

**Subject No 6            Air Navigation and Flight Planning**

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****6.2                    Form of the Earth**

6.2.2                Describe the general shape of the earth.

6.2.4                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.

**6.4                    Direction on the Earth**

6.4.2                Describe the 360° method of indicating direction.

6.4.4                Describe the earth's magnetic field.

6.4.6                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;
- (g) true direction;
- (h) magnetic direction;

**Sub Topic      Syllabus Item**

- (i) compass direction;
- (j) magnetic variation;
- (k) an isogonal;
- (l) compass deviation;
- (m) true bearing;
- (n) magnetic bearing;
- (o) compass bearing,;
- (p) relative bearing.

6.4.8            Convert between true, magnetic and compass directions.

6.4.10          Convert between relative, true, magnetic and compass bearings.

6.4.12          Plot and measure tracks and bearings ( $\pm 1^\circ$ ) on a NZ Aeronautical Chart.

**6.6            Distance on the Earth**

6.6.2           Define a:

- (a) statute mile;
- (b) nautical mile (nm);
- (c) kilometre.

6.6.4           Calculate the conversion between a statute mile, a nautical mile and a kilometre.

6.6.6           State the number of feet and metres in a statute mile, a nautical mile and a kilometre.

6.6.8           Measure distances ( $\pm 1\text{nm}$ ) on a NZ Aeronautical Chart.

**6.8            Speed**

6.8.2           Define:

- (a) a knot.
- (b) ground speed (GS);
- (c) indicated airspeed (IAS);
- (d) calibrated airspeed (CAS);
- (e) true airspeed (TAS).

**6.10          Position Referencing**

6.10.2          Define a:

- (a) ground position;

- | <b>Sub Topic</b> | <b>Syllabus Item</b>   |
|------------------|--|
|                  | (b) air position;  |
|                  | (c) DR position;   |
|                  | (d) pinpoint;  |
|                  | (e) fix.   |
| 6.10.4           | Describe and apply the following position reference methods:   |
|                  | (a) place name;  |
|                  | (b) bearing and distance;  |
|                  | (c) latitude and longitude.  |
| 6.10.6           | Calculate the relative bearing of a position from an aircraft.   |
| 6.10.8           | Calculate the bearing of an aircraft from a position.  |
| <b>6.12</b>      | <b>Altimetry</b>   |
| 6.12.2           | Define:  |
|                  | (a) height;  |
|                  | (b) altitude;  |
|                  | (c) mean sea level (MSL);  |
|                  | (d) ground level;  |
|                  | (e) elevation;   |
|                  | (f) pressure altitude (PA);  |
|                  | (h) QNH;   |
| 6.12.4           | Explain the effect of a change in mean sea level air pressure on the altimeter reading of a transiting aircraft. |
| 6.12.6           | State and apply the altimeter setting rules in New Zealand.  |
| 6.12.8           | Explain and apply the table of cruising levels.  |
| <b>6.14</b>      | <b>Principles and Terminology</b>  |
| 6.14.2           | Define:  |
|                  | (a) true and magnetic track / course;  |
|                  | (b) wind velocity (W/V);   |
|                  | (c) *head/tail wind;   |
|                  | (d) *cross wind;   |
|                  | (e) true heading;  |

<b>Sub Topic</b>	<b>Syllabus Item</b>
	(f) *magnetic heading;
	(g) *compass heading;
	(h) *drift (planned & actual);
	(i) *track / course made good (TMG / CMG);
	(j) port;
	(k) starboard;
	(l) dead (deduced) reckoning;
	(m) *track error (TE);
	(n) *closing angle (CA);
	(o) *estimated time of departure (ETD);
	(p) actual time of departure (ATD);
	(q) *estimated elapsed time (EET);
	(r) *estimated time of arrival (ETA);
	(s) actual time of arrival (ATA).
6.14.4	Explain and apply the 1:60 rule.
6.14.6	Calculate the values marked with an * in Syllabus Item 6.14.2.
<b>6.16</b>	<b>Time</b>
6.16.2	Describe the six figure systems of indicating date/time groups.
6.16.4	Define: (a) Coordinated Universal Time (UTC); (b) Standard Time (NZST); (c) Daylight Time (NZDT).
6.16.6	Calculate ETD and ETA in UTC given planned flight time details and reference time in NZST and/or NZDT.
<b>6.18</b>	<b>Triangle of Velocities</b>
6.18.2	Identify and label the three vectors of the triangle of velocities.
6.18.4	Using a navigation computer, solve triangle of velocity problems (given four of the six variables): (a) heading and track ( $\pm 2^\circ$ ); (b) TAS and GS ( $\pm 2$ kts);

**Sub Topic      Syllabus Item**

- (c) wind velocity ( $\pm 3^\circ \pm 3$  kts);
- (d) drift ( $\pm 1^\circ$ ).

**Aeronautical Maps and Charts****6.20      Properties and Principles**

- 6.20.2 Explain the difficulties associated with representing a spherical shape on a flat surface.
- 6.20.4 Define scale
- 6.20.6 List the uses of
  - (a) a NZ Aeronautical Chart;
  - (b) the Aerodrome Chart.

**6.22      Map Reading**

- 6.22.2 Interpret the features and symbols of a NZ Aeronautical Chart.
- 6.22.4 Describe the method of indicating relief on a NZ Aeronautical Chart.
- 6.22.6 Interpret information from Aerodrome Charts and Operational Data pages in the AIPNZ Volume 4.

**Circular Slide Rule****6.24      Computations**

- 6.24.2 Derive TAS, given IAS, pressure altitude and air temperature in degrees Celsius.
- 6.24.4 Solve mathematical equations:
  - (a) multiplication ( $\pm 2\%$ );
  - (b) division ( $\pm 2\%$ ); and,
  - (c) proportion ( $\pm 2\%$ ).
- 6.24.6 Derive time, speed, or distance, given two factors.
- 6.24.8 Calculate time and distance to climb, given groundspeed, rate of climb and height to climb.
- 6.24.10 Calculate rate of descent required to achieve a given height loss over time.
- 6.24.12 Calculate fuel consumption, given the burn rate and time.
- 6.24.14 Calculate fuel burn rate, given the consumption and time.
- 6.24.16 Calculate fuel endurance, given the fuel quantity and burn rate.
- 6.24.18 Convert between:
  - (a) degrees Fahrenheit and Celsius;

**Sub Topic      Syllabus Item**

- (b) nautical miles, statute miles and kilometres ( $\pm 1\%$ );
- (c) metres and feet ( $\pm 2\%$ );
- (d) pounds and kilograms;
- (e) litres, imperial and US gallons,
- (f) a volume of fuel (in litres, imperial or US gallons) and a volume of fuel (in pounds or kilograms).

**Mental Dead (Deduced) Reckoning****6.26      In-flight Revisions**

## 6.26.2      Mentally estimate:

- (a) a heading change, using the 1:60 rule ( $\pm 2^\circ$ );
- (b) a heading change, using driftlines ( $\pm 2^\circ$ );
- (c) a heading to make good a reciprocal track;
- (d) an ETA change, using proportional division;
- (e) the effect of inaccuracies in heading speed and height;
- (f) navigation in conditions of limited visibility.

**Flight Planning****6.28      Route Selection**

6.28.2      List the factors to be considered when selecting a VFR cross-country navigation route.

6.28.4      List the factors to be considered when selecting altitudes at which to fly in the cruise.

6.28.6      List the factors to be considered when selecting alternate routes and destination alternates.

**6.30      Map Preparation**

6.30.2      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.

6.30.4      Fold a map in a manner appropriate for a VFR cross-country flight.

**Sub Topic      Syllabus Item****6.32            Plan Preparation**

6.32.2          Complete a navigation log / flight plan for a VFR cross-country, including calculating the following values:

- (a) TASs;
- (b) tracks;
- (c) estimated wind velocities;
- (d) headings;
- (e) groundspeeds;
- (f) distances;
- (g) EETs;
- (h) ETAs;

**6.34            Fuel Planning**

6.34.2          Derive, from an Aircraft Flight Manual, the fuel consumption rate for a given leg.

6.34.4          Calculate the expected fuel burn on a given leg.

6.34.6          Calculate the minimum fuel required on a given VFR cross-country flight.

6.34.8          State the legal minimum fuel reserves required on a VFR cross-country flight.

6.34.10         Calculate the maximum holding time available for a given leg.

6.34.12         Calculate the latest time of departure for a given VFR cross-country flight or a given leg.

**6.36            Load Planning**

6.36.2          Calculate the take-off weight of a given aircraft on a VFR flight.

6.36.4          Calculate the landing weight of a given aircraft on a VFR flight.

6.36.6          Calculate the position of the Centre of Gravity of a given aircraft on a VFR flight.

6.36.8          Calculate the available payload of a given aircraft on a VFR flight.

**Visual Navigation Procedures****6.38            Flight Management**

6.38.2          Describe the techniques and procedures for:

- (a) setting heading;
- (b) cruise routine / activity cycle;
- (c) maintaining a flight log;

<b>Sub Topic</b>	<b>Syllabus Item</b>
	(d) turning points;
	(e) approaching / rejoining at a destination aerodrome.
6.38.4	Describe the techniques for map reading in flight.
6.38.6	Describe techniques for: <ul style="list-style-type: none"><li>(a) pinpointing;</li><li>(b) changing heading to make good the desired track;</li><li>(c) changing heading to make good next turning point or destination;</li><li>(d) amending ETA.</li></ul>
6.38.8	Estimate and calculate a heading to make good a reciprocal track.
6.38.10	Estimate and calculate an aircraft's position given bearing and distance from an identified ground position.
<b>6.40</b>	<b>Special Procedures</b>
6.40.2	Describe the techniques and procedures for: <ul style="list-style-type: none"><li>(a) re-establishing position if lost;</li><li>(b) diverting from the pre-planned route;</li><li>(c) navigating at low level when forced to do so by bad weather.</li></ul>