Subject No 18 Flight Navigation General

Each subject has been given a subject number and each topic within that subject a topic number. These reference numbers will be used on 'knowledge deficiency reports' and will provide valuable feed back to the examination candidate.

Sub Topic	Syllabus Item
	Fundamentals of Air Navigation
18.2	**Form of the Earth**
18.2.2	Describe the general shape of the earth
18.2.4	Define and identify, on a diagram of the earth, and explain the meaning of the following: (a) axis and direction of rotation; (b) geographic poles; (c) great circles; (d) small circles; (e) rhumb lines; (f) the equator; (g) parallels of latitude; (h) meridians of longitude; (i) Greenwich (Prime) Meridian; (j) position.
18.4	**Direction on the Earth**
18.4.2	Describe the 360º method of indicating direction.
18.4.4	Describe the earth's magnetic field.
18.4.6	Define: (a) magnetic pole; (b) true north; (c) magnetic north; (d) compass north; (e) the cardinal directions of the earth; (f) the quadrantal directions of the earth;

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	(g) true direction;
	(h) magnetic direction;
	(i) compass direction;
	(j) magnetic variation;
	(k) an isogonal;
	(l) compass deviation;
	(m) true bearing;
	(n) magnetic bearing;
	(o) compass bearing;
	(p) relative bearing;
	(q) back bearing.
18.4.8	Convert between true, magnetic and compass directions.
18.4.10	Convert between relative, true, magnetic and compass bearings.
18.4.12	Plot and measure tracks and bearings (± 1º) on a current published NZ Aeronautical Chart.
18.6	**Distance on the Earth**
18.6.2	Define a:
	(a) statute mile;
	(b) nautical mile (nm);
	(c) kilometre.
18.6.4	Calculate the conversion between a statute mile, a nautical mile and a kilometre.
18.6.6	Measure distances (± 1nm) on a current published NZ Aeronautical Chart.
18.8	**Speed**
18.8.2	Define:
	(a) a knot.
	(b) ground speed (GS);
	(c) indicated airspeed (IAS);
	(d) calibrated airspeed (CAS);

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	(e) equivalent airspeed (EAS);
	(f) true airspeed (TAS).
18.10	**Position Referencing**
18.10.2	Define a:
	(a) ground position;
	(b) air position;
	(c) DR position;
	(d) waypoint (WPT);
	(e) pinpoint;
	(f) fix; and,
	(g) position line.
18.10.4	Describe and apply the following position reference methods:
	(a) place name;
	(b) bearing and distance;
	(c) latitude and longitude;
18.10.6	Plot and reference a position (± 0.5 of a minute) on a current published NZ Aeronautical Chart.
18.10.8	Calculate the relative bearing of a position from an aircraft.
18.10.10	Calculate the bearing of an aircraft from a position.
18.12	**Altimetry**
18.12.2	Define:
	(a) height;
	(b) altitude;
	(c) mean sea level (MSL);
	(d) ground level;
	(e) elevation;
	(f) indicated altitude;
	(g) calibrated altitude;

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	(h) true altitude;
	(i) pressure altitude (PA);
	(j) density altitude (DA);
	(k) flight level (FL);
	(l) transition altitude;
	(m) transition level;
	(n) transition layer;
	(o) QNH;
	(p) QFE;
	(q) QNE.
18.12.4	Explain the effect of a change in mean sea level air pressure on the altimeter reading of a transiting aircraft.
18.12.6	State and apply the altimeter setting rules in New Zealand.
18.12.8	Explain and apply the table of cruising levels.
18.12.10	Explain how true and indicated altitudes are affected by changes in air pressure and air temperature.
18.14	**Principles and Terminology**
18.14.2	Define:
	(a) *track required;
	(b) true and magnetic track;
	(c) *wind velocity (W/V);
	(d) *wind angle;
	(e) *wind correction angle (WCA);
	(f) *head/tail wind;
	(g) *cross wind;
	(h) *true heading;
	(i) *magnetic heading;
	(j) *compass heading;
	(k) *drift (planned & actual);

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	(l) *track / TMG;
	(m) *port;
	(n) *starboard;
	(o) *dead (deduced) reckoning;
	(p) track error (TE);
	(q) *closing angle (CA);
	(r) estimated time of departure (ETD);
	(s) actual time of departure (ATD);
	(t) estimated elapsed time (EET) / estimated time interval (ETI);
	(u) estimated time of arrival (ETA);
	(v) actual time of arrival (ATA).
18.14.4	Explain and apply the 1:60 rule.
18.14.6	Calculate the values marked with an * in Syllabus Item 18.14.2.
18.16	**Time**
18.16.2	Describe the six and ten figure systems of indicating date/time groups.
18.16.4	Explain the relationship between time and longitude.
18.16.6	Convert between arc and time.
18.16.8	Define Local Mean Time (LMT).
18.16.10	Calculate the LMT at a given location.
18.16.12	Define:
	(a) Co-ordinated Universal Time (UTC);
	(b) Standard Time (NZST);
	(c) Daylight Time (NZDT);
	(d) The International Dateline.
18.16.14	Convert between LMT; UTC; NZST; and/or NZDT.
18.18	**Twilight**
18.18.2	Define:
	(a) sunrise;

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	(b) sunset;
	(c) daylight;
	(d) twilight;
	(e) morning civil twilight (MCT);
	(f) evening civil twilight (ECT).
18.18.4	Describe the factors that affect the times of sunrise and sunset (daylight).
18.18.6	Describe the factors that affect the duration of twilight.
18.18.8	Describe the factors that affect daylight conditions.
18.18.10	Derive or calculate the MCT and ECT at a given location.
18.20	**Triangle of Velocities**
18.20.2	Identify and label the three vectors of the triangle of velocities.
18.20.4	Using a navigation computer, solve triangle of velocity problems (given four of the six variables):
	(a) heading and track (± 2º);
	(b) TAS and GS (± 2kts);
	(c) wind velocity (± 3º/± 3kts);
	(d) drift (±1º).
18.22	**Aeronautical Maps and Charts**
18.22.2	Properties and Principles of aeronautical maps and charts.
18.22.4	Explain the difficulties associated with representing a spherical shape on a flat surface.
18.22.6	Reserved
18.22.8	List the ideal properties of an aeronautical chart.
18.22.10	Describe the process of creating:
	(a) a Mercator projection; and,
	(b) a Lambert's conformal projection.
18.22.12	List and explain the properties of:
	(a) a Mercator projection; and,
	(b) a Lambert's conformal projection.

Sub Topic	Syllabus Item
18.22.14	List and explain the uses of: (a) a Mercator projection; (b) a Lambert's conformal projection; (c) a NZ Visual Planning Chart (VPC); (d) a NZ Visual Navigation Chart (VNC); (e) the Aerodrome Chart.
18.22.16	Calculate earth distance and chart distance, given scale and one factor.
18.22.18	Calculate chart scale, given earth distance and chart distance.
18.24	**Map Reading**
18.24.2	Interpret the features and symbols of a NZ Visual Navigation Chart (VNC).
18.24.4	Describe the method of indicating relief on a NZ Visual Navigation Chart (VNC).
18.24.6	Interpret information from Aerodrome Charts and Operational Data pages in the AIPNZ Vol 4.
18.26	**Circular Slide Rule**
18.26.2	Computations of circular slide rules.
18.26.4	Derive or compute TAS, given IAS, pressure altitude and air temperature in degrees Celsius.
18.26.6	Solve mathematical equations: (a) multiplication (±2%); (b) division (±2%); (c) proportion (±2%).
18.26.8	Calculate time, speed, or distance, given two factors.
18.26.10	Calculate fuel consumption, given the burn rate and time.
18.26.12	Calculate fuel burn rate, given the consumption and time.
18.26.14	Calculate fuel endurance, given the fuel quantity and burn rate.
18.26.16	Convert between: (a) degrees Fahrenheit and Celsius; (b) nautical miles, statute miles and kilometres (±1%);

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	(c) metres and feet (±2%);
	(d) pounds and kilograms (±2%);
	(e) litres, imperial and US gallons (±2%),
	(f) a volume of fuel (in litres, imperial or US gallons) and a volume of fuel (in pounds or kilograms). (±2%)
18.28	**Triangle of Velocities**
18.28.2	Using graphs or vector diagrams to solve triangle of velocity problems:
	(a) heading and track (± 2º);
	(b) TAS and GS (± 2kts);
	(c) wind velocity (± 3º/± 3kts);
	(d) drift (±1º).
18.30	**Flight Planning**
18.30.2	Route Selection
18.30.4	List the factors to be considered when selecting a VFR cross-country navigation route.
18.30.6	List the factors to be considered when selecting altitudes at which to fly in the cruise.
18.30.8	List the factors to be considered when selecting alternate routes and destination alternates.
18.32	**Map Preparation**
18.32.2	Mark the following on a map:
	(a) departure aerodrome, turning points, and destination aerodrome;
	(b) tracks;
	(c) heading change markings, either 1:60 or driftlines;
	(d) ETA amendment markings.
18.34	**Plan Preparation**
18.34.2	Complete a navigation log / flight plan for a VFR cross-country, including calculating the following values:
	(a) top of climb point;
	(b) level cruise portion;

Sub Topic	Syllabus Item
	(c) top of descent point;
	(d) TASs;
	(e) tracks;
	(f) estimated wind velocities;
	(g) estimated temperatures;
	(h) headings;
	(i) groundspeeds;
	(j) distances;
	(k) EETs;
	(l) ETAs;
	(m) fuel consumption rates;
	(n) leg fuels.
18.36	**Fuel Planning**
18.36.2	Derive, from an Aircraft Flight Manual, the fuel consumption rate for a given leg.
18.36.4	Calculate the expected fuel burn on a given leg.
18.36.6	Calculate the minimum fuel required on a given VFR cross-country flight.
18.36.8	State the legal minimum fuel reserves required on a VFR cross-country flight.
18.36.10	Calculate the maximum holding time available for a given leg.
18.36.12	Calculate the latest time of departure for a given VFR cross-country flight or a given leg.
18.38	**Load Planning**
18.38.2	Calculate the take-off weight of a given aircraft on a VFR flight.
18.38.4	Calculate the landing weight of a given aircraft on a VFR flight.
18.38.6	Calculate the position of the Centre of Gravity of a given aircraft on a VFR flight.
18.38.8	Calculate the available payload of a given aircraft on a VFR flight.
	Visual Navigation Procedures
18.40	**Flight Management**

Sub Topic	Syllabus Item
18.40.2	Describe the techniques and procedures for: (a) setting heading; (b) cruise routine / activity cycle; (c) maintaining a flight log; (d) turning points; (e) approaching / rejoining at a destination aerodrome.
18.40.4	Describe the techniques for map reading in flight.
18.40.6	Describe techniques for: (a) pinpointing; (b) changing heading to make good the desired track; (c) changing heading to make good next turning point or destination; (d) amending ETA.
18.40.8	Estimate and calculate a heading to make good a reciprocal track.
18.40.10	Estimate and calculate an aircraft's position given bearing and distance from an identified ground position.
18.40.12	Calculate the maximum holding duration overhead an aerodrome prior to diversion to an alternate.
18.40.14	Using a crosswind graph, calculate headwind and crosswind, given reported wind and runway alignment.
18.42	**Special Procedures**
18.42.2	Describe the techniques, requirements, and procedures for: (a) re-establishing position if lost or unsure of position; (b) diverting from the pre-planned route; (c) navigating at low level when forced to do so by bad weather. (d) amending SARTIMES
	Radio Aids in Support of VFR Operations
18.44	**Automatic Direction Finder (ADF)**
18.44.2	Describe the function of the ADF needle on a fixed card indicator.
18.44.4	Describe the purpose of each control on the ADF control panel.

Sub Topic	Syllabus Item
18.44.6	List the publications and charts that show NDB callsigns and frequencies.
18.44.8	Explain why it is important to check the NDB ident before using an NDB.
18.44.10	Explain what is meant by relative bearing.
18.44.12	Given an aircraft magnetic heading and a relative bearing, calculate: (a) magnetic bearing to an NDB; (b) magnetic bearing from an NDB
18.44.14	Describe the track followed by an aircraft experiencing a crosswind when the ADF needle is kept on the 360°R position.
18.44.16	Explain how the ADF can be used to maintain track with drift correction applied: (a) when tracking to an NDB; (b) when tracking away from an NDB.
18.44.18	Explain the importance of Variation when using a NZ Visual Navigation Chart (VNC) to maintain a track with reference to the ADF.
18.44.20	Identify aircraft position relative to NDB or NDBs.
18.46	**VOR**
18.46.2	Explain the importance of station identification before using the VOR.
18.46.4	List the publications and charts that show VOR callsigns and frequencies.
18.46.6	Describe what is meant by a (VOR) radial.
18.46.8	Explain: (a) the effect of mountainous terrain on VOR reception; (b) the means whereby reception can be improved.
18.46.10	Describe how the VOR receiver can be used to: (a) establish orientation of the aircraft to and from a VOR station; (b) maintain a required track to a VOR station; (c) maintain a required track from a VOR station.
18.46.12	State the behaviour of the course deviation indicator (CDI) while the aircraft is off the selected radial, and the HDG °M and OBS selection are: (a) within 90° of each other; (b) more than 90° apart.

Sub Topic	Syllabus Item
18.46.14	State the orientation of the CDI while maintaining the required radial when drift correction is being applied.
18.46.16	Identify aircraft position relative to a VOR station or stations.
18.48	**Distance Measuring Equipment (DME)**
18.48.2	State the primary function of the DME.
18.48.4	State or explain: (a) the effect of mountainous terrain on DME range of reception; (b) the method whereby range of reception can be increased.
18.48.6	Explain the importance of station identification before using the DME.
18.48.8	Explain how to engage the DME: (a) when the aid is coupled to a VOR; (b) when the aid is not coupled to a VOR.
18.50	**Global Positioning System**
18.50.2	Explain the importance of using GPS only to supplement normal visual navigation.
18.50.4	Explain the precautions to be taken when: (a) inserting data with the keypad; (b) operating/reading the unit while maintaining a proper lookout; (c) operating/reading the unit in marginal weather conditions.
18.50.6	State the factors influencing GPS reliability.
18.52	**Radar**
18.52.2	State the two types of radar currently used in New Zealand.
18.52.4	Describe the principle of operation of each type of radar.
18.52.6	Explain what is meant by transponder Mode A and Mode C.
18.52.8	List and explain four radar services that may be available to VFR flights.
18.54	**Enroute Diversion Calculations**
18.54.2	Define: (a) point of no return (PNR); (b) equi-time point (ETP).

Sub Topic	Syllabus Item
18.54.4	Calculate: (a) time and distance to the point of no return (PNR); (b) time and distance to the equi-time point (ETP).