Spitfire AA810 aircraft

Activity Book

Penny

Peter

ROYAL AIR FORCE Youth STEM

ROYAL AIR FORCE Charitable Trust Inspire

SPITFIRE AA810

Research Toolkit

About Spitfire AA810

Spitfire AA810

Spitfire AA810 is a famous aircraft from World War II. It is known for its important role in taking photographs of enemy areas. This particular Spitfire was used by a special group that flew deep into enemy territory to gather information through aerial photography.

Unlike regular Spitfires, the AA810 aircraft had no guns but instead carried lots of extra fuel. This allowed it to fly much farther, nearly 2,000 miles, to complete some of its missions.

Today, there is a project to restore Spitfire AA810 so it can fly again. This project helps remember the brave pilots who flew it and it teaches people about their contributions during the war.

To find out more about this amazing aircraft, click here or scan the QR code

Penny the Pilot

Hello I'm Penny and I work for the Royal Air Force as a jet pilot. It is my job to fly the RAF's Typhoon jets on military missions across the world.

I guard the skies to keep them safe. I can survey the ground too from up in the air.

Peter the Pilot

Hello, I am Peter the Pilot and I work for the Royal Air Force. I'm part of a display team that flies Spitfires and other aircraft.

My good friend Sandy Gunn was a very brave Spitfire pilot during World War II. He flew very dangerous missions and was able to take photographs of enemy aircraft and equipment.

Sandy Gunn

We want you to join our team and help us to complete the activities in this booklet.

Ready for flight!

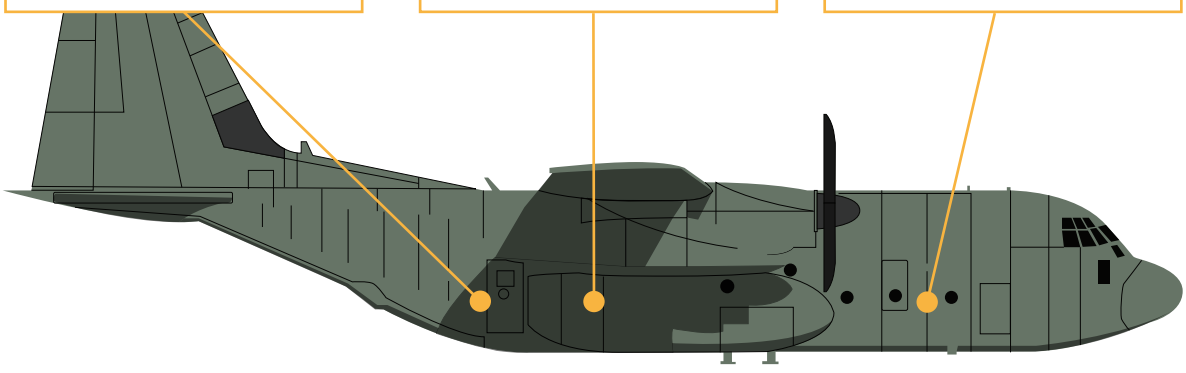
Peter and Penny are helping out with the preparations for a flight. They are taking much-needed supplies for civlians following an earthquake. The supplies they take must be equally balanced between the three compartments on the RAF aircraft so that the aircraft doesn't wobble and can reach top speed.

Can you help Peter and Penny distribute the supplies equally? Put two of the items below in each of the storage areas on the aircraft.

Supplies list:

Tents = 200 kg	Bedding = 175 kg	Toiletries = 50 kg
Water = 250 kg	Clothing = 100 kg	Food = 125 kg

Show your working out here:



How heavy is the aircraft when all the supplies are safely on board?

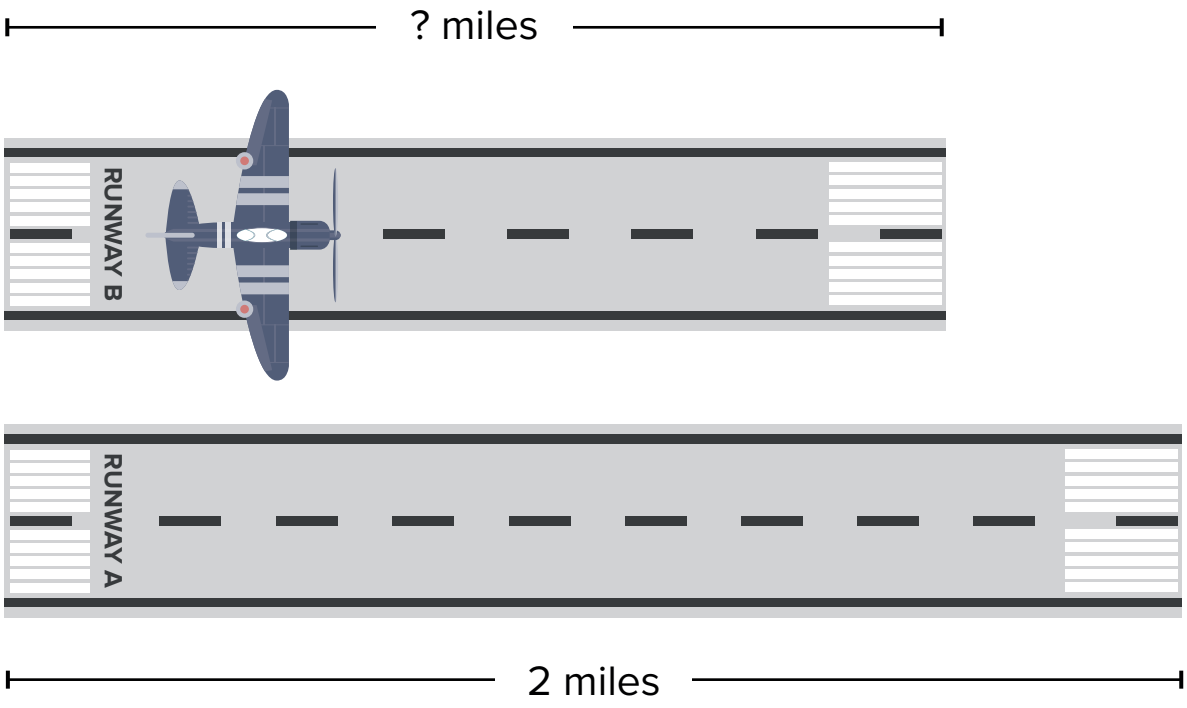
Runway Ratios

Peter the pilot is in the cockpit of a Spitfire! He is ready for take-off at the Royal International Air Tattoo. He will be flying the Spitfire above a big crowd to show them this famous World War II aircraft.

But first, Peter needs to know whether he has enough space on runway B to take off.

Runway A is 2 milles long. Peter knows he needs at least 1550m to take-off in the Spitfire safely.

Runway B is 4/5 of Runway A in length.
Is there enough space for Peter to take off in the Spitfire?



Show your working out here:

Answer:

Aircraft speed

Penny is at RAF Fairford. She sees a Spitfire and Hurricane set-off from the airport at the same time.

- The Hurricane is travelling **450 miles** to RAF Lossiemouth which will take **2 hours.**
- The Spitfire is travelling **100 miles** to RAF Cranwell, taking **30 minutes.**

Which aircraft will travel faster in miles per hour?
Speed can be calculated using this equation:

Speed = Distance ÷ Time

Remember! You must convert 30 minutes into hours, so the units are all the same.

Hurricane

Hurricane

	÷		=	

Spitfire

	÷		=	

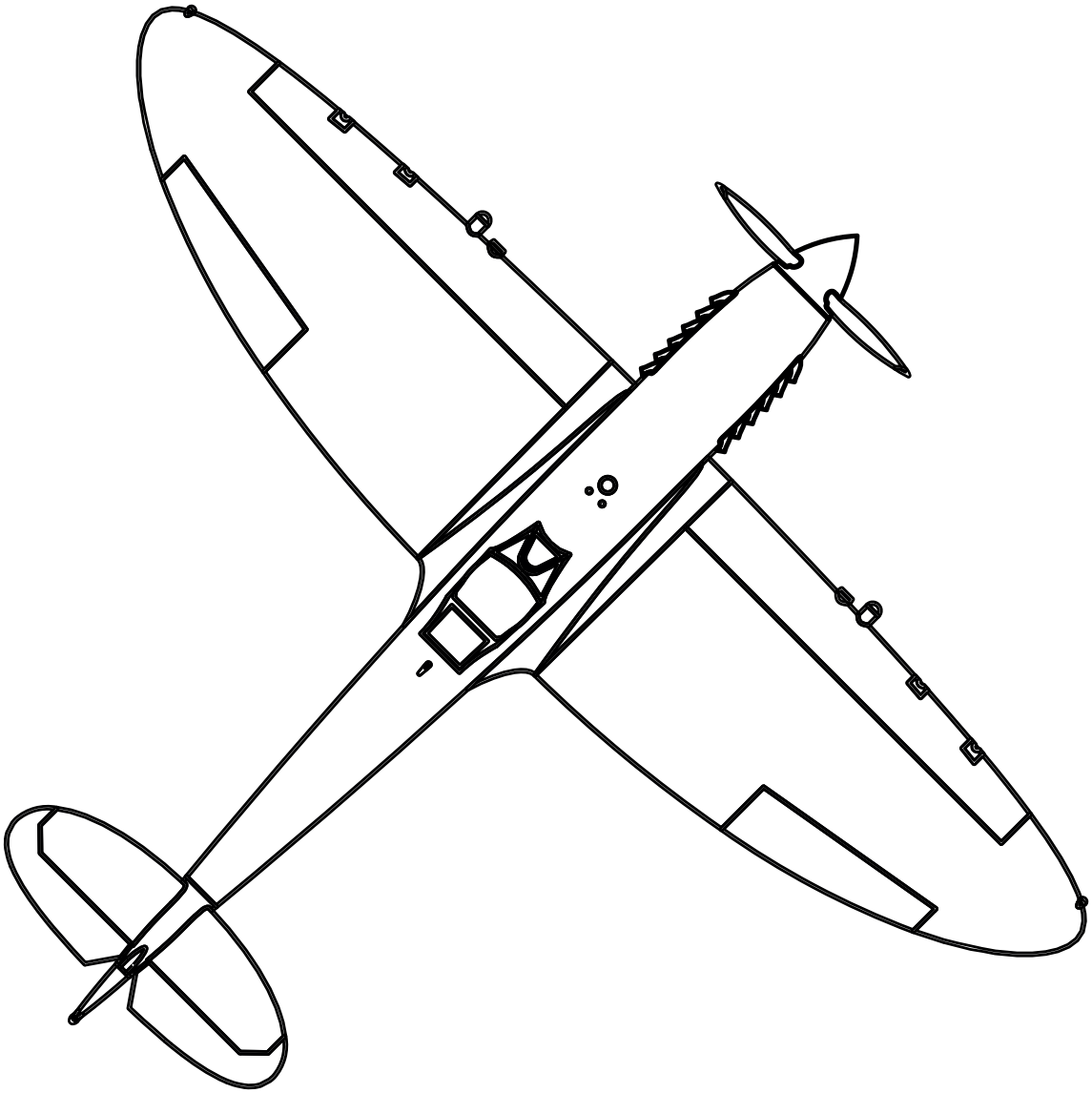
Spitfire

Which aircraft will travel faster to its destination?

Draw & Colour

The Battle of Britain Memorial Flight (BBMF) is a regular RAF unit and consists of many historic aircraft. This includes Spitfires very similar to Spitfire AA810

Can you draw and colour in your own Spitfire aircraft to complete the picture?



Which is fastest?

Peter knows that aerodynamics focuses on how the air moves around the front of an aircraft. If it has a nose that is thin and smooth the aircraft will move faster because the air will move faster around the nose shape - making it more **aerodynamic**.

Have a look at the aircraft below and rank them on which one will fly the fastest to the slowest, based how aerodynamic it looks.

Write your order here:

Ready for take-off?

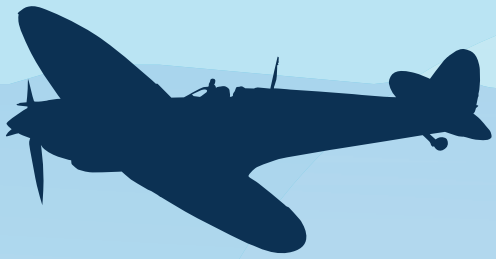
The speed of an aircraft can be calculated with the calculation:

Speed = Distance ÷ Time

Using this calculation can you calculate the Spitfire's speed on the runway?

The Spitfire travelled 40 feet and it took the aircraft 5 seconds.

40 feet ÷ 5 seconds = (f/s)



Once you have checked your answer was right, have a go at these next few aircraft speed calculations.

Each aircraft was travelling 1,000 feet, calculate the speed for each one depending on the time it took.

Aircraft 1 took 100 seconds, what was its speed:

(f/s)

Aircraft 2 took 200 seconds, what was its speed:

(f/s)

Aircraft 3 took 50 seconds, what was its speed:

(f/s)

Aircraft 4 took 1 second, what was its speed:

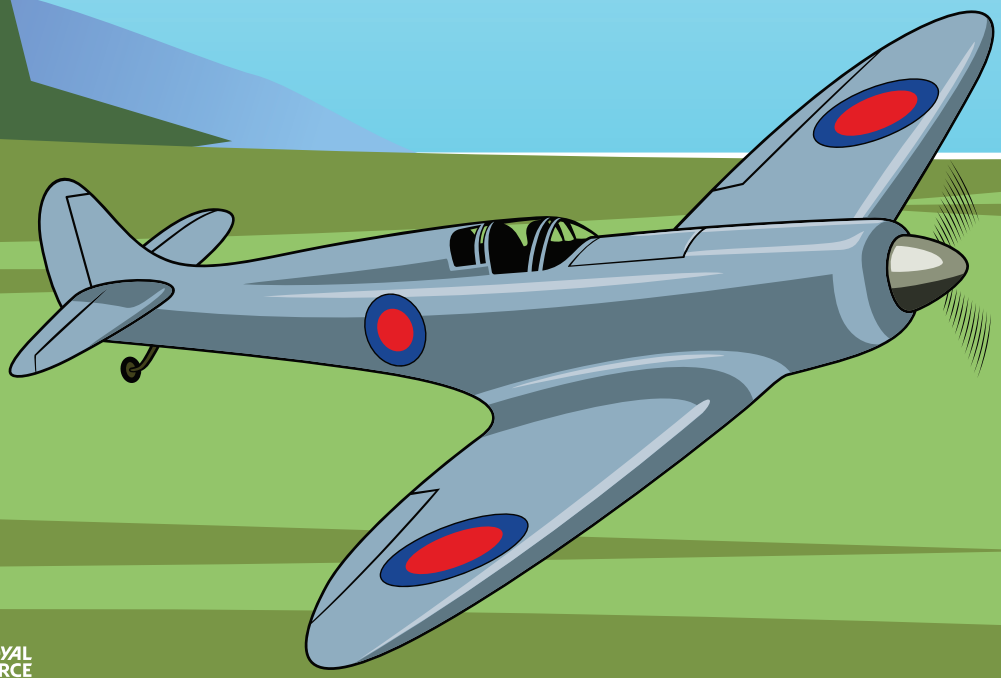
(f/s)

Aviation adventure

Peter is using an online flight tracker system to show where a Spitfire has travelled. He wants to work out on the grid where it has been and where it is flying to.

Can you help him? The code below shows how he needs to use the grid. Each arrow shows which square he needs to move to next. We've made the first move for you.

1 →	2 ↓	3 →	4 ↓	5 ↓
6 ←	7 ↓	8 ↓	9 →	10 ↓
11 →	12 →	13 ↑	14 ↑	15 ←
16 ↑	17 →	18 →	19 →	🏁



START 									
							VLY		
			BSN						
HNG						CWL			
			WTN						
	LMO							MHM	

RAF Station codes

BSN RAF Benson

CWL RAF Cranwell

HNG RAF Honington

LMO RAF Lossiemouth

MHM RAF Marham

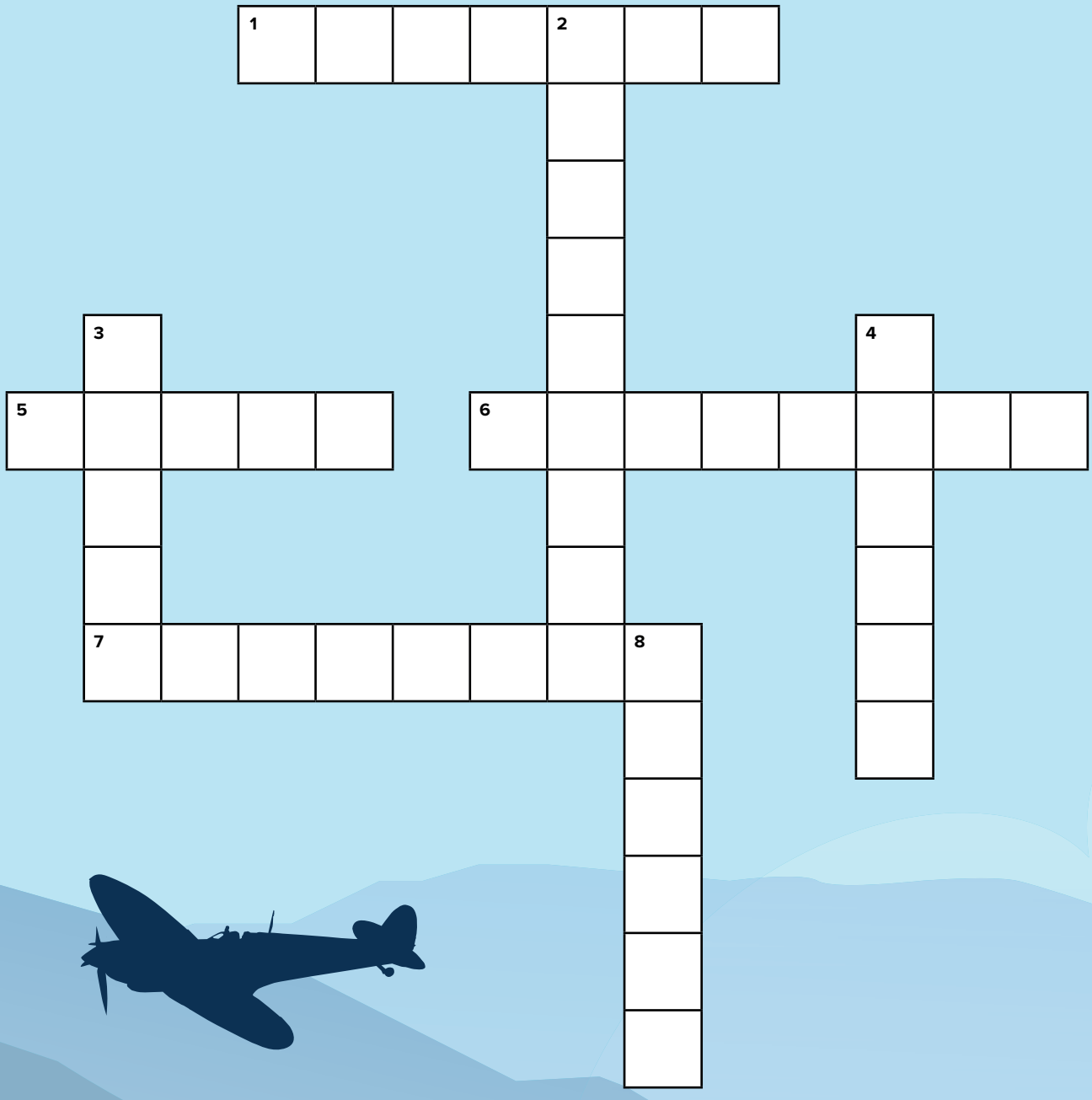
VLY RAF Valley

WTN RAF Waddington

Write here where the Spitfire is flying to:

Flight and aircraft crossword

Test your knowledge about aircraft and flight by completing our crossword.



Across

1. Compartment at the front of the aircraft.

5. The person who flies the aircraft.

6. Height above ground level.

7. WWII aircraft.

Down

2. Rotating blades on an aircraft.

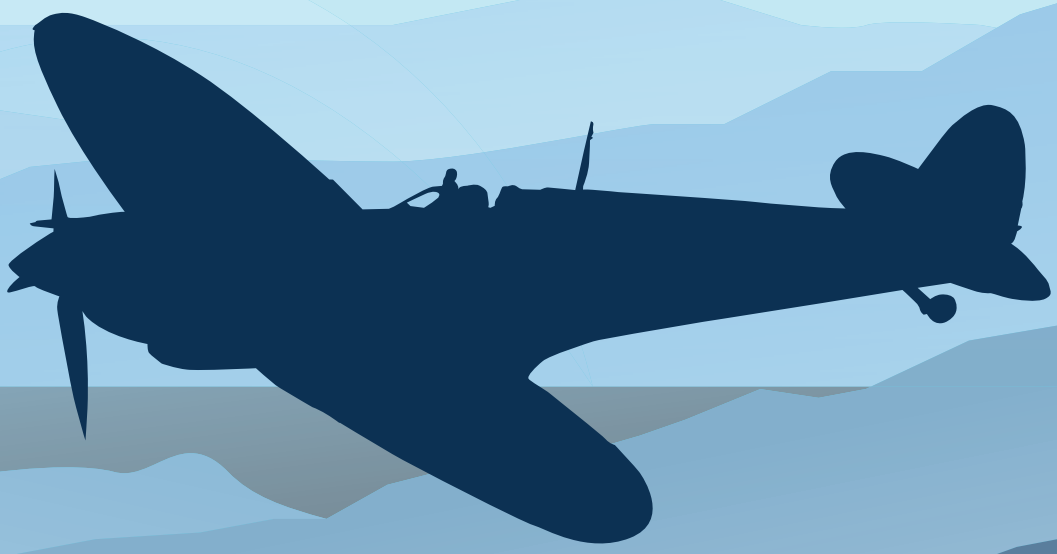
3. Birds also use these to fly.

4. Strip of land from which an aircraft takes off and lands.

8. This powers the aircraft.

Did you know?

RAF Valley on Anglesey (in Wales) is responsible for training the UK's next generation of world-class fighter pilots. They also trained Spitfire pilots during World War II.



Fuel and flight

Spitfire AA810 had an increased fuel capacity to allow the aircraft to fly for longer periods before it needed refuelling.

Can you answer the questions below to learn more about this?

The aircraft had a main fuel tank of 85 gallons with two additional side tanks of 66 gallons. How much fuel was it able to contain?

gallons

If there are 3.8 litres in a gallon, how many litres of fuel can the aircraft hold? Round to the nearest whole number.

litres

If there are 1.8 pints in a litre, how many pints of fuel can the aircraft hold? Round to the nearest whole number.

pints

If the longest flight duration of the aircraft was 10 hours using all available fuel, what is the fuel consumption rate?

gallons per hour

Going the distance

Spitfire AA810 could fly long distances, up to around 2,000 miles on a single tank of fuel! This allowed it to be used for a wide variety of purposes as it was able to travel further than other aircraft at the time of its use.

Answer the questions below to learn more about distances and their measurement.

There are 1.6 kilometers (km) in every mile. Can you use this to calculate the distance the Spitfire could fly in km?

km

If the aircraft travels at 200 miles per hour, how many hours would it take for the aircraft to travel its maximum distance?

hours

If the aircraft travels from London to Paris (455 km) and then from Paris to Amsterdam (430 km) and then from Amsterdam back to London (357 km) at a constant speed, how many more miles could the aircraft fly before it needs to refuel in km?

hours

Can you convert this result back into miles? Round to the nearest 10.

km

Calculating and rounding

Engineers on aircraft need to have a detailed understanding of maths. They use their maths skill every day to calculate the forces and load that the aircraft can withstand. They also use these skills to help design the shape of the aircraft to make sure its as aerodynamic as possible.

Can you show your math skills through the rounding tasks below?

Round these numbers to the nearest whole number:

9.122 =	79.9 =
34.58 =	26.3 =

Round these numbers to two decimal places:

7.897 =	5.3852 =
4.293 =	8.6324 =

Round these numbers to the nearest 100:

16809 =	36279 =
728 =	4087492 =

The phonetic alphabet

The phonetic alphabet is an internationally recognised way that pilots use to communicate more clearly and precisely. Penny the pilot often uses this system over radio to make sure her communication is understood correctly. This is particularly useful when she is saying letters which sound similar, such as B and D. To prevent misunderstanding, she would say Bravo for B, and Delta for D.

A Alpha	**B** Bravo	**C** Charlie	**D** Delta	**E** Echo	**F** Foxtrot	**G** Golf	**H** Hotel	**I** India
J Juliett	**K** Kilo	**L** Lima	**M** Mike	**N** November	**O** Oscar	**P** Papa	**Q** Quebec	**R** Romeo
S Sierra	**T** Tango	**U** Uniform	**V** Victor	**W** Whiskey	**X** Xray	**Y** Yankee	**Z** Zulu	

Can you write your name, or the name of someone you know, using the phonetic alphabet?

Now, can you decode the words given below?

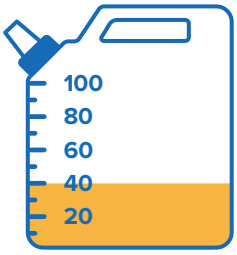
Alpha / India / Romeo / Papa / Oscar / Romeo / Tango

Echo / November / Golf / India / November / Echo

Proportions & percentages of fuel tanks

Look at the scales of the fuel tanks below and work out how much fuel there is by converting the numbers shown into proportions out of 100. Answers should be stated to two decimal places.

1



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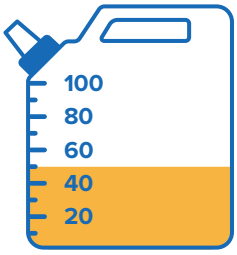
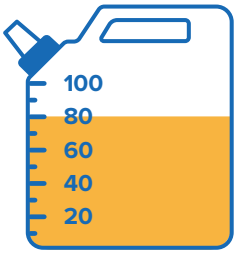
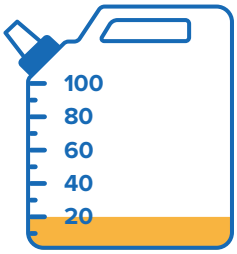


3



4



1. What is the proportion for tank 1?

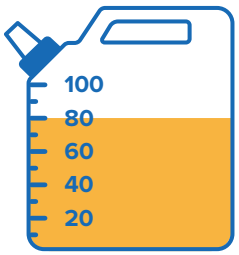
2. What is the proportion for tank 2?

3. What is the proportion for tank 3?

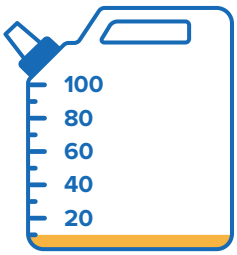
4. What is the proportion for tank 4?

Now work out the amount of fuel as percentages.

1



2



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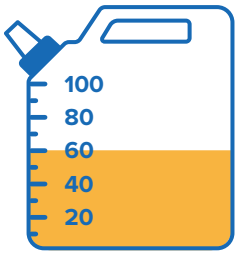
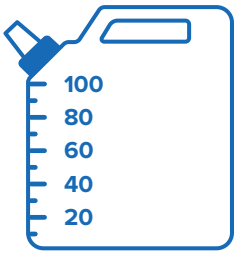


4



1. What is the percentage of fuel left in tank 1?

2. If tank 2 had 30% more fuel how much would there be?

3. Tank 3 has 20% less fuel in it than is showing. How much fuel is this?

4. Tank 4 has half as much fuel as tank 1. Can you draw this on the tank?

Did you know?

The longest flight on a single tank of fuel from the UK is 9,000 miles from London to Australia. The flight takes about 17 hours!

Match them up!

There are four forces that act upon an aircraft as it flies: weight, thrust, drag and lift.

Can you link the forces to their description below?

Weight	The force that pushes the aircraft up into the air, created by the wings as they move through the air.
Thrust	The force that pulls the aircraft down towards the ground because of gravity.
Drag	The force that slows the aircraft down, caused by air pushing against the plane as it flies.
Lift	The force that moves the aircraft forward, created by the engines.

What would happen to the aircraft if the weight increased?

What would happen to the aircraft if the lift force increased?

Try speaking like a pilot!

When pilots communicate through radios, they use specific phrases to convey their messages.

Can you write each pilot phrase below its meaning?

Distress Signal	**Urgent, non-life-threatening situation**
Phrase:	**Phrase:**
Message Received	**Heard your message, await your reply**
Phrase:	**Phrase:**
Yes	**Wait a moment**
Phrase:	**Phrase:**

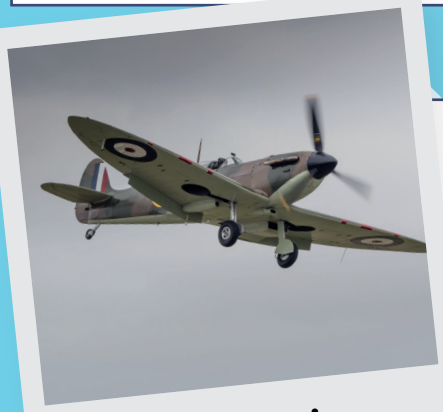
Mayday **Over** **Pan-Pan**

Roger **Stand-by** **Affirmative**

Types of aircraft

There are many different types of aircraft, all designed for different purposes such as speed or flight duration.

Below are details of three aircraft and some important information about them. Can you answer the questions comparing them?



Supermarine Spitfire

Supermarine Spitfire
First Flight: 1936
Top Speed: 370 mph
Range: 1,135 miles

Eurofighter Typhoon

Eurofighter Typhoon
First Flight: 1994
Top Speed: 1,550 mph
Range: 1,800 miles

Avro Lancaster

Avro Lancaster
First Flight: 1941
Top Speed: 287 mph
Range: 2,530 miles

What is the difference in range (how far the aircraft can fly) between the longest and shortest?

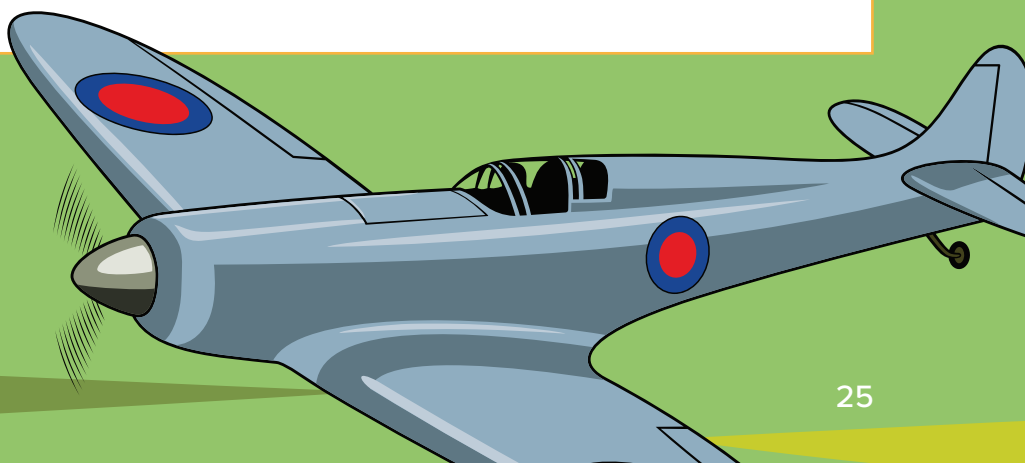
If you added all top speeds of the three aircraft, what speed would this be?

mph

Which aircraft had its first flight closest to 1950?

If the aircraft with the furthest range could travel twice as far, what would the total distance be?

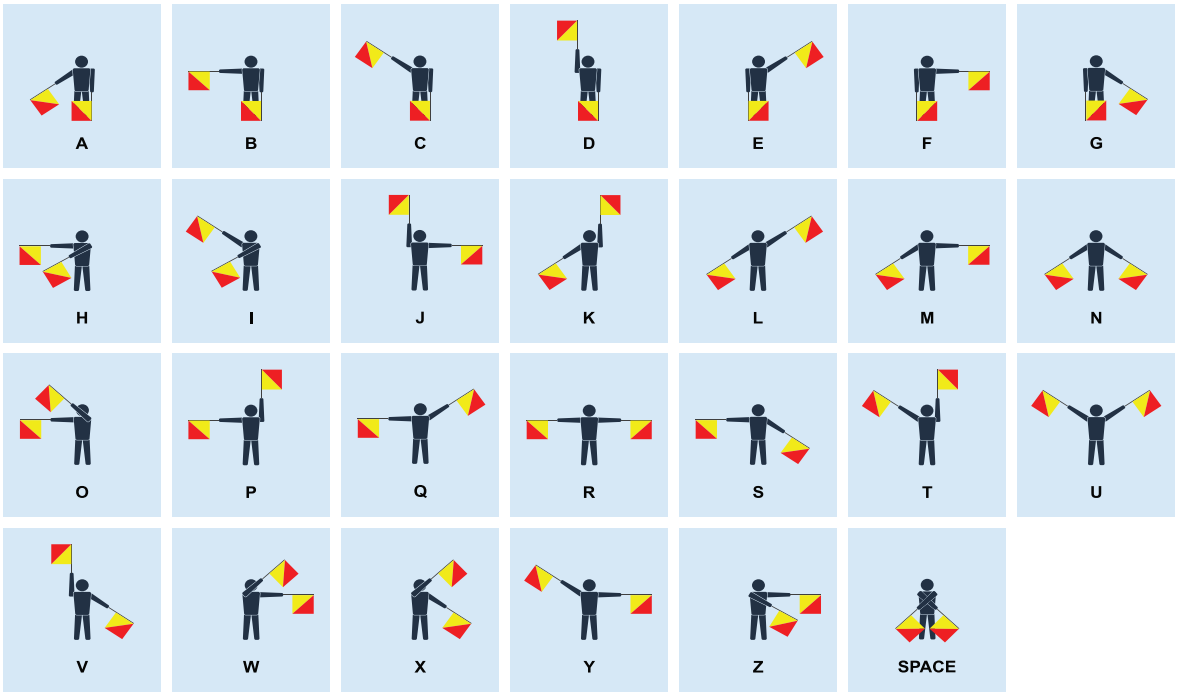
If you could fly one of the aircraft, which would you choose and why?



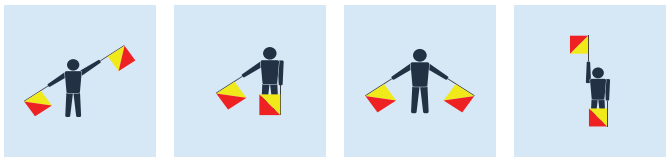
Semaphore flag signalling

Semaphore flag signalling is an alphabet signalling system based on waving hand-held flags in a particular pattern. The system was created in 1866 and was widely used in the maritime world including the US Navy. However, it is still acceptable for emergency communication in daylight or at night where lighted wands can be used instead of flags. During WW1 Semaphore Flags and Morse Signalling lamps were used in the RAF also and therefore the Semaphore Flag Signalling system is recognised by many as a way of communicating without being detected.

The below diagram displays the Semaphore Signalling Alphabet. Decode the words from the flag signals on the next page.



To look at the Semaphore Flag Signalling System positions in more detail scan the QR code or click here.



Now have a go at writing your name, the name of a pet, your town or city by drawing the Semaphore signalling flag positions.

Morse Code

Morse code is a communication system that uses dots and dashes and long signals to represent letters, numbers and punctuation marks.

During World War II morse code was used alongside other forms of code to communicate undetected. The RAF had a code breaking division and being able to crack opposing countries coded messages was said to be a large factor in winning World War II.

Listed below is the Morse Code Alphabet. Have a go at writing the 3 listed words in morse code. Once you have completed the words have a go at cracking the secret message written in morse code.

Morse Code Dictionary

A	B	C	D	E	F	G	H	I	J	K	L	M
·–	–···	–·–·	–··	·	··–·	––·	····	··	·–––	–·–	·–··	––
N	**O**	**P**	**Q**	**R**	**S**	**T**	**U**	**V**	**W**	**X**	**Y**	**Z**
–·	–––	·––·	––·–	·–·	···	–	··–	···–	·––	–··–	–·––	––··

For more information on Codebreaking during World War II scan the QR code or click here.

1. SPITFIRE (the first letter has been done for you)

...							

2. WEAPON

3. SURVEILLANCE

Now have a go at cracking the morse code below.
(Hint! Dashes mean spaces in Morse Code)

– .... . / –.. .–. ––– .––. / ––– ...–. ...–. /

.–.. ––– –.–. .– – .. ––– –. / .. ... /

.– – / .–. .– ...–. / ...– .– .–.. .–.. . –.––

Answers

Don't leave your luggage (p5)

Water (250kg) + Toiletries (50 kg)
Tents (200 kg) + Clothing (100 kg)
Bedding (175 kg) + Food (125 kg)

Runway ratios (p6)

Four fifths = 1.6 miles.

Aircraft speed (p7)

Hurricane = 450 / 2 = 225 miles per hour.
Spitfire = 100 /.5 = 200 miles per hour.
Hurricane travels 25 miles per hour faster.

Which is fastest (p9)

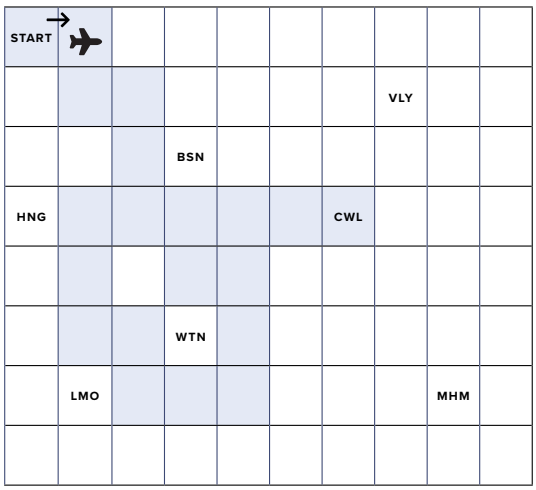
Based on the apparent aerodynamic shape of the nose of the aircraft:
4, 1, 3, 2

Ready for take off? (p10)

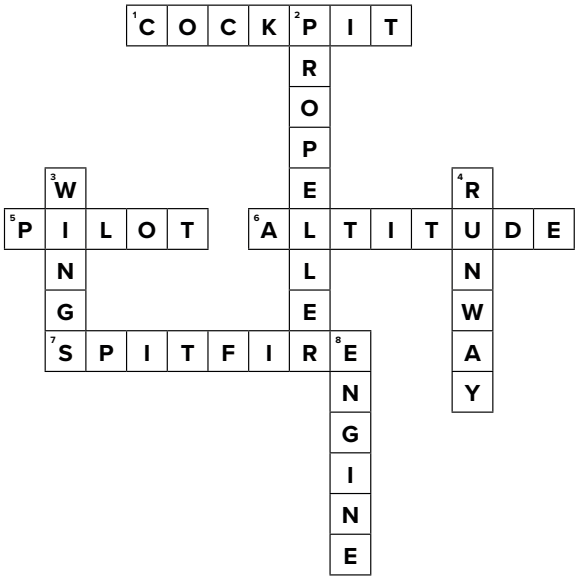
Spitfire = 40 / 5 = 8 feet per second.
Aircraft 1 = 1000 / 100
= 10 feet per second.
Aircraft 2 = 1000 / 200
= 5 feet per second.
Aircraft 3 = 1000 / 50
= 20 feet per second.
Aircraft 4 = 1000 / 1
= 1000 feet per second.

Aviation adventure (p12)

Spitfire is flying to RAF Cranwell.



Flight and aircraft crossword (p14)



Fuel and flight (p16)

85 gallons + 66 + 66 gallons = 217 gallons.
217 x 3.8 = (824.6) 825 litres.
824.6 x 1.8 = (1484.28) 1484 pints.
217 / 10 = 21.7 gallons per hour.

Going the distance (p17)

2,000 miles x 1.6km = 3,200km.
2,000 miles / 200mph = 10 hours.
3,200km – (455km – 430km – 357km) = 1,958km.
1,958km / 1.6 = (1,233.75) 1,234 miles.

Answers

Calculating and rounding (p18)

Round these numbers to up the nearest whole number:
9.122 = 9
79.9 = 80
34.58 = 35
26.3 = 26
Round these numbers to two decimal places:
7.897 = 7.90
5.3852 = 5.39
4.293 = 4.29
8.6324 = 8.63
Round these numbers to the nearest 100:
16809 = 16800
36279 = 36300
728 = 700
4087492 = 4087500

The phonetic alphabet (p19)

Airport.
Engine.

Proportions and percentages of fuel tanks (p20)

(1) Two fifths.
(2) Half.
(3) Four fifths.
(4) One fifth.

Proportions and percentages of fuel tanks (p21)

(1) 80%.
(2) 40%.
(3) 40%.
(4) 40%.

Match them up (p22)

Weight = The force that pulls the aircraft down towards the ground because of gravity.
Thrust = The force that moves the aircraft forward, created by the engines.
Drag = The force that slows the aircraft down, caused by air pushing against the plane as it flies.
Lift = The force that pushes the aircraft up into the air, created by the wings as they move through the air.

Try speaking like a pilot (p23)

Distress signal = Mayday.
Urgent, non-life-threatening situation = Pan-Pan.
Message received = Roger.
Will follow the instructions = Wilco.
Yes = Affirmative.
Wait a moment = Stand-by.

Types of aircraft (p24)

2,530 miles – 1,135 = 1,395 miles.
370mph + 1,550mpg + 287mpg = 2,207mph.
2,530 x 2 = 5,060

Semaphore flag signalling (p26)

AIM
LAND
WAVELENGTH

Morse code (p28)

Spitfire

··· ·−−· ·· − ··−· ·· ·−· ·

Weapon

·−− · ·− ·−−· −−− −·

Surveillance

··· ··− ·−· ···− · ·· ·−·· ·−·· ·− −· −·−· ·

ROYAL AIR FORCE Youth STEM

SPITFIRE AA810

Research Toolkit