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Revision Notes and Questions

Cadet ……………………………………….

HOW TO USE THIS BOOK

Only essential knowledge and key revision points have been included in this manual. You must have a thorough knowledge of its contents before the examination.

Read each page, then read the questions and underline or highlight the correct answer. Revise the questions and answers as they will constitute a high proportion of the actual examination questions (typically 23 out of the 25 questions!).

Ensure your answers are correct before using them in your final revision.

Dec 06 Final revision – no changes since Mar 06

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Extra Question

The question on the right has been asked in the Air Navigation examination, though it is not covered in the syllabus!

The earth revolves from West to East. Although we all know that the sun rises in the East and crosses to set in the West, it is actually the sun which is stationary and the earth which is rotating from West to East.

Which way does the Earth revolve on its axis?

a) East to West.
b) West to East.
c) North to South.
d) South to North.

Precipitation

Precipitation is rain, sleet, snow or hail. Heavy rain might restrict visibility or flood the runway. If the precipitation is frozen or the temperature at ground level is below zero, the precipitation may stick to the airframe causing icing and create serious problems during take-off.

Icing

In icing conditions ice sticks to the surface of the aircraft increasing the weight and changing the shape of the wings. Eventually, ice changes the shape of the wing so much that it becomes incapable of creating enough lift to keep the aircraft airborne.

Both jet and piston engines are also affected by icing. The best advice is to keep away from icing conditions, particularly in small aircraft which have little or no ice protection.

During periods of poor visibility due to fog, ATC will advise the pilot of the slant visibility along the runway.This visibility is measured accurately and is known as:

a) Runway Range.
b) Runway Visual Range.
c) Runway Radar Range.
d) Glide Slope Visibility.

The collective noun for rain, sleet, snow and hail is:

a) Participation.
b) VMC.
c) IMC.
d) Precipitation.

What problems can be caused by heavy rain?

a) Heavy snow.
b) Runway Visual Range.
c) Thunderstorms.
d) Restricted visibility and runway flooding.

What problems can be caused by precipitation at freezing temperatures?

a) Crosswinds.
b) Icing.
c) Fog.
d) Thunderstorms.

What can be the effects of heavy icing on an aircraft's performance?

a) Loss of aerodynamics only.
b) Loss of aerodynamics and reduced engine performance.
c) It will fly much slower.
d) There is no adverse affect on an aircraft's performance.

What effects can icing have on the aerodynamics of an aircraft?

a) The windscreen may freeze over.
b) Lift will decrease and weight will increase.
c) Ice forming on the leading edge of the wing will increase lift.
d) There will be no adverse effect on the aerodynamics.

A flight briefing indicates icing en-route. The aircraft has no ice protection. What advice would you give a novice pilot?

a) Fly above the cloud.
b) Fly slowly, the icing will have less effect.
c) Fly quickly, the icing will have less effect.
d) Plan a route avoiding icing conditions or cancel the flight.

CHAPTER 1 DISTANCE /SPEED /TIME

Pilots must make regular checks of their estimated time of arrival (ETA) at destination as well as estimated times for passing waypoints en-route. These are necessary for ATC reports, and vital for ensuring sufficient fuel remains to reach their destination.

Distance on the Earth

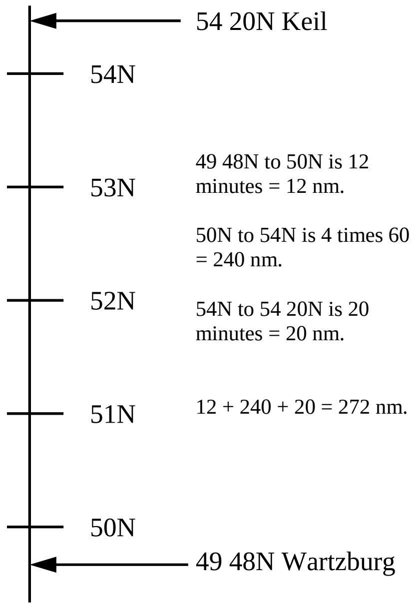
One degree of latitude equals 60 nautical miles, and one minute of latitude (one sixtieth of a degree) equals one nautical mile. The latitude of a point is its distance measured in degrees and minutes north or south of the equator

Note that, although the same is true for longitude on the equator, lines of longitude converge at the poles so parallels cannot be used to accurately measure distance.

Distances taken from charts using dividers should be measured against the nm scale on the closest meridian.

Change of Latitude

If two places are on the same meridian, it is possible to calculate how far they are apart in nautical miles by subtracting the latitude of one from the latitude of the other. As explained above, each degree is 60 nm, and each minute is one nm.



Regular checks of estimated time of arrival (ETA) are important. These checks help the crew determine that:

a) The aircraft has sufficient fuel to reach the destination.
b) The wind velocity will not change.
c) They are flying the shortest route.
d) The drift is correct.

Aircrew are always aware of their Estimated Time of Arrival (ETA). Why is this?

a) Fuel flow rate depends on ETA.
b) It is the easiest calculation to do.
c) It is important for fuel calculations and air traffic control purposes.
d) A revised ETA tells them the wind has changed.

Distance on the earth's surface is measured in nautical miles (nm). Which of the following is true?

a) One nm is equal to one minute of latitude.
b) One nm equals 1/10,000th of the distance from the North Pole to the Equator.
c) One nm is equal to 5280 feet.
d) One nm is equal to one minute of longitude.

One degree of latitude is equal to:

a) 360 nms b) 60 nms c) 60 kms d) 1 nm

One minute of latitude on the earth's surface is equal to:

a) 1 nautical mile. b) 60 nautical miles.
c) 1 knot. d) 1 km.

The LATITUDE of a point is its distance measured in degrees and minutes:

a) From the Greenwich (Prime) Meridian.
b) From the true North Pole.
c) North or South of the Equator.
d) From the true South Pole.

The distance between two points on a navigation chart can be measured with dividers. What scale will then be used to convert the distance to nautical miles?

a) 1:50,000 scale.
b) The minute scale along a meridian close to the area of interest on the chart.
c) The minute scale along a parallel of latitude.
d) Any meridian scale off any chart.

In Germany, Kiel is due north of Wartzburg. If Kiel's latitude is 54 20N and Wartzburg's is 49 48N how far are they apart?

a) 272 nm b) 2720 nm c) 27.2 nm d) 227 nm

Oslo airport (Norway) is due north of Braunschweig airfield near Hanover (Germany). If their latitudes are 59 53N and 52 20N respectively, how far are they apart?

a) 453 nm b) 454 nm
c) 554 nm d) 445 nm

Aircraft Speed

On land, we measure speed in miles per hour. In aviation we use nautical miles (nm) to measure distances and speed is measured in nm per hour (known as knots and abbreviated to 'kts').

To measure speed through the air we use an instrument called an Air Speed Indicator (ASI). This compares the pressure caused by the forward motion of the aircraft through the air (the 'Pitot' pressure) with the pressure of the air surrounding the aircraft (the 'Static' pressure). The faster the aircraft flies, the greater is the difference between these two pressures.

Calibrated Airspeed (CAS)

The speed read directly from the ASI is the indicated airspeed (IAS). This is corrected for Pressure Error and Instrument Error to give a more accurate airspeed—Calibrated Airspeed (CAS).

IAS + Pressure Error + Instrument Error = CAS

Pressure error is caused by the airflow around the aircraft. Although the pitot tube and static vents are carefully positioned to minimise this error, it cannot be eliminated completely.

Instrument error is caused by manufacturing tolerances within the ASI itself, rather like a car speedometer, it is rarely 100% accurate.

True Airspeed (TAS)

As an aircraft flies higher the air becomes less dense. The aircraft flies faster through the thinner air to achieve the same force on the pitot tube, and therefore the same CAS. The navigator, however, needs to know the actual speed of the aircraft through the air so that he can compare it with its speed over the ground and hence calculate the wind strength and direction.

To obtain True Airspeed (TAS) the Calibrated Airspeed (CAS) must be corrected for air density changes caused by temperature and altitude.

CAS + Density Error (temperature & altitude) = TAS

Speeds of over 300 kts will also need a correction for Compressibility Error.

Your destination airfield is situated due south of your departure airfield. If the two latitudes are 63 25N and 57 58N, how far are they apart?

a) 327 nms. b) 317 nms.
c) 323 nms. d) 333 nms.

Dundee is due north of Abergavenny. If their latitudes are 56 27N and 51 50N, how far are they apart?

a) 277 kms .b) 323 kms.
c) 323 nms. d) 277 nms.

In aviation, speed is measured in:

a) kilometres per hour (km/hr).
b) miles per hour (mph).
c) knots (kts).
d) metres per hour (m/hr).

The Air Speed Indicator (ASI) calculates speed by:

a) Measuring the pressure difference between pitot and static pressures.
b) Measuring the pitot pressure.
c) Measuring the static pressure.
d) Multiplying pitot pressure by static pressure.

Speed read directly from the ASI gauge is known as:

a) Groundspeed.
b) Rectified Air Speed.
c) Indicated Air Speed.
d) Pilot speed.

*** *Please note, in the old training syllabus Calibrated Air Speed (CAS) used to be known as Rectified Air Speed (RAS). Questions from the old syllabus are still appearing in current papers. If a question asks about Rectified Air Speed (RAS) then assume this means Calibrated Air Speed (CAS).* ***

Calibrated Air Speed (CAS) is:

a) Pitot pressure minus static pressure.
b) IAS after correction for pressure error and instrument error.
c) Always less than IAS.
d) Always greater than IAS.

Calibrated Air Speed (CAS) equals Indicated Air Speed (IAS) plus corrections for:

a) Altitude error.
b) Pressure error.
c) Instrument error.
d) Pressure and instrument error.

True Air Speed (TAS) is Calibrated Air Speed (CAS) corrected for: (two correct answers)

a) Density error.
b) Compressibility error.
c) Temperature and altitude.
d) Instrument error and compressibility error.

CHAPTER 5 WEATHER

Meteorological Conditions

Student pilots do not have the experience and basic training aircraft do not have the instrumentation to fly safely in cloud and fog. Beginners may fly only in Visual Met Conditions (VMC) when visibility is good and aircraft can remain clear of cloud.

When this is not the case, Instrument Met Conditions (IMC) apply. Only pilots with suitable instrument ratings and aircraft with suitable instrumentation may fly in these conditions.

The Visual Circuit

Trainee pilots will not be allowed to take off and fly circuits unless the cloudbase and visibility meet the aerodrome controller's requirements.

Wind

The take off runway will normally be the one which allows the take off to be made into wind. Into a strong wind an aircraft reaches flying speed very quickly and needs a shorter take off run.

Crosswind is the component of the wind which is not aligned with the aircraft's take off or landing run. If the wind is directly down the runway there is no crosswind, but if it is at 90° to the runway the whole of the wind strength is crosswind.

If the wind direction is 30° off the runway heading the crosswind will be 50% of the wind's strength.

Shallow Fog

In an evening, fog often starts to form in a shallow layer close to the ground, sometimes only a few feet thick. From directly above this layer is hardly visible, particularly at night when runway lights show clearly.

As the aircraft joins the glideslope to make its approach, however, the pilot will be looking through the fog at a shallow angle. It will suddenly appear much thicker and may well prevent the aircraft from landing.

This slant visibility can be measured and is known as Runway Visual Range (RVR).

Beginners may only fly in good weather conditions. These conditions are called:

a) Instrument Meteorological Conditions (IMC).
b) Runway Visual Range (RVR).
c) Visual Circuits (VC).
d) Visual Meteorological Conditions (VMC).

In order to fly in Instrument Met Conditions (IMC), which of the following are required:

a) A clear windscreen canopy.
b) No cloud in the local area.
c) An instrument rating only.
d) The correct instrumentation and a suitable pilot instrument rating.

In order to fly a visual circuit, a trainee pilot requires:

a) No wind.
b) Good visibility and no cloud in the sky.
c) Good visibility and no wind.
d) Visibility and cloudbase conditions to meet the aerodrome controller's requirements.

Why does an aircraft take off into wind?

a) To increase the groundspeed at take off.
b) To take off at a lower airspeed.
c) To use the full length of the runway.
d) To decrease the length of take off run.

A wind is blowing at 90 degrees angle off the runway direction. If the wind speed is 20 kts, what is the crosswind component?

a) 2 kts
b) 10 kts
c) 12 kts
d) 20 kts

The wind is blowing directly down the length of a runway. What is the crosswind component?

a) Equal to the wind's speed.
b) Equal to 3/4 of wind speed.
c) Equal to half the wind speed.
d) Zero.

The airfield has a covering of shallow fog. A pilot circling directly overhead sees the runway lights clearly. However, on the approach to land he may have great difficulty seeing any lights. Why is this?

a) Runway lights are designed to be seen from high level only.
b) Fog is more dense closer to the ground.
c) Fog will appear thicker when on the glide path because the pilot is looking at a shallower angle.
d) The thickest fog always settles at the end of the runway.

Gyro Errors

Gyroscopes suffer real and apparent errors. Real errors are due to inaccuracies during manufacturing and are very small in modern gyros.

Apparent errors are due to the fact that a gyro maintains a direction in space whilst the earth is rotating beneath it.

These errors are called gyro wander.

Inertial Navigation

Inertial navigation systems (INS) use accelerometers to detect rate of change of position along three axes. Providing your start point is accurately entered you can obtain an instant read-out of your position at any time.

Which of the following is one advantage of a gyro-magnetic compass over a Direct Indicating Compass?

a) A gyro-magnetic compass requires no electricity.
b) A gyro-magnetic compass can feed repeaters around the aircraft.
c) A gyro-magnetic compass is cheaper.
d) A gyro-magnetic compass does not work during turns or accelerations.

A gyroscope cannot be perfect, and so over a period of time it becomes inaccurate, this is called:

a) Gyro wander.
b) Variation.
c) Gyro rigidity.
d) Turn / acceleration error.

What principle does an Inertial Navigation System (INS) use to calculate the position of the aircraft?

a) A gyroscope feeds position to the computer.
b) The navigator must update the system all the time.
c) It uses compass heading and doppler values to compute aircraft position.
d) It is set accurately on the ground, then measures acceleration in the fore, aft and lateral.

Within an Inertial Navigation System the movement of the aircraft is measured by sensors called:

a) Axis.
b) Accelerators.
c) Accelerometers.
d) Inertials.

Units of Time

All military and commercial aviators use Greenwich Mean Time (GMT) or Universal Time (UT) as it is now commonly known.

Calculation of Flight Time

If a car travels 120 miles at 60 mph, it will take 2 hours to complete the journey.

$$\frac{\text{Distance (D)}}{\text{Speed (S)}} = \text{Time (T)} \qquad \frac{120 \text{ miles}}{60 \text{ mph}} = 2 \text{ hrs}$$

Similarly, if we know the distance and the time taken, we can calculate the speed.

$$\frac{\text{Distance (D)}}{\text{Time (T)}} = \text{Speed (S)} \qquad \frac{120 \text{ miles}}{2 \text{ hrs}} = 60 \text{ mph}$$

If we know the speed and the time the journey has taken, we can calculate the distance covered.

$$\text{Speed (S) X Time (T)} = \text{Distance (D)}$$

$$60 \text{ mph X } 2 \text{ hrs} = 120 \text{ miles.}$$

Aircraft normally fly at faster speeds and hence cover greater distances, but the principle and the mathematics remain the same.

How fast must an aircraft fly to cover 1500nm in 5 hours?

$$\frac{1500 \text{ nm}}{5 \text{ hrs}} = 300 \text{ kts}$$

When CAS is corrected for altitude and temperature it becomes:

a) True Air Speed (TAS).
b) Indicated Airspeed (IAS).
c) Mach Number.
d) Indicated Groundspeed.

Universal Time (UT) is used as the standard in military and commercial aviation. What other name is this known as?

a) British Summer Time (BST).
b) European Daylight Saving Time (EDST).
c) Greenwich Mean Time (GMT).
d) Local Time (i.e. the time of the country over which the aircraft is flying)

What time is used as standard in military and commercial aviation.

a) British Summer Time.
b) European Daylight Saving Time.
c) Greenwich Mean Time (Universal Time).
d) The time of the country over which the aircraft is flying.

How fast must an aircraft fly to cover 1200 nm in 3 hours?

a) 400 kts
b) 800 kts
c) 400 mph
d) 3600 kts

A Hercules is flying at a groundspeed of 210 kts. How far will it travel in 3 hours?

a) 630 nms.
b) 70 nms.
c) 630 km.
d) 210 nms.

A Tornado flies from its base to a target in 30 minutes. If the distance is 250 nms, what speed is it flying at?

a) 125 kts.
b) 500 kts.
c) 750 kts.
d) 800 kts.

A Nimrod flies on patrol for nine hours at a speed of 300 kts. How far does it travel in this time?

a) 2400 nms.
b) 2700 nms.
c) 3000 nms.
d) 3900 nms.

A Hercules flies from A to B, a distance of 1000 nms at a groundspeed of 250 kts. How long does the flight take?

CHAPTER 2 TRIANGLE OF VELOCITIES

Vectors and Velocity

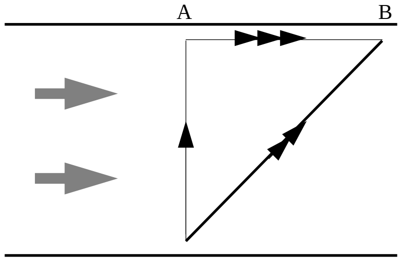
We will now consider the effect of wind on an aircraft. Whenever we talk about aircraft or wind movement, we must always give both the direction and speed of that movement.

*Direction and speed together are called a **velocity**.*

*A velocity can be represented on paper by a line called a **vector**.*

The bearing of the line represents the direction of the movement, and the length represents speed.

If a boat is pointed directly at the opposite bank of a river and sent across, the flow of the river will push the boat downstream.



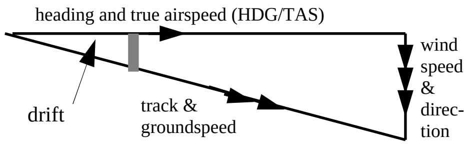
The line with one arrow represents the velocity of the boat (the direction it was pointing and its speed).

The line with three arrows represents the speed and direction of the current. Although the boat set off pointing at ‘A’ it finished up at ‘B’ because of this current.

Joining the ends of these two vectors with a third line completes the vector triangle. This line, with two arrows, is the *resultant* and represents the actual course of the boat.

The Air Triangle

The same triangle can represent an aircraft’s movement through air which is moving, though we use different names.



Wind direction is the direction the wind is from.

Velocity consists of:

a) Speed only.
b) Direction only.
c) Speed and direction together.
d) Several speed vectors together.

A vector is a representation on paper of:

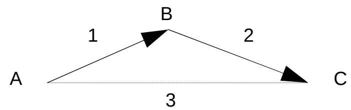
a) Speed. b) Time.
c) Direction. d) Direction and speed.

A vector is a line, drawn to represent a velocity. This is achieved by:

a) The bearing represents knots at all times.
b) The bearing represents speed and the length represents direction.
c) The length represents mph at all times.
d) The bearing represents direction and the length represents speed.

In the diagram below, vector 2 is added to vector 1. What is vector 3 (A-C) known as?

a) The ready vector. b) Current.
c) The resultant vector. d) Drift.



In the triangle of velocities, DRIFT is:

a) The bearing of the wind vector.
b) The angle between the wind and track vectors.
c) The angle between heading and track vectors.
d) The angle between heading and wind vectors.

In the air triangle, the heading vector includes 2 components. They are:

a) Heading and wind velocity.
b) Heading and groundspeed.
c) Heading and drift.
d) Heading and true air speed.

In the air triangle, the track vector includes 2 components. They are:

a) Track and drift.
b) Track and heading.
c) Track and groundspeed.
d) Track and true air speed.

In the air triangle, the wind vector includes 2 components. They are:

a) Wind speed and drift.
b) Wind speed and heading.
c) Wind speed and the direction the wind is blowing from.
d) Wind speed and the direction the wind is blowing to.

CHAPTER 4 COMPASSES

Magnetic Variation

The earth’s molten core creates a magnetic field around the earth which resembles the field around a bar magnet. As this ‘magnet’ is not exactly aligned with the true north and south poles there is a difference between true and magnetic north called variation. This magnetic variation is at its greatest in polar areas.

Just as the magnetic lines of force go into the ends of a bar magnet, they angle steeply into the earth in polar areas causing compass needles to ‘dip’ as they try and align themselves. For these reasons compasses are very inaccurate in polar areas.

The Direct Indicating Compass

The direct indicating compass (DIC) is a simple aircraft compass. Because of its limitations it is only used as a standby in most aircraft.

Its limitations are:

- It only reads correctly in unaccelerated straight and level flight.
- It only indicates magnetic heading.
- It is unreliable at high magnetic latitudes.

It does, however have three significant advantages:

- It is simple and reliable.
- It is cheap and lightweight.
- It does not require any form of power.

The Gyro-Magnetic Compass

The gyro-magnetic compass (GMC) was invented to overcome the limitations of the DIC. It has three main components:

- A magnetic detector (or flux valve).
- A turn / acceleration cut-out switch.
- A gyroscope.

During turns and accelerations when the detector unit is unreliable the cut-out switch allows the gyro to operate on its own until the manoeuvre is complete.

Gyro-magnetic systems can also provide outputs to repeater units in other parts of the aircraft.

Where are variation values at their greatest?

a) In the Northern hemisphere.
b) In polar regions.
c) At the equator.
d) In the Southern hemisphere.

As a compass nears the Magnetic North Pole, the compass detector will try and point at the magnetic material inside the Earth. This tilting is called:

a) Drip.
b) Drop.
c) Dip.
d) Variation.

When would a Direct Indicating Compass (DIC) be most accurate?

a) In unaccelerated flight.
b) In a turn.
c) In a steady climb.
d) In a steady descent.

Which of the following statements is true, concerning the Direct Indicating Compass (DIC)?

a) The DIC gives a reading of aircraft true heading.
b) The DIC needs only a small power supply.
c) The DIC is not affected by turns and accelerations.
d) The DIC only reads magnetic headings.

All RAF aircraft are equipped with a Direct Indicating Compass (DIC). Why is this?

a) The DIC is the most accurate compass available.
b) The DIC is not affected by turns or accelerations.
c) The DIC gives a reading of true heading.
d) The DIC is reliable and needs no power supply.

Which of the following is not a component within a Gyro-magnetic compass system?

a) A turn / acceleration cut-out switch.
b) A gyroscope.
c) A suspended magnet.
d) A flux valve magnetic detector.

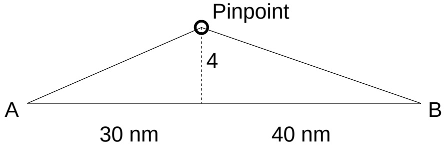
Which of the following statements about the Gyro-magnetic compass is true?

a) When the aircraft climbs or descends, the flux-valve takes over from the gyroscope.
b) The gyroscope takes over from the flux valve whenever the aircraft turns.
c) The Gyro-magnetic compass is less accurate than the Direct Indicating Compass.
d) The flux valve controls the speed of the gyroscope.

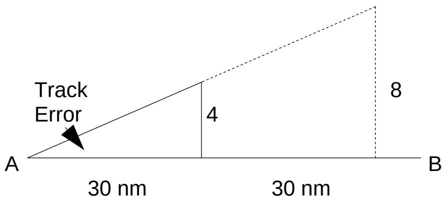
1 in 60 Rule Revision

Let's look at how to solve an example of the most difficult problem you will face.

If an aircraft flying from A to B finds that after 30 nms it is 4 nms left of track and it still has 40 nms left to travel, by how much will the pilot need to turn to regain track at B?

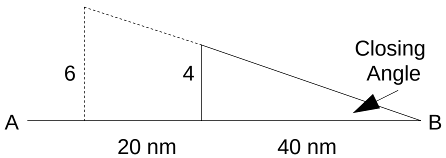


It is necessary to look at each triangle separately and apply the 1 in 60 rule to each.



Extending the left hand triangle to 60 nm would increase the 4 nm error to an 8 nm error making the track error 8 degrees.

Now let us examine the right hand triangle.



Extending this triangle to a 60 nm base shows that a 4 nm error at 40 nm becomes a 6 nm error at 60 nm, so the closing angle is 6 degrees.

Adding the 8° track error to the 6° closing angle means the pilot must turn 14° right to regain track at point B.

An aircraft flying from A to B finds that after 40 nms it is 4 nms off track. It has a further 60 nms to travel. By how much does the pilot need to turn to regain the intended track at B?

a) 12 degrees.
b) 10 degrees.
c) 6 degrees.
d) 4 degrees.

An aircraft flying from A to B finds that after 30 nms it is 4 nms left of track. It has a further 40 nms to travel. By how much does the pilot need to turn to regain the intended track at B?

a) 16 degrees to the right.
b) 14 degrees to the right.
c) 14 degrees to the left.
d) 12 degrees to the left.

An aircraft flying from A to B finds that after 20 nms it is 2 nms right of track. It has a further 40 nms to travel. By how much does the pilot need to turn to regain the intended track at B?

a) 12 degrees to the left.
B 9 degrees to the left.
c) 6 degrees to the left.
d) 6 degrees to the right.

An aircraft flying from A to B finds that after 40 nms it is 6 nms right of track. It has a further 30 nms to travel. By how much does the pilot need to turn to regain the intended track at B?

a) 24 degrees right.
b) 21 degrees left.
c) 18 degrees left.
d) 12 degrees left.

Solving the Vector Triangle

The vector triangle consists of 6 elements, heading and airspeed, wind direction and windspeed, track and groundspeed. (Drift, caused by the wind, is the angle between heading and track vectors).

Providing we know four elements of the vector triangle it is possible to calculate the other two. The Dalton Computer may be used, although nowadays onboard electronic computers are used.

Mental Calculations

Despite sophisticated electronics, aviators still use mental arithmetic to make quick, accurate calculations. All pilots should know the distance their aircraft will cover in one minute for any given groundspeed.

For instance, a Tornado flying at 420 kts groundspeed will cover 7 nm per minute. If the pilot has 35 miles to go before the next turning point, dividing 35 by 7 tells him he will be there in five minutes. Other examples are given below.

Groundspeed (GS)	NM per minute (nm/min)
60	1
120	*2*
180	3
240	4
300	5
360	*6*
420	*7*
480	8
540	9

Ensure you know the examples underlined above.

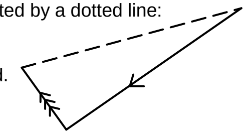
Estimated Time of Arrival (ETA)

Pilots are constantly calculating and updating estimated times of arrival, both for their next turning points, and for their destination.

ETA's are important, both for fuel calculations and for Air Traffic Control purposes.

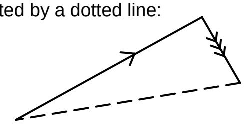
If an aircraft fails to arrive at its destination on time ATC will initiate 'overdue action'.

In the Air Triangle shown below, name the components of the 3rd side, represented by a dotted line:



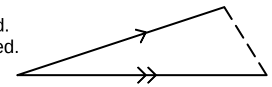
a) Wind velocity.
b) Heading and true airspeed.
c) Drift and groundspeed.
d) Track and groundspeed.

In the Air Triangle shown below, name the components of the 3rd side, represented by a dotted line:



a) Track and groundspeed.
b) Heading.
c) Track.
d) Wind velocity.

In the Air Triangle shown below, name the components of the 3rd side, represented by a dotted line:



a) Wind direction and speed.
b) Heading and true airspeed.
c) Drift and groundspeed.
d) Drift.

In the Air Triangle shown below, name the components of the 3rd side, represented by a dotted line:

The Air Triangle of velocities can be used to calculate flight data. There are 6 elements in total. How many elements are needed to calculate those missing?

a) 2 b) 4 c) 5 d) 6

You are flying at 120 kts groundspeed. How long will it take to fly 20 nms?

a) 60 minutes. b) 10 minutes.
c) 6 minutes. d) 2 minutes.

You are flying a Tornado at 420 kts groundspeed. How many miles do you travel each minute?

a) 42 nm b) 8 nm
c) 7 nm d) 6 nm

You fly between 2 features on the ground and you notice it takes 3 minutes. If the features are 18 nm apart, what is your groundspeed?

a) 54 kts
b) 180 kts
c) 280 kts
d) 360 kts

An aircraft departs from base, but does not arrive at the destination on its Estimated Time of Arrival (ETA). What action will Air Traffic Control take?

a) No immediate action is required.
b) Close down and go home.
c) Contact the departure base.
d) Initiate overdue action.

CHAPTER 3 THE 1 in 60 RULE

Track Required

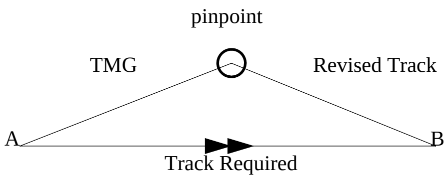
The Track Required is the line drawn on a map from the departure airfield to the destination, or from one turning point to another.

Track Made Good

If the aircraft drifts off track and we can establish our position overhead some unique feature (a pinpoint) then the line joining the departure point and the pinpoint is the Track Made Good (TMG).

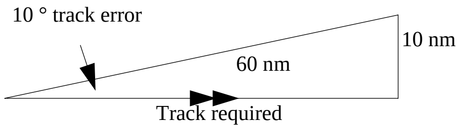
Revised Track

A line from the pinpoint to regain the required track, or more usually from the pinpoint to the next turning point is called the Revised Track.

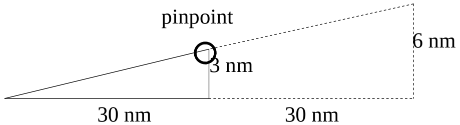


The One in 60 Rule

The 1 in 60 rule states that if an aircraft flies a TMG that is 1 degree in error from the required track, then after 60 miles of flying the aircraft will be one mile off the required track. Similarly, with a track error of 10 degrees the aircraft will be 10 miles off track after 60 miles.



Where the aircraft has not flown 60 miles before the fix is obtained, the triangle must be extended to find the solution. In the example below the aircraft is 3 nm off track after 30 nms.



After 60 nm the aircraft would be 6 nm off track, therefore the Track Error (TE) is 6 degrees.

The track drawn on a map between the departure airfield and the destination is known as:

a) Revised track.
b) Track required.
c) Track made good.
d) Heading required.

An aircraft is flying from point A to point B. Halfway, a pinpoint fix shows it to be off track. A line between point A and the fix would be known as:

a) Revised track.
b) Track required.
c) Track made good.
d) Drift.

An aircraft is flying from point A to point B. Halfway, a pinpoint fix shows it to be off track. A line from the pinpoint fix to point B would be known as:

a) Revised track.
b) Track required.
c) Track made good.
d) Heading required.

Using the 1 in 60 rule, calculate how many miles off track an aircraft will be if it flies 60 nms with a track error of 2 degrees.

a) 60 nms.
b) 6 nms.
c) 4 nms.
d) 2 nms.

An aircraft flies a track made good, 3 degrees in error from the required track. Using the 1 in 60 rule, how many miles will the aircraft be off track after 60 miles of flying?

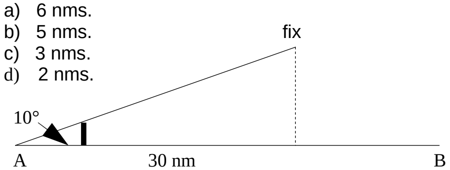
a) 6 nms.
b) 3 nms.
c) 2 nms.
d) 1 nm.

An aircraft is flying from A to B. After 20 miles it is found to be 3 nms off track. What is the track error?

a) 9 degrees.
b) 6 degrees.
c) 4 degrees.
d) 2 degrees.

An aircraft is flying from A to B. After flying 30 nms, a fix shows the aircraft to have a track error of 10 degrees. How far is the aircraft off track at the time of the fix?

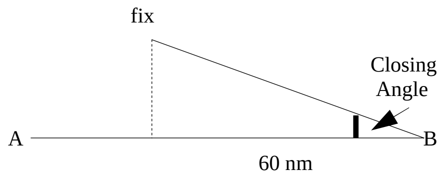
a) 6 nms.
b) 5 nms.
c) 3 nms.
d) 2 nms.



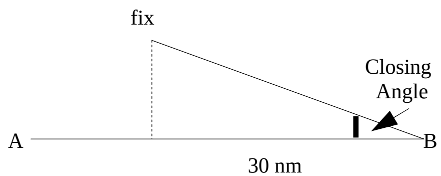
Closing Angle

Once the pilot has found his position and determined his track error he will initiate a turn to regain the track required by the next turning point or the destination.

If the pilot turns the number of degrees of his track error he will only succeed in paralleling the track required. He must determine the Closing Angle (CA) and add this to the Track Error to give the number of degrees he must turn.

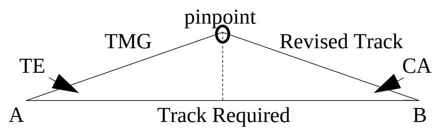


In the example above the aircraft has 60 miles to travel to point B. If the aircraft is 8 nm off track, applying the 1 in 60 rule means the pilot should add the 8 degrees closing angle to his track error.



In this example the aircraft only has 30 nm to travel. If the fix places him 2 nm off track, applying the 1 in 60 rule gives a closing angle of 4 degrees which must be added to his track error.

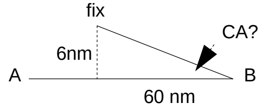
A special case, where the aircraft is exactly half way between turning points, or the pilot intends to regain track in the same distance covered since the last turning point. The closing angle will be exactly the same as the track error and the two triangles will be a mirror image of each other.



The pilot only needs to work out the track error and double it to make his correction..

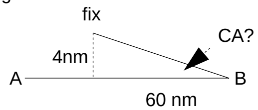
An aircraft flying from A to B finds itself 6 nms off track. It has a further 60 nms to travel. What is the required closing angle?

a) 10 degrees.
b) 6 degrees.
c) 3 degrees.
d) 2 degrees.



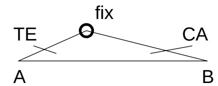
An aircraft flying from A to B finds itself 4 nm off track. It has a further 60 nms to travel. What is the required closing angle?

a) 6 degrees.
b) 4 degrees.
c) 3 degrees.
d) 2 degrees.



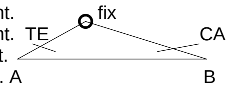
An aircraft when flying from A to B is found to be off track at the pinpoint shown below. The pilot calculates the track error (TE) as 6 degrees and the closing angle (CA) of 3 degrees. By how much does the pilot need to turn to reach point B?

a) 9 degrees to the left.
b) 9 degrees to the right.
c) 2 degrees to the left.
d) 2 degrees to the right.



An aircraft when flying from A to B is found to be off track at the pinpoint shown below. The pilot calculates the track error (TE) as 12 degrees and the closing angle (CA) of 8 degrees. By how much does the pilot need to turn to reach point B?

a) 20 degrees to the right.
b) 12 degrees to the right.
c) 8 degrees to the right.
d) 4 degrees to the right.



An aircraft is flying from A to B, a distance of 120 nms. Halfway, a fix shows the aircraft to be 4 nms right of track. What heading change does the pilot require to reach point B?

a) 8 degrees right.
b) 8 degrees left.
c) 4 degrees right.
d) 4 degrees left.

20 nm after take off for a pre-planned destination, a pilot finds that he is 3 nm off track. By how much does the pilot need to turn to regain the intended track after flying a further 20 nm?

a) 18 degrees.
b) 9 degrees.
c) 6 degrees.
d) 3 degrees.