

**JAA Administrative & Guidance Material**  
**Section Five: Licensing, Part Two: Procedures**

CHAPTER 17: DETAILED THEORETICAL KNOWLEDGE SYLLABUS AND LEARNING OBJECTIVES  
 Subject – 061 – General Navigation  
 See Appendix 1 to JAR-FCL 1.470 and JAR-FCL 2.470

Syllabus reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter		IR
		ATPL	CPL	ATPL/IR	ATPL	
<b>060 00 00 00</b>	<b>NAVIGATION</b>					
<b>061 00 00 00</b>	<b>GENERAL NAVIGATION</b>					
<b>061 01 00 00</b>	<b>BASICS OF NAVIGATION</b>					
<b>061 01 01 00</b>	<b>The solar system</b>					
061 01 01 01	Seasonal and apparent movements of the sun					
	LO State that the solar system consists of the Sun and nine planets of which the Earth is one.					
	LO Explain that the planets revolve around the sun in elliptical orbits. Each planet has its orbital period.	x	x	x	x	x
	LO State that Kepler's second law explains the variation in the speed of the Earth in its orbit. Each planet revolves so that the radius vector of any planet sweeps out equal areas in equal intervals of time.	x	x	x	x	x
	LO State that the highest speed of the Earth in its orbit is when the Earth is closest to the Sun. (perihelion)	x	x	x	x	x
	LO State that the lowest speed of the Earth in its orbit is when the Earth is furthest away from the Sun. (aphelion)	x	x	x	x	x
	LO Explain in which direction the earth rotates on its axis.	x	x	x	x	x
	LO Explain that the axis of rotation of the earth is inclined to its orbital path around the sun at an angle of about 66,5°	x	x	x	x	x
	LO Define the term "Ecliptic" and "plane of the Ecliptic". The ecliptic is the apparent path of sun around the earth. The plane of the ecliptic is inclined to the equator at an angle of approximately 23,5 degrees. The inclination of the polar axis to the plane of the ecliptic is the reason for the seasons.	x	x	x	x	x
	LO Explain that the Earth completes one orbit around the Sun in approximately 365,25 days.	x	x	x	x	x

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		ATPL	CPL	ATPL/IR	ATPL	
LO	Describe the effect of the inclination of the Earth's rotation axis to the plane of its orbit around the Sun, being the seasons and variation of sunrise and sunset with latitude and time of the year.	X	X	X	X	X
LO	Define the term's "apparent sun" and "mean sun" and state their relationship.	X	X	X	X	X
LO	Define the celestial equator. Is the projection of the earth's equator onto the celestial sphere.	X	X	X	X	X
LO	Define the term declination. Declination is the angular distance of a celestial body north or south of the celestial equator.	X	X	X	X	X
LO	State that the mean sun is conceived to move eastward along the celestial equator at a rate that provides a uniform measure of time equal to the average time reckoned from the true sun.	X	X	X	X	X
**LO	<b>Define the polar circles</b> , the tropic of Cancer and the tropic of Capricorn.	X	X	X	X	X
LO	Explain summer and winter solstice.	X	X	X	X	X
LO	Explain the terms spring and autumn equinox.	X	X	X	X	X
LO	Explain at which time of the year the length of a day changes at the highest rate.	X	X	X	X	X
LO	Explain the relationship between the declination of the sun, latitude and the period of daylight.	X	X	X	X	X
LO	State that perihelion occurs early January and aphelion occurs early July.	X	X	X	X	X
LO	Illustrate the position of the Earth relative to the Sun with respect to the seasons and months of the year.	X	X	X	X	X
LO	Define zenith. The point on the sky vertically overhead an observer.	X	X	X	X	X
<b>061 01 02 00</b>	<b>The earth</b>					
061 01 02 01	Great circle, small circle, rhumb line	X	X	X	X	X
LO	State that the earth is not a true sphere. It is flattened slightly at the poles. The value for flattening is 1/298.	X	X	X	X	X
LO	Given the earth flattening and either the semi-major or semi-minor axis in NM/km. Calculate the distance of the other axis.	X	X	X	X	X
LO	State that the Earth may be described as an "ellipsoid" or "oblate spheroid".	X	X	X	X	X

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		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain that the Equator has its plane perpendicular to the Earth's axis and defines east-west direction.	X	X	X	X	X	
LO	Given that the distance of the circumference of the earth is 40000 km or approximately 21600 NM. Calculate approximate earth diameter or earth radius.	X	X	X	X	X	
LO	Define a great circle in relation to the surface of a sphere.	X	X	X	X	X	
LO	Explain the geometric properties of a great circle.	X	X	X	X	X	
LO	Describe the geometric properties of a great circle, including vertex.	X	X	X	X	X	
LO	Define a small circle in relation to the surface of a sphere.	X	X	X	X	X	
061 01 02 02	Convergency, conversion angle						
LO	Explain the term convergency of meridians between two positions.	X	X	X	X	X	
LO	Explain how the value of convergency can be determined using either calculation or geometric construction.	X	X	X	X	X	
LO	The formula to calculate convergency between two positions relatively close to each other is: Convergency = Difference of longitude × sin mean latitude.	X	X	X	X	X	
LO	Calculate the value of convergency between two stated positions	X	X	X	X	X	
LO	Explain that the difference between great circle track and rhumb line track at a specified position is called conversion angle.	X	X	X	X	X	
LO	State that average great circle true track is equal to rhumb line true track between two positions.	X	X	X	X	X	
LO	Explain how the value of conversion angle can be calculated as half the value of convergency.	X	X	X	X	X	
LO	Calculate great circle track and rhumb line track angle at specified position involving calculations of convergency and conversion angle.	X	X	X	X	X	
061 01 02 03	Latitude, difference of latitude	X	X	X	X	X	
LO	Define latitude.	X	X	X	X	X	
LO	Explain the definition of latitude.	X	X	X	X	X	

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		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Define geocentric latitude as the angle between the plane of the equator and a line from the position to the centre of the earth.	X	X	X	X	X	
LO	State that maximum difference between geographic and geocentric latitude occurs at a latitude of 45 degrees.	X	X	X	X	X	
LO	Calculate difference of latitude between two given positions lat/long.	X	X	X	X	X	
LO	State that one-degree difference of latitude equals 60 nautical miles.	X	X	X	X	X	
LO	Convert difference of latitude to distance.	X	X	X	X	X	
LO	State mean latitude between two positions.	X	X	X	X	X	
061 01 02 04	Longitude, difference of longitude						
LO	Define longitude.	X	X	X	X	X	
LO	Explain the definition of longitude.	X	X	X	X	X	
LO	State that the Greenwich meridian is also known as the Prime meridian.	X	X	X	X	X	
LO	Explain the Greenwich anti meridian is the maximum longitude possible, namely 180 degree E/W.	X	X	X	X	X	
LO	Calculate difference of longitude between two given positions lat/long.	X	X	X	X	X	
LO	Describe a meridian as a semi great circle, which runs north and south from pole to pole.	X	X	X	X	X	
LO	Explain that the meridians and their anti meridian complete a great circle.	X	X	X	X	X	
LO	Name examples of great circles on the surface of the Earth.	X	X	X	X	X	
LO	Name examples of small circles on the surface of the earth.	X	X	X	X	X	
LO	Define a rhumb line. A line intersecting all meridians at the same angle.	X	X	X	X	X	
LO	Explain the geometrical properties of a rhumb line. Parallels and meridians are special cases of rhumb lines.	X	X	X	X	X	
061 01 02 05	Use of latitude and longitude co-ordinates to locate any specific position						

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		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain that along the equator a difference of longitude of one degree equals a distance of 60 NM.	x	x	x	x	x	
LO	Explain that because the meridians converge towards the poles the distance between meridians will decrease with increase in latitude.	x	x	x	x	x	
LO	Explain the connection between the cosine function and the calculation of earth distance.	x	x	x	x	x	
LO	State that earth distance along a parallel of latitude is also known as departure.	x	x	x	x	x	
LO	Calculate the earth distance between two meridians along a parallel of latitude using the following formula: Distance = Difference of longitude × 60 × cos latitude.	x	x	x	x	x	
LO	Given a position lat/long, distances travelled north/south in NM/km and distance travelled east/west in NM/km along a parallel of latitude. Calculate new position.	x	x	x	x	x	
LO	State that when flying great circle tracks between two positions on the same parallel of latitude, the great circle will be on the polar side of the parallel of latitude. The formula to calculate the maximum cross track distance between rhumb line and great circle is:  $\text{Cross track distance} = \frac{\text{conversion angle} \times \text{distance}}{230}$ The distance is between the positions in question.	x	x	x	x	x	
LO	Given two positions on same meridian (or one on the anti-meridian) calculate distance.	x	x	x	x	x	
<b>061 01 03 00</b>	<b>Time and time conversions</b>						
061 01 03 01	Apparent time	x	x	x	x	x	
LO	Explain the meaning of the term twilight.	x	x	x	x	x	
LO	Define duration of evening civil twilight. The time from sunset to the time when the centre of the sun is 6 degrees below the celestial horizon.	x	x	x	x	x	
LO	Define duration of morning civil twilight. The time from when the centre of the sun is 6 degrees below the celestial horizon to the time of sunrise.	x	x	x	x	x	

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		ATPL	CPL	ATPL/IR	ATPL	
LO	State that the beginning of morning civil twilight and the end of evening civil twilight has been tabulated in UTC with latitude and date as the entering argument. May be taken to be the LMT for any other meridian.	X	X	X	X	X
LO	Calculate examples of twilight in UTC and ST given a twilight table, latitude and longitude of place in question and the date.	X	X	X	X	X
LO	Determine the duration of civil twilight for morning and/or evening.	X	X	X	X	X
LO	Explain the effect of declination and latitude on the duration of twilight. State that the longest twilight on a specific place occurs at spring and autumn equinox. State that the duration of twilight will increase with increase of latitude.	X	X	X	X	X
LO	Explain the principles of zone time.	X	X	X	X	X
LO	Explain that, because the earth rotates on it's axis from west to east, the celestial bodies appear to revolve around the earth from east to west.	X	X	X	X	X
LO	Define and explain the term transit. Explain that transit means that a heavenly body crosses the observer's meridian.	X	X	X	X	X
LO	Explain that the time period a "day" is the elapsed time between two successive transits of a heavenly body.	X	X	X	X	X
LO	Explain that the term sidereal day is time measured with reference to a fixed point on the celestial sphere.	X	X	X	X	X
LO	State that the sidereal day is of constant duration.	X	X	X	X	X
LO	State that, if the day is measured by the apparent passage of the sun the length of a day will vary.	X	X	X	X	X
LO	Explain the reason for the variation in the length of an apparent day, being a combination of the variation in the earth orbital speed around the sun, and the inclination of the earth rotation axis to the plane of the ecliptic.	X	X	X	X	X
LO	Illustrate that, since both the direction of rotation of the earth around its axis, and its orbital rotation around the sun are the same, the earth must rotate through more than 360 degrees to produce successive transits.	X	X	X	X	X

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		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State that the period between two successive transits of the sun is called an apparent solar day and that the time based on this is called apparent time.	x	x	x	x	x	
LO	State that the time of orbital revolution of the earth in one year around the sun is approximately 365 ¼ calendar days.	x	x	x	x	x	
LO	State that in order to have a constant measurement of time, which will still have the solar day as a basis, the average length of an apparent solar day is taken. This average day is called the mean solar day. It is divided into 24 hours of mean time.	x	x	x	x	x	
LO	State that the mean sun is orbiting along the plane of the equator at a rate that provides a uniform measure of time.	x	x	x	x	x	
LO	State that the time between two successive transits of the mean sun over a meridian is constant.	x	x	x	x	x	
LO	Explain that the difference between apparent time and mean time is defined as the “equation of time”.	x	x	x	x	x	
LO	State that the calendar year is 365 days and every 4th year a leap year with 366 days and 3 leap years are suppressed every 4 centuries.	x	x	x	x	x	
LO	State that the length of a year = $365 + \frac{1}{4} - \frac{1}{100} + \frac{1}{400} - \frac{1}{3000}$ days	x	x	x	x	x	
LO	State that time can also be measured in arc since, in one day of mean solar time, the mean sun is imagined to travel in a complete circle round the earth, a motion of 360 degrees in 24 hours.	x	x	x	x	x	
LO	Illustrate the relationship between time and arc along the equator.	x	x	x	x	x	
LO	Deduce conversion values for arc to time and visa-versa.	x	x	x	x	x	
061 01 03 02	UTC						
LO	State that the Greenwich meridian is selected as standard meridian, and that LMT at the Greenwich meridian is equal to Greenwich mean time (GMT).	x	x	x	x	x	
LO	State that UTC is more accurately calculated than GMT but in practice is the same as GMT.	x	x	x	x	x	
LO	State that UTC is regulated against international atomic time (IAT).	x	x	x	x	x	

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		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State that the conversion factor between LMT and UTC is Arc (Change of longitude) converted to time.	x	x	x	x	x	
LO	Convert arc to time.	x	x	x	x	x	
LO	Convert time to arc.	x	x	x	x	x	
LO	Convert between UTC and LMT.	x	x	x	x	x	
061 01 03 03	LMT						
LO	State that the beginning of the local mean day at any location is when the mean sun is in transit with the anti meridian. This is known as midnight or 0000 hours LMT.	x	x	x	x	x	
LO	State that when the mean sun is in transit with the location's meridian it is noon or 1200 hours LMT.	x	x	x	x	x	
LO	State that the LMT at locations <b>at</b> different longitudes vary by an amount corresponding to the change in longitude.						
061 01 03 04	Standard times						
LO	State that standard time is the time used by a particular country (or part of country) determined by the government of that particular country.	x	x	x	x	x	
LO	State that some countries use summer time (daylight saving time)	x	x	x	x	x	
LO	State that conversion from UTC to standard time and visa versa is usually done using extracts from the air almanac published in appropriate documents.	x	x	x	x	x	
LO	Given appropriate documents convert from UTC to ST of a specific country and from ST of a specific country to UTC.	x	x	x	x	x	
061 01 03 05	Dateline						
LO	Explain the effect on the LMT when approaching the 180 degrees meridian line from either side.	x	x	x	x	x	
LO	State that the dateline does not follow exactly the 180° E/W meridian	x	x	x	x	x	
LO	Explain that when crossing the anti meridian of Greenwich, one day is lost or gained depending on direction of travel.	x	x	x	x	x	



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		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State that the date line is the actual place where the change is made and, although mainly at the 180 degree meridian, there are some slight divergences in order to avoid countries being divided by the date line.	x	x	x	x	x	
LO	State that when calculating times, the date line is automatically taken into account by doing all conversions via UTC.	x	x	x	x	x	
LO	Calculate conversions of LMT and GMT/UTC and ST for cases involving the international date line.	x	x	x	x	x	
061 01 03 06	Determination of sunrise, sunset and civil twilight						
LO	State that SR or SS is when the sun's upper edge is at the observer's horizon. State how atmospheric refraction affects this apparent sighting.	x	x	x	x	x	
LO	Explain that SR and SS occurs at different times on the same meridian depending on the latitude for a given day.	x	x	x	x	x	
LO	Explain that SR will occur earlier and SS occurs later with increase in altitude.	x	x	x	x	x	
LO	State that the times for SR and SS given in the air almanac are calculated for the Greenwich meridian.	x	x	x	x	x	
LO	Explain that at the spring and autumn equinox SR and SS occurs approximately at the same time at all latitudes.	x	x	x	x	x	
LO	State that, except in high latitudes, the times of SR and SS at any place changes only a little each day. So for all places of the same latitude, SR or SS will occur at approximately the same LMT.	x	x	x	x	x	
LO	State that the reason for the variation of the duration of daylight and night throughout the year is the inclination of the earth rotation axis to the ecliptic.	x	x	x	x	x	
LO	State that SR and SS times are tabulated against specified dates and latitudes.	x	x	x	x	x	
LO	State that at equator SR is always close to 0600 LMT and SS close to 1800 LMT (within 15 minutes).	x	x	x	x	x	
LO	Calculate examples of SR and SS at mean sea level in LMT, ST or UTC, given SR and SS tables, latitudes and longitude of the place in question and the date.	x	x	x	x	x	
LO	Given sunrise or sunset time in UTC or ST for a given position, calculate sunrise or sunset for another position on the same latitude in UTC or ST.	x	x	x	x	x	

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		ATPL	CPL	ATPL/IR	ATPL	
<b>061 01 04 00</b>	<b>Directions</b>					
061 01 04 01	<u>True north, magnetic north, compass north and grid north</u>					
	LO State that all meridians run in north-south direction and the true north direction is along any meridian towards the geographic north pole.	x	x	x	x	x
	LO State that true directions are measured clockwise as an angle in degrees from true north (TN).	x	x	x	x	x
061 01 04 02	<u>Terrestrial magnetism: inclination and variation</u>					
	LO State that a freely suspended compass needle will turn to the direction of the local magnetic field. The horizontal component of this field is the direction of magnetic north (MN).	x	x	x	x	x
	LO State that the magnetic variation varies as a function of time due to the movement of the northern magnetic pole rotating around the geographic north pole. One complete rotation is completed in approximately 1000 years.	x	x	x	x	x
	LO Define magnetic dip or inclination. The angle between the horizontal and the total component of the magnetic field.	x	x	x	x	x
	LO State that the angle of inclination at the magnetic poles is 90 degrees.	x	x	x	x	x
	LO Explain that the accuracy of the compass depends on the strength of the horizontal component of the earth's magnetic field	x	x	x	x	x
	LO State that, in the polar areas, the horizontal component of the earth's magnetic field is too weak to permit the use of a magnetic compass.	x	x	x	x	x
061 01 04 03	<u>Compass deviation</u>					
	LO State that, in a direct reading compass, the magnetic element will align along a magnetic field. This is compass north (CN). The field is a resultant of the earth's magnetic field, the magnetic field of the aeroplane and the effects of attitude and movement of the aircraft.	x	x	x	x	x
	LO State that the effect of the aircraft magnetism on the compass changes with different headings, as well as different latitudes.	x	x	x	x	x
	LO State that the angle between magnetic north and compass north is called deviation (DEV) and is given in degrees east (+ or E) or west (- or W) of magnetic north.	x	x	x	x	x
	LO Convert between compass, magnetic and true directions.	x	x	x	x	x

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		ATPL	CPL	ATPL/IR	ATPL	
061 01 04 04	Isogonals, relationship between true and magnetic	X	X	X	X	X
LO	State that the angle between the true north and magnetic north is called variation (VAR) being measured in degrees east (+ or E) or west (- or W) of true north.	X	X	X	X	X
LO	Define an isogonal line. A line joining positions of equal variation.	X	X	X	X	X
061 01 04 05	Gridlines, isogrives					
LO	Explain the purpose of a Grid north (GN) based on a suitable meridian on a polar stereographic chart. (reference or datum meridian).	X	X	X	X	X
LO	Explain that the gridlines or the grid meridians are drawn on the chart parallel to the reference meridian.	X	X	X	X	X
LO	State that the angle between the grid north (GN) and true north (TN) is called grid convergence being measured in degrees east (+ or E) or west (- or W) of grid north.	X	X	X	X	X
LO	State that the angle between the grid north (GN) and magnetic north (MN) is called grivation (griv) being measured in degrees east (+ or E) or west (- or W) of grid north.	X	X	X	X	X
LO	State that a line joining points, which have the same grivation is called an isogriv.	X	X	X	X	X
LO	convert between compass, magnetic, true and grid directions.	X	X	X	X	X
<b>061 01 05 00</b>	<b>Distance</b>					
061 01 05 01	Units of distance and height used in navigation: nautical miles, statute miles, kilometres, metres, and feet	X	X	X	X	X
LO	Define the nautical mile. A distance being equal to 1,852 km.	X	X	X	X	X
LO	In map/charts distance between two positions is measured along a meridian at mean latitude, where one minute of latitude presents 1 NM.	X	X	X	X	X
LO	State that when dealing with heights and altitudes the unit used is metres or feet subject to the choice of individual states.	X	X	X	X	X
061 01 05 02	Conversion from one unit to another					
LO	Convert between the following units: nautical miles (NM), statute miles (SM), kilometres (km), metres (m) and feet (ft).	X	X	X	X	X

Supprimé : yards

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		ATPL	CPL	ATPL/IR	ATPL	
061 01 05 03	Relationship between nautical miles and minutes of latitude <a href="#">and minutes of longitude</a>					
LO	State that horizontal distances are calculated in metres, kilometres and nautical miles.	X	X	X	X	X
LO	Given two positions on the same latitude calculate distance along the parallel in NM or km, using the formula for departure: Distance (NM) = difference of longitude in arc minutes x cos latitude	X	X	X	X	X
LO	Given two positions or latitude/longitude difference, calculate the distance	X	X	X	X	X
LO	Given two positions on the same latitude and distance between the two positions in km or NM, calculate difference of longitude between the two positions.	X	X	X	X	X
LO	Flying a rhumb line true track of 090, 180, 270 and 360 degrees given an initial geographical position, flight time and ground speed, calculate new geographic position.	X	X	X	X	X
<b>061 02 00 00</b>	<b>MAGNETISM AND COMPASSES</b>					
<b>061 02 01 00</b>	<b>General Principles</b>					
061 02 01 01	Terrestrial magnetism					
LO	Describe in simple terms why a compass needle can be used to indicate magnetic direction on the earth.	X	X	X	X	X
LO	State the properties of a magnet (poles and magnetic field).	X	X	X	X	X
LO	Illustrate the approximate location of the magnetic north and south poles.	X	X	X	X	X
061 02 01 02	Resolution of the earth's total magnetic force into vertical and horizontal components					
LO	Resolution of the earth's total magnetic force (intensity) into vertical and horizontal components.	X	X	X	X	X
LO	State the relationship between the vertical (Z) and horizontal (H) components of the earth's magnetic field and the total magnetic force (T).	X	X	X	X	X
061 02 01 03	The effects of change of latitude on the vertical and horizontal components					
LO	Explain how H and Z are affected by a change of latitude.	X	X	X	X	X
061 02 01 04	Variation					

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Syllabus reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain that variation changes with location on the earth and with time.	X	X	X	X	X	
<b>061 02 02 00</b>	<b>Aircraft magnetism</b>						
061 02 02 01	Hard iron and soft iron						
LO	Define hard iron magnetism. Magnetism in iron material permanent of nature from the aircraft construction.	X	X	X	X	X	
LO	Define soft iron magnetism. Magnetism in iron material non permanent of nature, created by the magnetic fields from the aircraft electronics.	X	X	X	X	X	
LO	Explain how magnetism in the aircraft structure and instruments produces compass deviation.	X	X	X	X	X	
LO	State that the deviation value is kept to a minimum by compass swinging.	X	X	X	X	X	
061 02 02 02	The resulting magnetic fields						
LO	State that an electrical current creates a magnetic field, and a magnetic field may create electrical currents.	X	X	X	X	X	
061 02 02 03	Change of deviation with change of latitude and with change in the aircraft's heading						
LO	State that the effect of the aircraft magnetism on the compass changes with different headings, as well as different latitudes.	X	X	X	X	X	
LO	Calculate magnetic heading, compass heading or deviation given a deviation table for a direct reading compass.	X	X	X	X	X	
061 02 02 04	Keeping magnetic materials clear of the compass						
LO	Explain that magnetic materials must be kept clear of the compass, in order not to disturb the compass indication.	X	X	X	X	X	
<b>061 02 03 00</b>	<b>Knowledge of the principles <u>of the direct reading (standby) compass</u></b>						
061 02 03 01	<u>The use of this compass</u>						
LO	Direct reading compass (DRC):	X	X	X	X	X	
LO	Interpret the indications on a DRC, given an indication on the compass, deviation or deviation table and variation.	X	X	X	X	X	

Supprimé : vertical

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		ATPL	CPL	ATPL/IR	ATPL	CPL	
061 02 03 02	Serviceability tests						
LO	State the pre-flight serviceability check of the DRC, such as: general condition check indication is within limits	X	X	X	X	X	
LO	State that the serviceability test consists of comparing the DRC indication to another reference (e.g.other compass system or runway direction)	X	X	X	X	X	
061 02 03 03	<u>Situations requiring a compass swing</u>						
LO	State occurrences when a compass swing may be required:  if transferred to another base involving a large change in latitude. major changes in aircraft equipment. aircraft hit by lightning. aircraft parked in same direction for long period of time. when a new compass is fitted. at any time when the compass or recorded deviation is suspect.	X	X	X	X	X	
<b>061 03 00 00</b>	<b>CHARTS</b>						
<b>061 03 01 00</b>	<b>General properties of miscellaneous types of projections</b>						
LO	Define the term conformal. At any given point on the chart the scale over a small area must be the same in all directions. The meridians and parallels must cut each other at right angles.	X	X	X	X	X	
LO	State that on a conformal chart the angles and distances measured on the chart are the same as on the earth.	X	X	X	X	X	
LO	State that different chart projections are used, depending on the application and area of use involved.	X	X	X	X	X	
LO	State that all charts, although they have been developed mathematically, are designated as projections.	X	X	X	X	X	
LO	State that the following projection surfaces are used when projecting charts: - plane - cylindrical - conical	X	X	X	X	X	

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Syllabus reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Define the scale of a chart. The ratio of the chart length compared to the earth distance that it represents.	X	X	X	X	X	
LO	Scale = Chart Length / Earth Distance with both Length and Distance being in the same unit	X	X	X	X	X	
LO	Use the scale of a chart to calculate particular distances.	X	X	X	X	X	
LO	Calculate scale given chart length and earth distance.	X	X	X	X	X	
LO	Define the term chart convergency. The difference in direction from true north at two positions.	X	X	X	X	X	
LO	Define parallel of origin. The parallel where the projection surface touches the surface of the reduced earth.	X	X	X	X	X	
061 03 01 01	<a href="#">Direct Mercator</a>						
LO	State that the Direct Mercator is a cylindrical projection. The parallel of origin is the Equator.	X	X	X	X	X	
LO	State that the convergency on the map is 0°.	X	X	X	X	X	
LO	State that the scale increases with increasing distance from the Equator.	X	X	X	X	X	
LO	Given the scale at one latitude, calculate the scale at different latitudes.	X	X	X	X	X	
LO	Given a chart length at one latitude, show that it represents a different earth distance at other latitudes.	X	X	X	X	X	
061 03 01 02	Lambert conformal conic						
LO	State that the Lambert conformal chart is based on a conical projection. Only Lambert conformal charts mathematically produced with two standard parallels will be considered.	X	X	X	X	X	
LO	State that at the parallel of origin earth convergency is equal to chart convergency.	X	X	X	X	X	
LO	Define the term standard parallel. The latitudes where the cone cuts the reduced earth.	X	X	X	X	X	
LO	State that the parallel of origin is close to the mean latitude between the standard parallels.	X	X	X	X	X	
LO	Explain the scale variation throughout the charts as follows: - The scale indicated on the chart will be correct at the standard parallels. - The scale will increase away from the parallel of origin.	X	X	X	X	X	

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Syllabus reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Define the term constant of cone/convergency factor. The ratio between the top angle of the unfolded cone and 360°, or sine of the parallel of origin.	X	X	X	X	X	
LO	Chart convergency = Difference of longitude × constant of cone	X	X	X	X	X	
LO	Given appropriate data calculate initial, final or rhumb line tracks between two positions (lat/long).	X	X	X	X	X	
LO	Given two positions (lat/long) and information to determine convergency between the two positions, calculate the parallel of origin.	X	X	X	X	X	
LO	Given a Lambert chart determine the parallel of origin, or constant of cone.	X	X	X	X	X	
LO	Given constant of cone or parallel of origin, great circle track at one position and great circle track at another position, calculate difference of longitude between the two positions.	X	X	X	X	X	
061 03 01 03	Polar stereographic						
LO	State that the Polar Stereographic projection is based on a plane projection, the parallel of origin is the pole.	X		X	X		
LO	State that constant of cone for the chart is 1.	X		X	X		
LO	State that chart convergency = difference of longitude.	X		X	X		
LO	State that the scale is increasing with increasing distance from the Pole.	X		X	X		
LO	Given two positions (lat/long), rhumb line true track or initial/final great circle true track, calculate the missing track angles.	X		X	X		
LO	Calculate the chart scale at a latitudes, given the chart distance from the pole to the latitude in question.	X		X	X		
LO	Calculate the chart scale at a specific latitude when difference of longitude and chart distance along the parallel of longitude are given.	X		X	X		
<b>061 03 02 00</b>	<b>The representation of meridians, parallels, great circles and rhumb lines</b>						
061 03 02 01	Direct Mercator						
LO	State that meridians are straight parallel lines, which cut parallels of latitudes at right angles.	X	X	X	X	X	
LO	State that parallels of latitude are straight lines parallel to the equator.	X	X	X	X	X	



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Syllabus reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State that a straight line on the chart is a rhumb line.	X	X	X	X	X	
LO	State that the great circle is a line convex to the nearest pole.	X	X	X	X	X	
LO	For great circle track angle calculations over short distances, the conversion angle may be calculated by the formula: Conversion angle = $\frac{1}{2} \times$ difference of longitude $\times$ sin mean latitude.	X	X	X	X	X	
LO	Given rhumb line true track between two positions (lat/long), calculate initial or final great circle true track.	X	X	X	X	X	
061 03 02 02	Lambert conformal conic						
LO	State that meridians are straight lines, which cut parallels of latitudes at right angles.	X	X	X	X	X	
LO	State that parallels of latitude are arcs of concentric circles.	X	X	X	X	X	
LO	State that great circles are curved lines concave towards the parallels of origin.	X	X	X	X	X	
LO	State that for short distances the great circle is approximately a straight line.	X	X	X	X	X	
LO	State that between the standard parallels the great circle is a straight line.	X	X	X	X	X	
061 03 02 03	Polar stereographic						
LO	State that meridians are straight lines radiating from the pole, which cut parallels of latitudes at right angles.	X		X	X		
LO	State that parallels of latitude are concentric circles, and distance apart increasing away from the pole.	X		X	X		
LO	State that great circles are approximately straight lines close to the pole. The exact great circle being concave to the pole.	X		X	X		
<b>061 03 03 00</b>	<b>The use of current aeronautical charts</b>						
061 03 03 01	Plotting positions						
LO	Enter position on a chart using range and bearing from a VOR DME station, and derive geographical coordinates.	X	X	X	X	X	X
LO	Enter positions on a chart using geographical coordinates and derive tracks and distances.	X	X	X	X	X	X

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Syllabus reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter		IR	
		ATPL	CPL	ATPL/IR	ATPL		CPL
LO	Plot DME ranges on an aeronautical chart and derive geographical coordinates.	X	X	X	X	X	X
LO	Describe the available information on the following charts. - ICAO topographical map. - VFR chart. - En route chart. - Radio facility chart. - Terminal area chart. - Standard instrument arrival chart (STAR). - Standard instrument departure chart (SID). - Instrument approach and landing chart. - Aerodrome chart.	X	X	X	X	X	X
LO	Describe the methods used to provide information on chart scale. Use the chart scales stated and be aware of the limitations of the stated scale for each projection.	X	X	X	X	X	X
061 03 03 02	Methods of indicating scale and relief						
LO	Describe methods of representing relief and demonstrate the ability to interpret data.	X	X	X	X	X	X
061 03 03 03	Conventional signs						
LO	Interpret conventional signs and symbols on ICAO and other most frequently used charts.	X	X	X	X	X	X
061 03 03 02	Measuring tracks and distances						
LO	Given two positions measure the track and the distance between them	X	X	X	X	X	X
061 03 03 03	Plotting bearings						
LO	Resolve bearings of a NDB station for plotting on an aeronautical chart.	X	X	X	X	X	X
LO	Resolve radials from VOR stations for plotting on an aeronautical chart.	X	X	X	X	X	X
<b>061 04 00 00</b>	<b>DEAD RECKONING NAVIGATION (DR)</b>						

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Syllabus reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter		IR
		ATPL	CPL	ATPL/IR	ATPL	
<b>061 04 01 00</b>	<b>Basis of dead reckoning</b>					
LO	Explain the triangle of velocities, e.g. true heading/TAS, W/V and true track/GS.	X	X	X	X	X
061 04 01 01	Track					
LO	Explain the concept of vectors including adding together or splitting in two directions.	X	X	X	X	X
061 04 01 02	Heading (compass, magnetic, true, grid)					
LO	Calculate (compass, magnetic, true, grid) heading given appropriate data.	X	X	X	X	X
061 04 01 03	Wind velocity					
LO	Calculate wind velocity given appropriate data.	X	X	X	X	X
061 04 01 04	Airspeed (IAS, CAS, TAS, Mach number)					
LO	Calculate TAS from IAS/CAS and Mach number given appropriate data.	X	X	X	X	X
061 04 01 05	Groundspeed					
LO	Calculate groundspeed given appropriate data.	X	X	X	X	X
061 04 01 06	ETA					
LO	Calculate ETA, flying time from distance and GS.	X	X	X	X	X
LO	Calculate revised directional data for heading, track, course and W/V, e.g. true, magnetic, compass and grid given appropriate data.	X	X	X	X	X
061 04 01 07	Drift, wind correction angle					
LO	Calculate Drift, wind correction angle given appropriate data.	X	X	X	X	X
<b>061 04 02 00</b>	<b>Use of the navigational computer</b>					
061 04 02 01	Speed					
LO	Given appropriate data determine speed	X	X	X	X	X
061 04 02 02	Time					

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Syllabus reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter		IR	
		ATPL	CPL	ATPL/IR	ATPL		CPL
LO	Given appropriate data determine time	X	X	X	X	X	X
061 04 02 03	Distance						
LO	Given appropriate data determine distance	X	X	X	X	X	X
061 04 02 04	Fuel consumption						
LO	Calculation of fuel used/fuel flow/flying time.	X	X	X	X	X	X
061 04 02 05	Conversions						
LO	Conversion between kilograms/ pounds/litres/U.S. gallons/Imp. Gallons.	X	X	X	X	X	X
LO	Conversion of distances. Kilometres/Nautical miles/Statute miles.	X	X	X	X	X	X
LO	Conversion of distances. Feet/metres.	X	X	X	X	X	X
LO	Conversion of volumes and weight of fuel using specific gravity.	X	X	X	X	X	X
061 04 02 06	Airspeed						
LO	Calculation of air speed problems including IAS/EAS/CAS/TAS/ and Mach number, given appropriate data	X	X	X	X	X	X
061 04 02 07	Wind velocity						
LO	Given appropriate data determine Wind velocity	X	X	X	X	X	X
061 04 02 08	True altitude						
LO	Given appropriate data determine true altitude / indicated altitude / density altitude	X	X	X	X	X	X
<b>061 04 03 00</b>	<b>The triangle of velocities</b>						

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Syllabus reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Solve problems to determine: Heading Groundspeed Wind velocity and speed Track/course Drift angle/wind correction angle Head/tail/cross wind components.	X	X	X	X	X	X
<b>061 04 04 00</b>	<b>Determination of DR position</b>						
061 04 04 01	Confirmation of flight progress (DR)						
LO	Describe the role and purpose of DR navigation.	X	X	X	X	X	
LO	Demonstrate mental DR techniques:	X	X	X	X	X	
LO	Define speed factor. Speed divided by 60, used for mental flight path calculations.	X	X	X	X	X	
LO	Calculate head/tailwind component.	X	X	X	X	X	
LO	Calculate wind correction angle (WCA) using the formula: $WCA = \frac{XWC \text{ (cross wind component)}}{SF \text{ (speed factor)}}$	X	X	X	X	X	
LO	Distance, speed and time calculations.	X	X	X	X	X	
LO	Demonstrate DR position graphically and by means of DR computer:	X	X	X	X	X	
LO	Given any four of the parts of the triangle of velocities, calculate the other two.	X	X	X	X	X	
LO	Apply the validity of wind triangle symbols correctly. Heading vector one arrow, track vector two arrows and W/V vector three arrows.	X	X	X	X	X	
061 04 04 02	Lost procedures						
LO	Describe course of action when lost.	X	X	X	X	X	
<b>061 04 05 00</b>	<b>Measurement of DR elements</b>						

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Syllabus reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter		IR
		ATPL	CPL	ATPL/IR	ATPL	
061 04 05 01	Calculation of altitude, adjustments, corrections, errors					
LO	Calculate true altitude (T ALT) given indicated altitude, airfield elevation, static air temperature (SAT)/outside air temperature (OAT) and QNH/QFE.	x	x	x	x	x
LO	Calculate indicated altitude given true altitude (T ALT), airfield elevation, static air temperature (SAT)/outside air temperature (OAT) and QNH/QFE.	x	x	x	x	x
LO	Calculate density altitude given pressure altitude and static air temperature (SAT)/outside air temperature (OAT).	x	x	x	x	x
LO	Calculate density altitude given, airfield elevation, static air temperature (SAT)/outside air temperature (OAT) and QNH/QFE.	x	x	x	x	x
061 04 05 02	Determination of temperature					
LO	Define outside air temperature (OAT)/ static air temperature (SAT). The temperature of the surrounding air.	x	x	x	x	x
LO	Define ram air temperature (RAT)/ total air temperature (TAT)/ IOAT indicated outside air temperature. The temperature measured by the temperature probe affected by friction and compressibility.	x	x	x	x	x
LO	Define ram-rise. The increase of temperature at the temperature probe due to friction and compressibility.	x	x	x	x	x
LO	$RAT (TAT, IOAT) = OAT (SAT) + \text{ram-rise.}$	x	x	x	x	x
LO	Explain the difference in using OAT/SAT compared to RAT/TAT/IOAT in airspeed calculations.	x	x	x	x	x
061 04 05 03	Determination of appropriate speed					
LO	Explain the relationship between IAS – CAS – EAS and TAS.	x	x	x	x	x
LO	Calculate TAS given IAS/CAS, OAT/SAT and pressure inputs.	x	x	x	x	x
LO	Calculate CAS given TAS, OAT/SAT and pressure inputs.	x	x	x	x	x
061 04 05 04	Determination of Mach number	x	x	x	x	x
LO	Calculate Mach number given TAS and OAT/SAT.	x	x	x	x	x

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Syllabus reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter		IR
		ATPL	CPL	ATPL/IR	ATPL	
<b>061 04 06 00</b>	<b>Measurements of Point of Equal Time and Point of Safe Return</b>					
061 04 06 01	Point of equal time					
LO	Define point of equal time. The position from which the flying time to destination point is the same as the flying time returning to departure point.	x	x	x	x	x
LO	Calculate point of equal time given total distance, wind components and appropriate speeds. Point of equal time is calculated for all engines and for engine failure on multi-engine aircraft.	x	x	x	x	x
LO	Formula: $X = D \times GS_R / (GS_R + GS_O)$ X = distance to PET D = total distance GS <sub>R</sub> = Groundspeed return GS <sub>O</sub> = Groundspeed on	x	x	x	x	x
061 04 06 02	Point of safe return					
LO	Calculate point of safe return given safe endurance, wind components and appropriate speeds.	x	x	x	x	x
LO	Define point of safe return. A position to which a flight can proceed and return from with specific reserves intact.	x	x	x	x	x
LO	Formula: $T_{PSR} = SE \times GS_R / (GS_R + GS_O)$ T <sub>PSR</sub> = time to point of safe return SE = safe endurance in minutes GS <sub>R</sub> = Groundspeed return GS <sub>O</sub> = Groundspeed out	x	x	x	x	x
<b>061 05 00 00</b>	<b>IN-FLIGHT NAVIGATION</b>					
<b>061 05 01 00</b>	<b>Use of visual observations and application to in-flight navigation</b>	x	x	x	x	x
LO	Describe what is meant by the term “map reading”.	x	x	x	x	x
LO	Define the term “visual check point”.	x	x	x	x	x
LO	Discuss the general features of a visual checkpoint and give examples.	x	x	x	x	x

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		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State that evaluating the differences between DR positions and actual position can refine the flight performance and navigation.	X	X	X	X	X	
LO	Establish fixes on navigational charts by plotting visually derived intersecting lines of position.	X	X	X	X	X	
LO	Describe the use of a single observed position line to check flight progress.	X	X	X	X	X	
LO	Describe how to prepare and align a map/chart for use in visual navigation.	X	X	X	X	X	
LO	Describe visual navigation techniques including: - Use of DR position to locate identifiable landmarks. - Identification of charted features/landmarks. - Factors affecting the selection of landmarks. - An understanding of seasonal and meteorological affects on the appearance and visibility of landmarks. - Selection of suitable landmarks. - Estimation of distance from landmarks from successive bearings. - Estimation of the distance from a landmark using an approximation of the sighting angle and the flight altitude	X	X	X	X	X	
LO	Describe the action to be taken, if there is no visual checkpoint available at a scheduled turning point.	X	X	X	X	X	
LO	Understanding the difficulties and limitations that may be encountered in map reading in some geographical areas due to nature of terrain, lack of distinctive landmarks or lack of detailed and accurate charted data.	X	X	X	X	X	
LO	State the function of contour lines on a topographical chart.	X	X	X	X	X	
LO	Indicate the role of "layer tinting" (colour gradient) in relation to the depiction of topography on a chart.	X	X	X	X	X	
LO	Using the contours shown on a chart, describe the appearance of a significant feature.	X	X	X	X	X	
LO	Understand that in areas of snow and ice from horizon to horizon and where the sky is covered with a uniform layer of clouds so that no shadows are cast, the horizon disappears, causing earth and sky to blend.	X	X	X	X	X	
<b>061 05 02 00</b>	<b>Navigation in climb and descent</b>						



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		ATPL	CPL	ATPL/IR	ATPL	
061 05 02 01	Average airspeed					
LO	Average TAS used for climb problems is calculated at the altitude 2/3 of the cruising altitude.	x	x	x	x	x
LO	Average TAS used for descent problems is calculated at the altitude ½ of the descent altitude.	x	x	x	x	x
061 05 02 02	Average wind velocity					
LO	W/V used for climb problems is W/V at the altitude 2/3 of the cruising altitude.	x	x	x	x	x
LO	W/V used for descent problems is W/V at the altitude ½ of the descent altitude.	x	x	x	x	x
LO	Calculate average climb/descent GS, given TAS at various altitudes, W/V at various altitudes and true track.	x	x	x	x	x
LO	Calculate flying time and distance during climb/descent given average rate of climb/descent and using average GS.	x	x	x	x	x
LO	Calculate rate of descent on a given glide path angle using the following formulae Rate of descent = $\frac{GS \text{ (ground speed)} \times 10}{2}$ valid for 3° glidepath Rate of descent = SF (speed factor) × glidepath angle × 100	x	x	x	x	x
LO	Given distance, speed and present altitude, calculate rate of climb/descent in order to reach a certain position at a given altitude	x	x	x	x	x
LO	Given speed, rate of climb/descent and altitude, calculate distance required in order to reach a position at a given altitude.	x	x	x	x	x
LO	Given speed, distance to go and altitude to climb/descent, calculate rate of climb/descent.	x	x	x	x	x
LO	State the effect on TAS and Mach number when climbing/descending with a constant CAS.					
061 05 02 03	Ground speed/distance covered during climb or descent					
LO	State that most aircraft operation manuals supply graphical material to calculate climb and descent problems.	x	x	x	x	x
LO	Given distance, speed and present altitude, calculate rate of climb / descent in order to reach a certain position at a given altitude	x	x	x	x	x

**JAA Administrative & Guidance Material**  
**Section Five: Licensing, Part Two: Procedures**

CHAPTER 17: DETAILED THEORETICAL KNOWLEDGE SYLLABUS AND LEARNING OBJECTIVES

Subject – 061 – General Navigation

See Appendix 1 to JAR-FCL 1.470 and JAR-FCL 2.470

Syllabus reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Given speed, rate of climb / descent and altitude, calculate distance required in order to reach a certain position at a given altitude	x	x	x	x	x	
061 05 02 04	Gradients versus rate of climb/descent						
LO	Calculate climb/descent gradient (ft/NM, % and degrees), GS or vertical speed according to the following formulae: $\frac{\text{Ground speed (kt)} \times \text{gradient (feet/NM)}}{60} = \text{vertical speed (feet/min)}$	x	x	x	x	x	
LO	Gradient in % = altitude difference (feet) x 100 / Ground difference (feet)	x	x	x	x	x	
LO	Gradient in degrees = Arctg (altitude difference (feet) / Ground distance (feet) )	x	x	x	x	x	
LO	Rate of climb/descent (feet/min) = Gradient (%) x GS (kt)	x	x	x	x	x	
LO	State that it is necessary to determine the position of the aircraft accurately before commencing descent in order to ensure safe ground clearance.	x	x	x	x	x	
<b>061 05 03 00</b>	<b>Navigation in cruising flight, use of fixes to revise navigation data</b>						
061 05 03 01	Ground speed revision						
LO	Calculate revised groundspeed to reach a waypoint at a specific time.	x	x	x	x	x	
LO	Calculate the average ground speed based on two observed fixes.	x	x	x	x	x	
LO	Calculate distance to the position passing abeam an NDB station, by timing from the position with a Relative bearing of 045/315 to the position abeam (Relative bearing 090/270).	x	x	x	x	x	
061 05 03 02	Off-track corrections						
LO	Calculate the track error angle given course from A to B and an off-course fix, using the one in sixty rule.	x	x	x	x	x	
LO	Calculate the heading change at an off-course fix to directly reach the next waypoint using the one in sixty rule.	x	x	x	x	x	
LO	Calculate the average drift angle based upon an off-course fix observation.	x	x	x	x	x	
061 05 03 03	Calculation of wind speed and direction						

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Syllabus reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter		IR
		ATPL	CPL	ATPL/IR	ATPL	
LO	Calculate average wind speed and direction based on two observed fixes.	X	X	X	X	X
061 05 03 04	ETA revisions					
LO	Calculate ETA revisions based upon observed fixes and revised ground speed.	X	X	X	X	X
<b>061 05 04 00</b>	<b>Flight Log</b>					
LO	Given relevant flight plan data calculate the missing data.	X	X	X	X	X
LO	Enter revised navigational en-route data, for the legs concerned, into the flight log. (e.g. updated wind and ground speed and correspondingly losses or gains in time and fuel consumption).	X	X	X	X	X
LO	Enter, in the progress of flight, at check point or turning point, the “actual time over” and the “estimated time over” for the next check point into the flight log.	X	X	X	X	X