest 100 m .

## Men's Events Results

| Name | Country | Distance (m) | Time | Average Speed (m/s) |
| :--- | :--- | :--- | :--- | :--- |
| Michel | Netherlands | 500 m | 34.7 seconds |  |
| Jan | Netherlands | 500 m |  | 14.2 |
| Zbigniew | Poland |  | 105 seconds | 14.3 |
| Sven | Netherlands | 5000 m | 6 minutes 10.8 seconds |  |
| Jorrit | Netherlands |  | 12 minutes 44.5 seconds | 13.1 |

Women's Events Results

| Name | Country | Distance (km) | Time | Average Speed (m/s) |
| :--- | :--- | :--- | :--- | :--- |
| Martina | Czech Republic | 3 | 4 minutes 2.0 seconds |  |
| Olga | Russia | 3 |  | 12.3 |
| Sang | Korea |  | 35.45 seconds | 14.1 |
| Ireen | Netherlands | 5 |  | 12.1 |
| Hong | China |  | 1 minute 14.1 seconds | 13.5 |

## Extension:

The world record time for the 500 m in 1994 was 35.76 seconds. Which competitors achieved a greater average speed in their event in the table?
$\qquad$
$\qquad$
$\qquad$

What is the percentage improvement in time from the world record holder in 1994 to the fastest competitor in the table?

## Winter Olympics Codebreaking Answers

Calculate the percentage of each amount to find a letter. Unscramble your letters to find the name of an event from the Winter Olympics.

| A | B | C | D | E | G | H | I | K | L | N | O | R | S | T | U | W |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1.5 | 8 | 17 | 69.3 | 90 | 18 | 100 | 3 | 21 | 30 | 7.5 | 5 | 27 | 14 | 45 | 9 | 37.6 |

a. $25 \%$ of 120 30 8

100
5
18
8
$5 \%$ of 60,
3
14
90
Bobsleigh
b. $50 \%$ of 10 ,
$25 \%$ of 30 ,
$20 \%$ of 40 ,
$50 \%$ of 90 ,
$25 \%$ of 400 ,
100
$75 \%$ of 40 ,
$10 \%$ of 30 ,
$5 \%$ of 30
5
7.5

8
45
30
3
1.5
c. $60 \%$ of $50,25 \%$ of $12,20 \%$ of $90,10 \%$ of $90,30 \%$ of $90,50 \%$ of $34,10 \%$ of 75

9
27
17
7.5

Curling
d. $20 \%$ of 150

30
14
90
45
5
21
90
7.5

Skeleton
e. $12 \%$ of $150,150 \%$ of $20,15 \%$ of $60,60 \%$ of 150

18
30
9
90
f. $99 \%$ of $70,90 \%$ of $30,3 \%$ of $50,47 \%$ of $80,12.5 \%$ of 64 ,
$12.5 \%$ of 40 $4 \%$ of $125,7.5 \%$ of 100 ,
$25 \%$ of 56
69.3

27
1.5
37.6

8
5
5
7.5

14

## Winter Olympics Codebreaking

Calculate the percentage of each amount to find a letter. Unscramble your letters to find the name of an event from the Winter Olympics.

| A | B | C | D | E | G | H | I | K | L | N | O | R | S | T | U | W |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1.5 | 8 | 17 | 69.3 | 90 | 18 | 100 | 3 | 21 | 30 | 7.5 | 5 | 27 | 14 | 45 | 9 | 37.6 |

a. $25 \%$ of $120,10 \%$ of $80,50 \%$ of $200,10 \%$ of $50,30 \%$ of $60,5 \%$ of $160,5 \%$ of $60,20 \%$ of $70,75 \%$ of 120
b. $50 \%$ of $10,25 \%$ of $30,20 \%$ of $40,50 \%$ of $90,25 \%$ of $400,75 \%$ of $40,10 \%$ of $30,5 \%$ of 30
c. $60 \%$ of $50,25 \%$ of $12,20 \%$ of $90,10 \%$ of $90,30 \%$ of $90,50 \%$ of $34,10 \%$ of 75
$\qquad$
$\square$
e. $12 \%$ of $150,150 \%$ of $20,15 \%$ of $60,60 \%$ of 150
$\qquad$
$\square$
f. $99 \%$ of $70, ~ 90 \%$ of $30,3 \%$ of $50,47 \%$ of $80,12.5 \%$ of $64,12.5 \%$ of $40,4 \%$ of $125,7.5 \%$ of $100,25 \%$ of 56

## Winter Olympics - Luge Statistics Answers

The tables on the next page contain the times taken to complete the run for the women's and men's luge event, correct to 1 decimal place.

1. Calculate the mean, median, mode and range for each set of results.

## Men's event:

mean $=209.4$ seconds
mode $=209.4$ seconds
median $=209.5$ seconds
range $=2.8$ seconds

## Women's event:

mean $=202.12$ seconds
mode $=201.2$ seconds and 202.1 seconds (this is called bimodal)
median $=202.1$ seconds
range $=4.3$ seconds
2. Construct a box plot for each set of results.

## Men's event:

lower quartile = 209.4 seconds
upper quartile $=209.8$ seconds


## Women's event:

lower quartile $=201.2$ seconds
upper quartile $=203.1$ seconds

3. Compare the averages and distributions of each set of results. In which event were the competitors faster? Explain these results.

On average, the women's times were lower; we know this because their mean, median and modal times were all lower than the men's. However, the interquartile range for the women was larger which means their results were less consistent.
4. The women's event is actually 300 m shorter than the men's event. Suggest a fairer way to compare the results.

The speeds rather than the times should be compared.


| Men's Singles |  | Country |
| :--- | :--- | :--- |
| Name | Time (Seconds) |  |
| Felix | Germany | 207.5 |
| Albert | Russia | 208.0 |
| Armin | Italy | 208.8 |
| Andi | Germany | 209.4 |
| Seme | Russia | 209.4 |
| Dominik | Italy | 209.4 |
| Aleksander | Russia | 209.5 |
| Reinhard | Austria | 209.5 |
| Wolfgang | Austria | 209.7 |
| Martins | Latvia | 209.7 |
| Samuel | Canada | 209.8 |
| Gregory | Switzerland | 209.8 |
| Christopher | USA | 210.0 |
| David | Germany | 210.2 |
| Daniel | Austria | 210.3 |
|  |  |  |

Women's Singles

| Name | Country | Time (Seconds) |
| :---: | :---: | :---: |
| Natalie | Germany | 199.8 |
| Tatjana | Germany | 200.9 |
| Erin | USA | 201.1 |
| Alex | Canada | 201.2 |
| Kimberly | Canada | 201.2 |
| Anke | Germany | 202.0 |
| Tatina | Russia | 202.1 |
| Natalia | Russia | 202.1 |
| Martina | Switzerland | 202.2 |
| Kate | USA | 202.3 |
| Ekaterina | Russia | 202.7 |
| Eliza | Latvia | 203.1 |
| Arianne | Canada | 203.2 |
| Sandra | Italy | 203.8 |
| Summer | USA | 204.1 |

## Winter Olympics - Luge Statistics

The tables on the next page contain the times taken to complete the run for the women's and men's luge event, correct to 1 decimal place.

1. Calculate the mean, median, mode and range for each set of results.
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$\qquad$
$\qquad$
$\qquad$
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$\qquad$
$\qquad$
$\qquad$
2. Construct a box plot for each set of results.
$\qquad$
$\qquad$
$\qquad$

$\qquad$
$\qquad$
$\qquad$

3. Compare the averages and distributions of each set of results. In which event were the competitors faster? Explain these results.
$\qquad$
$\qquad$
$\qquad$
$\qquad$
4. The women's event is actually 300 m shorter than the men's event. Suggest a fairer way to compare the results.


## Men's Singles

| Name | Country | Time (Seconds) |
| :--- | :--- | :--- |
| Felix | Germany | 207.5 |
| Albert | Russia | 208.0 |
| Armin | Italy | 208.8 |
| Andi | Germany | 209.4 |
| Seme | Russia | 209.4 |
| Dominik | Italy | 209.4 |
| Aleksander | Russia | 209.5 |
| Reinhard | Austria | 209.5 |
| Wolfgang | Austria | 209.7 |
| Martins | Latvia | 209.7 |
| Samuel | Canada | 209.8 |
| Gregory | Switzerland | 209.8 |
| Christopher | USA | 210.0 |
| David | Germany | 210.2 |
| Daniel | Austria | 210.3 |
|  |  |  |


| Women's Singles |  |  |
| :--- | :--- | :--- |
| Name | Country | Time (Seconds) |
| Natalie | Germany | 199.8 |
| Tatjana | Germany | 200.9 |
| Erin | USA | 201.1 |
| Alex | Canada | 201.2 |
| Kimberly | Canada | 201.2 |
| Anke | Germany | 202.0 |
| Tatina | Russia | 202.1 |
| Natalia | Russia | 202.1 |
| Martina | Switzerland | 202.2 |
| Kate | USA | 202.3 |
| Ekaterina | Russia | 202.7 |
| Eliza | Latvia | 203.1 |
| Arianne | Canada | 203.2 |
| Sandra | Italy | 203.8 |
| Summer | USA | 204.1 |

## Winter Olympics Answers

1. The Winter Olympics began in 1924, when Team GB's fastest four-man bobsleigh time was 88 seconds. Ninety years later, Team GB's fastest time was 55 seconds. Calculate the percentage decrease in their fastest time.
88-55 = 33
or
$\frac{55}{88}=0.625=62.5 \%$
$\frac{33}{88} \times 100=37.5 \%$
100-62.5 = 37.5\%
2. A competitor completed the 1000 m speed skating track in 1 minute 26 seconds. Calculate his average speed in $\mathrm{m} / \mathrm{s}$, giving your answer correct to 1 decimal place.

Speed $=$ distance $\div$ time
Speed $=1000 \div 86$

$$
=11.6 \mathrm{~m} / \mathrm{s} \text { (to 1d.p.) }
$$

3. In the snowboard half-pipe event, competitors perform tricks whilst in the air above the half-pipe. When completing a full jump, the snowboarder's height in metres (y) at $t$ seconds is given by $y=5 t-t^{2}+10$. Calculate the snowboarder's height after 1.5 seconds.
$y=5 \times 1.5-1.5^{2}+10$
$y=15.25 \mathrm{~m}$
4. The biathlon combines cross-country skiing with rifle shooting.
a. The start of the ski slope is 1650 ft above the end of the slope. The competitors descend the slope at an angle of $43^{\circ}$ with the horizontal. Calculate the length of the slope. Give your answer correct to one decimal place.

$1650 \div \sin (43)=2419.4 \mathrm{ft}$
b. A biathlete carries a small-bore rifle which weighs 3.5 kilograms, measured to 1 decimal place. Using inequalities, describe the error interval.
$3.45 \mathrm{~kg} \leq x<3.55 \mathrm{~kg}$
Where $x$ is the weight of the rifle.
5. The elevation of the starting point of each of the alpine skiing events are given as follows:

2045m, 1755m, 1160m, 1947m, 1755m, 1592m, 1580m, 1370m, 1365m, 1100m, 1160m
a. Calculate the median elevation.

The median is the middle number when they are in order.
1100, 1160, 1160, 1365, 1370, 1580, 1592, 1755, 1755, 1947, 2045
median $=1580 \mathrm{~m}$
b. Construct a box and whisker plot showing the distribution of elevations for this event.
smallest $=1100 \quad$ median $=1580 \quad$ largest $=2045$
$L Q=1160 \quad U Q=1755$

c. Information about the starting point elevations for the cross-country skiing events are shown in the box and whisker plot below. Compare the data for the alpine skiing events and the cross-country skiing events.


The median for the cross-country skiing event is lower which means the average elevation is lower than in the alpine skiing event. The interquartile range for the alpine skiing event is larger which means the elevations are less consistent/more spread out than the cross-country skiing event.
6. A speed skating ice rink is a circle with a diameter of 61 m . Calculate the area of the ice rink, giving your answer correct to 3 significant figures.

Area $=\pi \times 30.5^{2}$
Area $=2920 \mathrm{~m}^{2}$

## Winter Olympics

1. The Winter Olympics began in 1924, when Team GB's fastest four-man bobsleigh time was 88 seconds. Ninety years later, Team GB's fastest time was 55 seconds. Calculate the percentage decrease in their fastest time.
$\qquad$
$\qquad$
2. A competitor completed the 1000 m speed skating track in 1 minute 26 seconds. Calculate his average speed in $\mathrm{m} / \mathrm{s}$, giving your answer correct to 1 decimal place.
$\qquad$
$\qquad$
3. In the snowboard half-pipe event, competitors perform tricks whilst in the air above the half-pipe. When completing a full jump, the snowboarder's height in metres (y) at $t$ seconds is given by $y=5 t-t^{2}+10$. Calculate the snowboarder's height after 1.5 seconds.
$\qquad$
$\qquad$
4. The biathlon combines cross-country skiing with rifle shooting.
a. The start of the ski slope is 1650 ft above the end of the slope. The competitors descend the slope at an angle of $43^{\circ}$ with the horizontal. Calculate the length of the slope. Give your answer correct to one decimal place.

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5. The elevation of the starting point of each of the alpine skiing events are given as follows:

2045m, 1755m, 1160m, 1947m, 1755m, 1592m, 1580m, 1370m, 1365m, 1100m, 1160m
a. Calculate the median elevation.
$\qquad$
$\qquad$
$\qquad$
b. Construct a box and whisker plot showing the distribution of elevations for this event.
$\qquad$
$\qquad$
$\qquad$
$\qquad$
$\qquad$
$\qquad$

c. Information about the starting point elevations for the cross-country skiing events are shown in the box and whisker plot below. Compare the data for the alpine skiing events and the cross-country skiing events.

$\qquad$
$\qquad$
$\qquad$
$\qquad$
6. A speed skating ice rink is a circle with a diameter of 61 m . Calculate the area of the ice rink, giving your answer correct to 3 significant figures.
$\qquad$
$\qquad$

