

## Toetsmatrijs PPL Navigation + Flight planning and monitoring

In deze toetsmatrijs staat wat u moet kunnen en kennen. De toetsmatrijs vormt daarom de basis van de opleiding en het examen.

<b>Opgesteld door:</b>	<b>CBR divisie CCV</b>
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Categoriecode:	LVPAPNV (PPLA, LAPLA) en LVPHPNV (PPLH, LAPLH)
Toetsvorm:	Digitaal
Totaal aantal vragen:	18 meerkeuzevragen
Cesuur:	75% (14 van de 18 vragen goed)
Bijzonderheden:	Geen

Nr	Eindtermen
<b>060 00 00 00</b>	<b>NAVIGATION</b>
<b>061 00 00 00</b>	<b>General Navigation</b>
061 01 00 00	Basics of navigation
061 02 00 00	Visual Flight Rule (VFR) Navigation
061 03 00 00	Great circles and rhumb lines
061 04 00 00	Charts
061 05 00 00	Time
<b>062 00 00 00</b>	<b>Radio Navigation</b>
062 01 00 00	Basic radio propagation theory
062 02 00 00	Radio Aids
062 03 00 00	Radar
062 06 00 00	Global navigation satellite systems (GNSSs)
<b>030 00 00 00</b>	<b>FLIGHT PERFORMANCE AND PLANNING</b>
<b>033 00 00 00</b>	<b>Flight planning and monitoring</b>

033 01 00 00	Flight planning for VFR Flights
033 03 00 00	Fuel planning
033 04 00 00	Pre-flight preparation
033 05 00 00	ICAO Flight plan (ATS Flight plan)
033 06 00 00	Flight monitoring and in-flight re-planning

<b>Vastgesteld door:</b>	Technische Commissie Navigation + Flight planning and monitoring
<b>Beoordeeld door:</b>	Logistiek, Transport en Personenvervoer raad; kamer 3: Luchtvaart <14 september 2018>
<b>Goedgekeurd door:</b>	Divisiemanager CCV <17 september 2018>
<b>Ingangsdatum:</b>	<1 april 2019>

### **Toelichting**

Eindtermen: Dit zijn de hoofdonderwerpen die in het examen voorkomen. Hierin staat 'ruim' omschreven wat er in het examen terug kan komen.

Toetstermen: Dit zijn onderdelen van een eindterm. Hierin staat meer uitgebreid omschreven wat er in het examen terug kan komen.

Tax: Dit is de taxonomiecode van Romiszowski. Deze code geeft aan op welk niveau de vragen over een toetsterm gesteld worden.

F = Feitelijke kennis. De kandidaat kan feiten reproduceren (herkennen of herinneren).

B = Begripsmatige kennis. De kandidaat kan begrippen of principes omschrijven.

R = Reproductieve vaardigheden. De kandidaat kan acties uitvoeren die volgens een vastgelegde procedure verlopen.

P = Productieve vaardigheden. De kandidaat kan acties uitvoeren waarbij hij zijn eigen creativiteit en inzicht nodig heeft.

		Tax	PPLA	PPLH
<b>Eind- en toetstermen</b>				
<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 earth</b>			
<b>061 01 01 01</b>	<b>Form</b>			
(01)	State that the geoid is an irregular shape based on the surface of the oceans influenced only by gravity and centrifugal force.	F	X	X
(02)	State that WGS-84 is the reference ellipsoid required for geographical coordinates.	F	X	X
<b>061 01 01 02</b>	<b>Earth rotation</b>			
(01)	Describe the rotation of the Earth around its own spin axis and the plane of the ecliptic (including the relationship of the spin axis to the plane of the ecliptic).	B	X	X
(02)	Explain the effect that the inclination of the Earth's spin axis has on insolation and duration of daylight.	B	X	X
<b>061 01 02 00</b>	<b>Position</b>			
<b>061 01 02 01</b>	<b>Position reference system</b>			
(01)	State that geodetic latitude and longitude is used to define a position on the WGS-84 ellipsoid.	F	X	X
(02)	Define geographic (geodetic) latitude and parallels of latitude.	F	X	X
(03)	Calculate the difference in latitude between any two given positions.	R	X	X
(04)	Define geographic (geodetic) longitude and meridians.	F	X	X
(05)	Calculate the difference in longitude between any two given positions.	R	X	X
<b>061 01 03 00</b>	<b>Direction</b>			
<b>061 01 03 01</b>	<b>Datums</b>			
(01)	Define 'true north' (TN).	F	X	X
(02)	Measure a true direction on any given aeronautical chart.	R	X	X
(03)	Define 'magnetic north' (MN).	F	X	X
(04)	Define and apply variation.	F	X	X
(05)	Explain changes of variation with time and position.	B	X	X
(06)	Define 'compass north' (CN).	F	X	X
(07)	Apply deviation.	R	X	X

<b>Eind- en toetstermen</b>		<b>Tax</b>	<b>PPLA</b>	<b>PPLH</b>
<b>061 01 03 02</b>	<b>Track and heading</b>			
(01)	Calculate XWC by: — trigonometry; and — MDR (Mental Dead Reckoning)	R	X	X
(02)	Explain and apply the concepts of drift and WCA.	B	X	X
(03)	Calculate the actual track with appropriate data of heading and drift.	R	X	X
(04)	Calculate TKE with appropriate data of WCA and drift.	R	X	X
(05)	Calculate the heading change at an off-course fix to directly reach the next waypoint using the 1:60 rule.	R	X	X
<b>061 01 04 00</b>	<b>Distance</b>			
<b>061 01 04 01</b>	<b>WGS-84 ellipsoid</b>			
(01)	State that 1 NM is equal to 1.852 km, which is the average distance of 1' of latitude change on the WGS-84 ellipsoid.	F	X	X
(02)	State that 1' of longitude change at the equator on the WGS-84 ellipsoid is approximately equal to 1 NM.	F	X	X
<b>061 01 04 02</b>	<b>Units</b>			
(01)	Convert between units of distance (nautical mile (NM), kilometre (km), statute mile (SM), feet (ft)).	B	X	X
<b>061 01 04 03</b>	<b>Graticule distances</b>			
(01)	Calculate the distance between positions on the same meridian and calculate new longitude when given distances north- south.	R	X	X
<b>061 01 05 00</b>	<b>Speed</b>			
<b>061 01 05 01</b>	<b>True airspeed (TAS)</b>			
(01)	Calculate TAS from CAS, and CAS from TAS by: — mechanical computer; and — rule of thumb (2 % per 1 000 ft).	R	X	X
<b>061 01 05 03</b>	<b>CAS/TAS relationship</b>			
(01)	Deduce CAS and TAS in climb/descent/cruise (flying at constant CAS).	B	X	X
<b>061 01 05 04</b>	<b>Ground speed (GS)</b>			
(01)	Calculate headwind component (HWC) and tailwind component (TWC) by: — trigonometry; and — MDR.	R	X	X
(02)	Apply HWC and TWC to determine GS from TAS and vice versa.	R	X	X

<b>Eind- en toetstermen</b>		<b>Tax</b>	<b>PPLA</b>	<b>PPLH</b>
(03)	Explain the relationship between GS and TAS with increasing WCA.	B	X	X
(04)	Calculate GS with: — mechanical computer (TOV solution); and — MDR (given track, TAS and WV).	R	X	X
(05)	Perform GS, distance and time calculations.	B	X	X
<b>061 01 06 00</b>	<b>Triangle of velocities (TOV)</b>			
<b>061 01 06 01</b>	<b>Construction</b>			
(01)	Draw and correctly label the TOV.	R	X	X
<b>061 01 06 02</b>	<b>Solutions</b>			
(01)	Resolve the TOV for: — heading and GS; — WV; — track and GS	R	X	X
<b>061 01 07 00</b>	<b>Dead reckoning (DR)</b>			
<b>061 01 07 01</b>	<b>Dead reckoning (DR) technique</b>			
(01)	Determine a DR position.	R	X	X
(02)	Evaluate the difference between a DR and a fix position.	R	X	X
<b>061 02 00 00</b>	<b>Visual flight rule (vfr) navigation</b>			
<b>061 02 01 00</b>	<b>Ground features</b>			
<b>061 02 01 01</b>	<b>Ground features</b>			
(01)	Recognise which elements would make a ground feature suitable for use for VFR navigation.	R	X	X
<b>061 02 01 02</b>	<b>Visual identification</b>			
(01)	Describe the problems of VFR navigation at lower levels and the causes of reduced visibility.	B	X	X
(02)	Describe the problems of VFR navigation at night.	B	X	X
<b>061 02 02 00</b>	<b>VFR navigation techniques</b>			
<b>061 02 02 01</b>	<b>Use of visual observations and application to in-flight navigation</b>			
(03)	Discuss the general features of a visual checkpoint and give examples.	B	X	X

<b>Eind- en toetstermen</b>		<b>Tax</b>	<b>PPLA</b>	<b>PPLH</b>
(04)	State that the evaluation of the differences between DR positions and actual position can refine flight performance and navigation.	F	X	X
(05)	Establish fixes on navigational charts by plotting visually derived intersecting lines of position.	R	X	X
(06)	Describe the use of a single observed position line to check flight progress.	B	X	X
(08)	Describe visual-navigation techniques including: <ul style="list-style-type: none"> <li>— use of DR position to locate identifiable landmarks;</li> <li>— identification of charted features/landmarks;</li> <li>— factors affecting the selection of landmarks;</li> <li>— an understanding of seasonal and meteorological effects on the appearance and visibility of landmarks;</li> <li>— selection of suitable landmarks;</li> </ul>	B	X	X
(10)	Understand the difficulties and limitations that may be encountered in map reading in some geographical areas due to the nature of terrain, lack of distinctive landmarks, or lack of detailed and accurate charted data.	B	X	X
(11)	State the function of contour lines on a topographical chart.	F	X	X
(12)	Indicate the role of 'layer tinting' (colour gradient) in relation to the depiction of topography on a chart.	B	X	X
(13)	Using the contours shown on a chart, describe the appearance of a significant feature.	B	X	X
(14)	Apply the techniques of DR, map reading, orientation, timing and revision of ETAs and headings.	R	X	X
<b>061 02 02 02</b>	<b>Unplanned events</b>			
(01)	Explain what needs to be considered in case of diversion, when unsure of position and when lost.	B	X	X
<b>061 03 00 00</b>	<b>Great circles and rhumb lines</b>			
<b>061 03 01 00</b>	<b>Great circles</b>			
<b>061 03 01 01</b>	<b>Properties</b>			
(01)	Describe the geometric properties of a great circle and a small circle.	B	X	X
(03)	State that a great-circle route is the shortest distance between any two positions on the Earth.	F	X	X
(04)	Name examples of great circles on the surface of the Earth.	F	X	X
<b>061 03 01 02</b>	<b>Convergence</b>			
(01)	Explain why the track direction of a great-circle route (other than following a meridian or the equator) changes.	B	X	X
<b>061 03 02 00</b>	<b>Rhumb lines</b>			
<b>061 03 02 01</b>	<b>Properties</b>			

		Tax	PPLA	PPLH
<b>Eind- en toetstermen</b>				
(01)	Describe the geometric properties of a rhumb line.	B	X	X
(02)	State that a rhumb-line route is not the shortest distance between any two positions on the Earth (excluding meridians and equator).	F	X	X
<b>061 04 00 00</b>	<b>Charts</b>			
<b>061 04 01 00</b>	<b>Chart requirements</b>			
<b>061 04 01 01</b>	<b>ICAO Annex 4 'Aeronautical Charts'</b>			
(01)	State the requirement for conformality and for a straight line to approximate a great circle.	F	X	X
<b>061 04 01 03</b>	<b>Scale</b>			
(01)	Recognise methods of representing scale on aeronautical charts.	B	X	X
(02)	Perform scale calculations based on typical en-route chart scales.	R	X	X
<b>061 04 02 00</b>	<b>Projections</b>			
<b>061 04 02 01</b>	<b>Methods of projection</b>			
(01)	Identify cylindrical and conical projections.	R	X	X
<b>061 04 02 03</b>	<b>Direct Mercator</b>			
(01)	State the properties of a direct Mercator projection.	F	X	X
(p01)	State that the scale increases with increasing distance from the Equator.	F	X	X
<b>061 04 02 04</b>	<b>Lambert</b>			
(01)	State the properties of a Lambert projection.	F	X	X
(03)	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; — the scale within the standard parallels differs by less than 1 % from the scale stated on the chart.	B	X	X
<b>061 04 03 00</b>	<b>Practical use</b>			
<b>061 04 03 01</b>	<b>Symbology</b>			
(01)	Recognise ICAO Annex 4 symbology, and the symbology on the Aeronautical chart 1:500.000 The Netherlands (published by LVNL).	F	X	X
<b>061 04 03 02</b>	<b>Plotting</b>			
(01)	Measure tracks and distances on VFR charts.	R	X	X



		Tax	PPLA	PPLH
<b>Eind- en toetstermen</b>				
(02)	Fix the aircraft position on an en-route chart with information from VOR and DME equipment.	R	X	X
<b>061 05 00 00</b>	<b>Time</b>			
<b>061 05 01 00</b>	<b>Local Mean Time (LMT)</b>			
<b>061 05 01 01</b>	<b>Mean solar day</b>			
(01)	Explain the concepts of a mean solar day and LMT.	B	X	X
<b>061 05 01 02</b>	<b>Local Mean Time (LMT) and Universal Time Coordinated (UTC)</b>			
(01)	Perform LMT and UTC calculations.	R	X	X
<b>061 05 02 00</b>	<b>Standard time</b>			
<b>061 05 02 01</b>	<b>Standard time and daylight saving time</b>			
(01)	Explain and apply the concept of standard time and daylight saving time, and perform standard time and daylight saving time calculations.	B	X	X
<b>061 05 02 02</b>	<b>International Date Line</b>			
(01)	State the changes when crossing the International Date Line.	F	X	X
<b>061 05 03 00</b>	<b>Sunrise and sunset</b>			
<b>061 05 03 01</b>	<b>Sunrise and sunset times</b>			
(01)	Define UDP, sunrise, sunset, and civil twilight, and extract times from a suitable source (e.g. an almanac).	F	X	X
(02)	Explain the changes to sunrise, sunset, and civil twilight times with date, latitude and altitude.	B	X	X
(03)	Explain at which time of the year the duration of daylight changes at the highest rate.	B	X	X
<b>062 00 00 00</b>	<b>RADIO NAVIGATION</b>			
<b>062 01 00 00</b>	<b>Basic radio propagation theory</b>			
<b>062 01 01 00</b>	<b>Basic principles</b>			
<b>062 01 01 02</b>	<b>Frequency, wavelength, amplitude, phase angle</b>			
(01)	Define 'frequency': the number of cycles occurring in 1 second expressed in Hertz (Hz).	F	X	X
(02)	Define 'wavelength': the physical distance travelled by a radio wave during one cycle of transmission.	F	X	X
(05)	Define 'phase': the fraction of one wavelength expressed in degrees from 000° to 360°.	F	X	X
(06)	Define 'phase difference/shift': the angular difference between the corresponding points of two cycles of equal wavelength, which is measurable in degrees (°).	F	X	X
<b>062 01 01 03</b>	<b>Frequency bands, sidebands, single sideband</b>			

<b>Eind- en toetstermen</b>		<b>Tax</b>	<b>PPLA</b>	<b>PPLH</b>
(01)	List the bands of the frequency spectrum for electromagnetic waves: <ul style="list-style-type: none"> <li>— low frequency (LF): 30–300 kHz;</li> <li>— medium frequency (MF): 300–3 000 kHz;</li> <li>— high frequency (HF): 3–30 MHz;</li> <li>— very high frequency (VHF): 30–300 MHz;</li> <li>— ultra-high frequency (UHF): 300–3 000 MHz;</li> </ul>	F	X	X
<b>062 01 03 00</b>	<b>Wave propagation</b>			
<b>062 01 03 01</b>	<b>Structure of the ionosphere and its effect on radio waves</b>			
(01)	State that the ionosphere is the ionised component of the Earth's upper atmosphere from approximately 60 to 400 km above the surface, which is vertically structured in three regions or layers.	F	X	X
(03)	State that electromagnetic waves refracted from the ionosphere are called sky waves.	F	X	X
<b>062 01 03 02</b>	<b>Ground waves</b>			
(01)	Define 'ground or surface waves': the electromagnetic waves travelling along the surface of the Earth.	F	X	X
<b>062 01 03 03</b>	<b>Space waves</b>			
(01)	Define 'space waves': the electromagnetic waves travelling through the air directly from the transmitter to the receiver.	F	X	X
<b>062 01 03 04</b>	<b>Propagation with the frequency bands</b>			
(01)	State that radio waves in VHF and UHF propagate as space waves.	F	X	X
(02)	State that radio waves in LF, MF and HF propagate as surface/ground waves and sky waves.	F	X	X
<b>062 01 03 06</b>	<b>Factors affecting propagation</b>			
(04)	State that radio waves in the VHF band and above are limited in range as they are not reflected by the ionosphere and do not have a surface wave.	F	X	X
<b>062 02 00 00</b>	<b>Radio aids</b>			
<b>062 02 01 00</b>	<b>Ground direction finding (DF)</b>			
<b>062 02 01 01</b>	<b>Principles</b>			
(01)	Describe the use of a ground DF.	B	X	X
(02)	Explain the limitation of range because of the path of the VHF signal.	B	X	X
<b>062 02 01 02</b>	<b>Presentation and interpretation</b>			
(01)	Define the term 'QDM': the magnetic bearing to the station.	F	X	X

<b>Eind- en toetstermen</b>		<b>Tax</b>	<b>PPLA</b>	<b>PPLH</b>
(02)	Define the term 'QDR': the magnetic bearing from the station.	F	X	X
(03)	Explain that by using more than one ground station, the position of an aircraft can be determined and transmitted to the pilot.	B	X	X
<b>062 02 01 03</b>	<b>Coverage and range</b>			
(01)	Use the formula: $1.23 \times \sqrt{\text{transmitter height in feet}} + 1.23 \times \sqrt{\text{receiver height in feet}}$ to calculate the range in NM.	B	X	X
<b>062 02 01 04</b>	<b>Errors and accuracy</b>			
(01)	Explain why synchronous transmissions will cause errors.	B	X	X
(03)	Explain that VDF information is divided into the following classes according to ICAO Annex 10: <ul style="list-style-type: none"> <li>▪ Class A: accurate to a range within <math>\pm 2^\circ</math>;</li> <li>▪ Class B: accurate to a range within <math>\pm 5^\circ</math>;</li> <li>▪ Class C: accurate to a range within <math>\pm 10^\circ</math>;</li> <li>▪ Class D: accurate to less than Class C.</li> </ul>	B	X	X
<b>062 02 02 00</b>	<b>Non-directional radio beacon (NDB)/automatic direction finding (ADF)</b>			
<b>062 02 02 01</b>	<b>Principles</b>			
(01)	Define the acronym 'NDB': non-directional radio beacon.	F	X	X
(02)	Define the acronym 'ADF': automatic direction-finding equipment.	F	X	X
(03)	State that the NDB is the ground part of the system.	F	X	X
(04)	State that the ADF is the airborne part of the system.	F	X	X
(05)	State that the NDB operates in the LF and MF frequency bands.	F	X	X
(06)	State that the frequency band assigned to aeronautical NDBs according to ICAO Annex 10 is 190–1 750 kHz.	F	X	X
(07)	Define a 'locator beacon': an LF/MF NDB used as an aid to final approach usually with a range of 10–25 NM.	F	X	X
(08)	State that certain commercial radio stations transmit within the frequency band of the NDB.	F	X	X
(10)	Describe the use of NDBs for navigation.	B	X	X
(11)	Describe the procedure to identify an NDB station.	B	X	X
<b>062 02 02 02</b>	<b>Presentation and interpretation</b>			

<b>Eind- en toetstermen</b>		<b>Tax</b>	<b>PPLA</b>	<b>PPLH</b>
(01)	Name the types of indicators commonly in use: — electronic display; — radio magnetic indicator (RMI); — fixed-card ADF (radio compass); — moving-card ADF.	F	X	X
(02)	Interpret the indications given on fixed-card and moving card ADF displays.	R	X	X
(03)	Given a display, interpret the relevant ADF information.	R	X	X
(04)	Calculate the true bearing from the compass heading and relative bearing.	R	X	X
<b>062 02 02 03</b>	<b>Coverage and range</b>			
(01)	State that the power of the transmitter limits the range of an NDB.	F	X	X
(06)	State that there is no warning indication of NDB failure.	F	X	X
<b>062 02 02 04</b>	<b>Errors and accuracy</b>			
(01)	Explain 'coastal refraction': as a radio wave travelling over land crosses the coast, the wave speeds up over water and the wave front bends.	B	X	X
(02)	Define 'night/twilight effect': the influence of sky waves and ground waves arriving at the ADF receiver with a difference of phase and polarisation which introduce bearing errors.	F	X	X
(03)	State that interference from other NDB stations on the same frequency may occur at night due to sky-wave contamination.	F	X	X
<b>062 02 02 05</b>	<b>Factors affecting range and accuracy</b>			
(01)	Describe diffraction of radio waves in mountainous terrain (mountain effect).	B	X	X
(02)	State that static radiation energy from a cumulonimbus cloud may interfere with the radio wave and influence the ADF bearing indication.	F	X	X
<b>062 02 03 00</b>	<b>VHF omnidirectional radio range (VOR): conventional VOR (CVOR) and Doppler VOR (DVOR)</b>			
<b>062 02 03 01</b>	<b>Principles</b>			
(01)	Explain the working principle of VOR using the following general terms: — reference phase; — variable phase; — phase difference.	B	X	X

<b>Eind- en toetstermen</b>		<b>Tax</b>	<b>PPLA</b>	<b>PPLH</b>
(02)	State that the frequency band allocated to VOR according to ICAO Annex 10 is VHF, and the frequencies used are 108.0–117.975 MHz.	F	X	X
(05)	State that automatic terminal information service (ATIS) information is transmitted on VOR frequencies.	F	X	X
(06)	List the three main components of VOR airborne equipment: — the antenna; — the receiver; — the indicator.	F	X	X
(07)	Describe the identification of a VOR in terms of Morse- code letters and additional plain text.	B	X	X
(08)	State that according to ICAO Annex 10, a VOR station has an automatic ground monitoring system.	F	X	X
<b>062 02 03 02</b>	<b>Presentation and interpretation</b>			
(02)	Read off the angular displacement in relation to a preselected radial on a horizontal situation indicator (HSI) or omnibearing indicator (OBI).	R	X	X
(03)	Explain the use of the TO/FROM indicator in order to determine aircraft position relative to the VOR considering also the heading of the aircraft.	B	X	X
(04)	Interpret VOR information as displayed on HSI and CDI.	R	X	X
(05)	Describe the following in-flight VOR procedures: — tracking, and explain the influence of wind when tracking;	B	X	X
<b>062 02 03 04</b>	<b>Errors and accuracy</b>			
(02)	State that due to reflections from terrain, radials can be bent and lead to wrong or fluctuating indications, which is called 'scalping'.	F	X	X
<b>062 02 04 00</b>	<b>Distance-measuring equipment (DME)</b>			
<b>062 02 04 01</b>	<b>Principles</b>			
(01)	State that DME operates in the UHF band.	F	X	X
(02)	State that the system comprises two basic components: — the aircraft component: the interrogator; — the ground component: the transponder.	F	X	X
(03)	Describe the principle of distance measurement using DME in terms of a timed transmission from the interrogator and reply from the transponder on different frequencies.	B	X	X
(04)	Explain that the distance measured by DME is slant range.	B	X	X

<b>Eind- en toetstermen</b>		<b>Tax</b>	<b>PPLA</b>	<b>PPLH</b>
(05)	Illustrate that a position line using DME is a circle with the station at its centre.	R	X	X
(06)	State that the pairing of VHF and UHF frequencies (VOR/DME) enables the selection of two items of navigation information from one frequency setting.	F	X	X
(07)	Describe, in the case of co-location with VOR and ILS, the frequency pairing and identification procedure.	B	X	X
(08)	State that military UHF tactical air navigation aid (TACAN) stations may be used for DME information.	F	X	X
<b>062 02 04 02</b>	<b>Presentation and interpretation</b>			
(01)	State that when identifying a DME station co-located with a VOR station, the identification signal with the higher- tone frequency is the DME which identifies itself approximately every 40 seconds.	F	X	X
(04)	State that a DME system may have a ground speed (GS) and time to station read-out combined with the DME read-out.	F	X	X
<b>062 02 04 05</b>	<b>Factors affecting range and accuracy</b>			
(01)	Explain why the GS read-out from a DME can be less than the actual GS, and is only correct when tracking directly to or from the DME station.	B	X	X
<b>062 03 00 00</b>	<b>Radar</b>			
<b>062 03 04 00</b>	<b>Secondary surveillance radar and transponder</b>			
<b>062 03 04 01</b>	<b>Principles</b>			
(01)	State that the ATC system is based on the replies provided by the airborne transponders in response to interrogations from the ATC secondary radar.	F	X	X
(02)	State that the ground ATC secondary radar uses techniques which provide the ATC with information that cannot be acquired by the primary radar.	F	X	X
(03)	State that an airborne transponder provides coded-reply signals in response to interrogation signals from the ground secondary radar and from aircraft equipped with traffic alert and collision avoidance system (TCAS).	F	X	X
(04)	State the advantages of secondary surveillance radar (SSR) over a primary radar regarding range and collected information due to transponder principal information and active participation of the aircraft.	F	X	X
<b>062 03 04 02</b>	<b>Modes and codes</b>			
(02)	Name the interrogation modes: — Mode A; — Mode C; — Mode S.	F	X	X

<b>Eind- en toetstermen</b>		<b>Tax</b>	<b>PPLA</b>	<b>PPLH</b>
(04)	State the different operating modes of the transponder: — Mode A: transmission of aircraft transponder code; — Mode C: transmission of aircraft pressure altitude; — Mode S: selection of aircraft address and transmission of flight data for the ground surveillance.	F	X	X
(05)	State that Mode A designation is a sequence of four digits which can be manually selected from 4096 available codes.	F	X	X
(06)	State that in Mode C reply, the pressure altitude is reported in 100-ft increments.	F	X	X
(07)	State that in addition to the information provided, on request from ATC, a special position identification (SPI) pulse can be transmitted but only as a result of a manual selection by the pilot (IDENT button).	F	X	X
(08)	State the need for compatibility of Mode S with Mode A and C.	F	X	X
(09)	Explain that Mode S transponders receive interrogations from TCAS and SSR ground stations.	B	X	X
(10)	State that Mode S interrogation contains either the aircraft address, selective call or all-call address.	F	X	X
(11)	State that every aircraft is allocated an ICAO aircraft address, which is hard-coded into the Mode S transponder (Mode S address).	F	X	X
(12)	Explain that a 24-bit address is used in all Mode S transmissions, so that every interrogation can be directed to a specific aircraft.	B	X	X
(13)	State that Mode S can provide enhanced vertical tracking, using a 25-ft altitude increment.	F	X	X
<b>062 03 04 03</b>	<b>Presentation and interpretation</b>			
(01)	State that an aircraft can be identified by a unique code.	F	X	X
(02)	State which information can be presented on the ATC display system: — pressure altitude; — flight level; — flight number or aircraft registration number; — GS.	F	X	X
(03)	Explain the use and function of the selector modes: OFF, Standby, ON (Mode A), ALT (Mode A, C and S), TEST, and of the reply lamp.	B	X	X
<b>062 06 00 00</b>	<b>Global navigation satellite systems (GNSSs)</b>			
<b>062 06 01 00</b>	<b>Global navigation satellite systems (GNSSs)</b>			
<b>062 06 01 01</b>	<b>General</b>			

<b>Eind- en toetstermen</b>		<b>Tax</b>	<b>PPLA</b>	<b>PPLH</b>
(01)	State the three main GNSSs: — USA NAVigation System with Timing And Ranging Global Positioning System (NAVSTAR GPS); — Russian GLObal Navigation Satellite System (GLONASS); — European Galileo (under construction);	F	X	X
(02)	State that all systems (will) consist of a constellation of satellites which can be used by a suitably equipped receiver to determine position.	F	X	X
<b>062 06 01 02</b>	<b>Operation</b>			
	<b>Global navigation satellite system (GNSS)</b>			
(01)	State that there are currently two modes of operation: standard positioning service (SPS) for civilian users, and precise positioning service (PPS) for authorised users.	F	X	X
(02)	SPS was originally designed to provide civilian users with a less accurate positioning capability than PPS.	F	X	X
(03)	Name the three GNSS segments as follows: — space segment; — control segment; — user segment.	F	X	X
	<b>Space segment (example: NAVSTAR GPS)</b>			
(04)	State that each satellite broadcasts ranging signals on UHF frequencies.	F	X	X
(07)	State that the satellites transmit a coded signal used for ranging, identification (satellite individual PRN code), timing and navigation.	F	X	X
(08)	State that the navigation message contains: — satellite clock correction parameters; — Universal Time Coordinated (UTC) parameters; — an ionospheric model; — satellite health data.	F	X	X
(09)	State that an ionospheric model is used to calculate the time delay of the signal travelling through the ionosphere.	F	X	X
(11)	State that satellites are equipped with atomic clocks which allow the system to keep very accurate time reference.	F	X	X
	<b>User segment</b>			
(14)	State that GNSS supplies three-dimensional position fixes and speed data, plus a precise time reference.	F	X	X



<b>Eind- en toetstermen</b>		<b>Tax</b>	<b>PPLA</b>	<b>PPLH</b>
(15)	State that a GNSS receiver is able to determine the distance to a satellite by determining the difference between the time of transmission by the satellite and the time of reception.	F	X	X
(17)	State that each range defines a sphere with its centre at the satellite.	F	X	X
(18)	State that there are four unknown parameters ( $x$ , $y$ , $z$ and $\Delta t$ ) (receiver clock error) which require the measurement of ranges to four different satellites in order to get the position.	F	X	X
(19)	State that the GNSS receiver is able to synchronise to the correct time reference when receiving four satellites.	F	X	X
(20)	State that the receiver is able to calculate aircraft ground speed using the space vehicle (SV) Doppler frequency shift or the change in receiver position over time.	F	X	X
<b>062 06 01 03</b>	<b>Errors and factors affecting accuracy</b>			
(01)	List the most significant factors that affect accuracy: <ul style="list-style-type: none"> <li>— ionospheric propagation delay;</li> <li>— dilution of position;</li> <li>— satellite clock error;</li> <li>— satellite orbital variations;</li> <li>— multipath.</li> </ul>	F	X	X
(04)	State that ionospheric delay is the most significant error.	F	X	X
(05)	State that dilution of position arises from the geometry and number of satellites in view. It is called geometric dilution of precision (GDOP).	F	X	X

<b>Eind- en toetstermen</b>		<b>Tax</b>	<b>PPLA</b>	<b>PPLH</b>
<b>030 00 00 00</b>	<b>FLIGHT PERFORMANCE AND PLANNING</b>			
<b>033 00 00 00</b>	<b>Flight planning and flight monitoring</b>			
<b>033 01 00 00</b>	<b>Flight planning for VFR flights</b>			
<b>033 01 01 00</b>	<b>VFR Navigation plan</b>			
<b>033 01 01 01</b>	<b>Airspace, communication, visual and radio-navigation data from VFR charts</b>			
(01)	Select routes taking the following criteria into account: - Classification of airspace; - Restricted areas; - Minimum safe altitudes; - VFR Semi-circular rules; - Visually conspicuous points; - Radio navigation aids.	R	X	X
(02)	Find the frequency and/or identifiers of radio navigation aids from charts	R	X	X
(03)	Find communication frequencies and call signs for the following: - control agencies and service facilities - flight information services - weather information stations - Automatic Terminal Information Service	R	X	X
<b>033 01 01 02</b>	<b>Planning courses, distances and cruising levels with VFR charts</b>			
(01)	Choose visual waypoints in accordance with specified criteria (large, unique, contrast, vertical extent, etc.)	R	X	X
(02)	Measure courses and distances from a VFR chart.	B	X	X
(03)	Find the highest obstacle within a given distance either side of the course.	R	X	X
(04)	Find the following data from a VFR chart and transfer to them to a navigation plan: - waypoints or turning points; - distances; - true/magnetic courses.	R	X	X
(06)	Calculate the vertical or horizontal distance and time to climb or descend to/from a given level or altitude.	R	X	X
<b>033 01 01 03</b>	<b>Aerodrome charts and aerodrome directory</b>			
(01)	Explain the reasons for studying the visual departure procedures and the available approach procedures	B	X	X

		Tax	PPLA	PPLH
<b>Eind- en toetstermen</b>				
(02)	Find all visual procedures which can be expected at the departure, destination and alternate airfields	R	X	X
(03)	Find all relevant aeronautical and regulatory information required for VFR flight planning from the aerodrome charts or aerodrome directory.	R	X	X
<b>033 01 01 05</b>	<b>Completion of navigation plan</b>			
(01)	Calculate the true air speed (TAS) given aircraft performance data, altitude and OAT.	R	X	X
(03)	Calculate individual and accumulated times for each leg to destination and alternate aerodromes.	R	X	X
<b>033 03 00 00</b>	<b>Fuel planning</b>			
<b>033 03 01 00</b>	<b>General</b>			
<b>033 03 01 01</b>	<b>Fuel planning (general)</b>			
(01)	Convert between volume, mass and density given in different units which are commonly used in aviation.	R	X	X
(02)	Determine relevant data, such as fuel capacity, fuel flow/consumption at different power/thrust settings, altitudes and atmospheric conditions, from the flight manual.	R	X	X
(03)	Calculate attainable flight time/range from given fuel flow/consumption and available amount of fuel.	R	X	X
(04)	Calculate the required fuel from given average fuel flow/consumption and required time/range to be flown.	R	X	X
(05)	Calculate the required fuel for a VFR flight given forecast meteorological conditions.	R	X	X
<b>033 03 02 00</b>	<b>Pre-flight fuel planning for flights under Part-NCO</b>			
<b>033 03 02 01</b>	<b>Taxi fuel</b>			
(01)	Define taxi fuel	F	X	X
<b>033 03 02 02</b>	<b>Trip fuel</b>			
(01)	Define trip fuel and name the segments of flight for which the trip fuel is relevant.	F	X	X
(02)	Determine the trip fuel for the flight using data from the navigation plan and fuel tables and/or graphs from the flight manual.	R	X	X
<b>033 03 02 03</b>	<b>Reserve fuel and its components</b>			
	<b>Contingency fuel</b>			
(01)	Explain the reasons for having contingency fuel.	B	X	X
	<b>Alternate fuel</b>			

<b>Eind- en toetstermen</b>		<b>Tax</b>	<b>PPLA</b>	<b>PPLH</b>
(03)	Explain the reasons and regulations for having alternate fuel and name the segments of flight for which the fuel is relevant.	B	X	X
	<b>Reserve fuel</b>			
(05)	Explain the reasons and regulations for having reserve fuel.	B	X	X
<b>033 03 02 04</b>	<b>Extra fuel</b>			
(02)	Calculate the possible extra fuel under given conditions.	R	X	X
<b>033 03 02 05</b>	<b>Calculation of total fuel and completion of the fuel section of the navigation plan (fuel log)</b>			
(01)	Calculate the total fuel required for a flight.	R	X	X
<b>033 04 00 00</b>	<b>Pre-flight preparation</b>			
<b>033 04 01 00</b>	<b>Notice to airmen (NOTAM) briefing</b>			
<b>033 04 01 01</b>	<b>Ground- and satellite-based facilities and services</b>			
(01)	Check that ground facilities and services required for the planned flight are available and adequate.	R	X	X
<b>033 04 01 02</b>	<b>Departure, destination and alternate aerodromes</b>			
(p01)	Explain the contents of a NOTAM, including commonly used abbreviations.	B	X	X
<b>033 04 01 03</b>	<b>Airway routings and airspace structure</b>			
(01)	Find and analyse the latest en-route state for: - route(s); - restricted, danger and prohibited areas; - changes of frequencies for communications, navigation aids and facilities.	R	X	X
<b>033 05 00 00</b>	<b>ICAO flight plan (ATS flight plan (FPL))</b>			
<b>033 05 01 00</b>	<b>Individual FPL</b>			
<b>033 05 01 01</b>	<b>Format of FPL</b>			

<b>Eind- en toetstermen</b>		<b>Tax</b>	<b>PPLA</b>	<b>PPLH</b>
(02)	Determine the correct entries to complete an ATS FPL, particularly for the following: - Aircraft identification (Item 7) - Flight rules and type of flight (Item 8) - Number and type of aircraft and wake turbulence category (Item 9) - Equipment (Item 10) - Departure aerodrome and time (Item 13) - Route (Item 15) - Destination aerodrome, total estimated elapsed time and alternate aerodrome (Item 16) - Other information (Item 18) - Supplementary Information (Item 19)	R	X	X
<b>033 06 00 00</b>	<b>Flight monitoring and in-flight re-planning</b>			
<b>033 06 01 00</b>	<b>Flight monitoring</b>			
<b>033 06 01 01</b>	<b>Monitoring of track and time</b>			
(01)	State the reasons for possible deviations from planned track and planned timings.	F	X	X
(02)	Calculate the ground speed using actual in-flight parameters.	R	X	X
(03)	Calculate expected leg times using actual flight parameters.	R	X	X
<b>033 06 01 02</b>	<b>In-flight fuel management</b>			
(02)	Assess deviations of actual fuel consumption from planned consumption.	R	X	X
(03)	Calculate fuel quantities used, fuel consumption and fuel remaining at navigation checkpoints/waypoints.	R	X	X
(04)	Compare the actual and the planned fuel consumption by means of calculation.	B	X	X
(05)	Determine the remaining range and endurance by means of calculation.	B	X	X
(06)	Calculate revised fuel consumption based on changes to the pre-flight plan including changes of W/V, cruise level, distances, and CAS.	R	X	X

Alleen de onderwerpen die als meest relevant voor privévliegers worden beschouwd zijn uitgewerkt in de leerdoelen. De onderwerpen die niet in de leerdoelen zijn uitgewerkt, maar wel terugkomen in de AMC-syllabus zijn in onderstaand tekstvak onder benoemd:

De volgende onderwerpen uit de AMC-syllabus zijn niet uitgewerkt in bovenstaande leerdoelen:

- **Magnetism and compasses:** General principles, Aircraft magnetism
- **Use of the navigational computer:** True altitude
- Antennas
- Ground radar

## **Wijzigingen toetsmatrijs LVPAPNV**

Wijzigingen leerdoelen versie 26-02-2019 (t.o.v. versie 12-11-2013)

### **Algemene wijzigingen**

- De leerdoelen van de vakken die in één examen worden afgenomen, zijn in één document gevoegd.
- De leerdoelen zijn genummerd.
- De kolom met 'opmerkingen' is verwijderd. Alle informatie die (niet) geldt voor PPL staat (niet) in de LO's.

### **Wijzigingen navigation**

De leerdoelen voor het vak Navigatie zijn in lijn gebracht met de nieuwe CPL-leerdoelen. Daarbij is de opzet van de leerdoelen aanmerkelijk gewijzigd, waarbij leerdoelen zijn samengevoegd of herschreven. Het is daarom voor dit vak niet goed mogelijk om 1-op-1 een lijst te geven van oude leerdoelen die in de nieuwe versie vervallen zijn. Er zijn geen nieuwe onderwerpen bijgekomen, wel zijn er onderwerpen vervallen. Hieronder staat per hoofdleerdoel van het oude leerdoelendocument aangegeven wat vervallen is:

#### **General Navigation**

- **061 01 01 00 The solar system:** Astronomische kennis (onder meer de wetten van kepler, perihelion/aphelion, declination, celestial equator, solstice/equinox, zenith) is grotendeels vervallen.
- **061 01 02 00 The earth:** de begrippen 'conversion angle', 'geocentric latitude' en 'calculation of mean latitude' zijn vervallen.
- **061 01 03 00 Time and time conversions:** De vereiste achtergrondkennis met betrekking tot tijdrekening is ingekort. Vervallen zijn onder meer begrippen als 'transit' en 'apparent solar day/time'.
- **061 01 04 00 Directions:** De achtergronden van het aardmagnetisch veld en de werking van het magnetisch kompas zijn grotendeels vervallen. De betreffende onderdelen zijn in deze sectie geschrapt en worden alleen nog bij AGK geëxamineerd.
- **061 02 00 00 Magnetism and compasses:** Dit onderdeel is geheel geschrapt.
- **061 03 00 00 Charts:** Vervallen zijn de begrippen/onderdelen: '(chart) convergency, constant of the cone' en 'plotting NDB bearings'.
- **061 04 02 04 Fuel consumption:** Dit onderwerp is geschrapt bij NAV omdat het ook al voorkomt bij het onderdeel Flight Planning and Monitoring (FPM).
- **061 04 02 08 True altitude:** Dit onderwerp is geschrapt bij NAV. Het wordt nog wel geëxamineerd bij de vakken FPP (033) en Meteo (050).
- **061 04 05 01 Calculation of altitude, adjustments, corrections, errors:** Dit onderwerp is geschrapt.

#### **Radio Navigation**

- **062 01 01 00 Basic principles:** Vervallen zijn onder meer de volgende begrippen/onderdelen: 'lichtsnelheid (verband frequentie/golflengte)', 'amplitude', 'VLF', 'pulse characteristics, carrier, (kinds of) modulation' en 'antennas, polarisation'.
- **062 01 03 01 Structure of the ionosphere:** De benaming van de ionosfeerlagen is vervallen.
- **062 01 03 06 Factors affecting propagation:** Vervallen zijn onder meer de volgende begrippen/onderdelen: 'skip distance etc.' en 'reflection, refraction, diffraction etc.'
- **062 02 02 00 NDB/ADF:** Vervallen zijn onder meer de volgende begrippen/onderdelen: 'modulation types (N0N/A1A etc.)', 'BFO' en 'Quadrantal error'.
- **062 02 03 00 VOR:** Vervallen zijn onder meer de volgende begrippen/onderdelen: 'allocated frequencies', 'types of VOR stations', 'VOT' en 'RMI'.
- **062 03 01 00 Pulse techniques:** Dit gehele onderdeel is vervallen.
- **062 03 02 00 Ground radar:** Dit gehele onderdeel is vervallen.
- **062 03 04 00 Secondary Surveillance Radar and transponder:** Vervallen zijn de volgende begrippen: 'interrogation modes, except mode A, C and S', 'interrogation frequencies', 'codes 7700/7600/750' (die laatste worden nu geëxamineerd bij Communications en Airlaw).
- **062 06 00 00 Global navigation satellite systems:** Vervallen zijn de volgende begrippen: 'space segment (constellation and orbital data; almanac, ephemeris)', 'control segment (structure, responsibility and main tasks)', 'RAIM', 'elimination of IPD by using 2 frequencies' en 'IPD correction in SPS receivers'.

### **Grote wijzigingen FPM**

- 033 01 01 01: tweede en derde LO zijn verwijderd.
- 033 01 01 01: leerdoel (03) is toegevoegd.
- 033 01 01 02: leerdoel (06) is toegevoegd.
- 033 01 01 04: dit gehele onderdeel is verwijderd.
- 033 01 01 05: eerste, tweede, derde, vierde en zesde LO zijn verwijderd.
- 033 03 02 03: 'additional fuel' (met bijbehorende LO) is verwijderd.
- 033 03 02 05: tweede LO is verwijderd.
- 033 04 01 02: eerste LO is verwijderd en vervangen door (p01): Explain the contents of a NOTAM, including commonly used abbreviations.
- 033 04 02 00: dit gehele onderdeel (Meteorological briefing) is verwijderd (033 04 02 05 (calculate revised fuel data in accordance with changed conditions' is verplaatst naar 033 06 01 02 (06)).
- 033 05 01 02: dit gehele onderdeel is verwijderd.
- 033 06 01 01: eerste LO is verwijderd.
- 033 06 01 02: eerste en derde LO zijn verwijderd.
- 033 06 01 02: leerdoel (06) is toegevoegd (zie 033 04 02 05 oude leerdoelen).
- 033 06 02 00: dit gehele onderdeel (In-flight re-planning in case of deviation from planned data) is verwijderd.

### **Kleine wijzigingen FPM**

- Nummering van de leerdoelen is toegevoegd.
- De leerdoelen van Navigation en Flight planning and flight monitoring zijn in één document gevoegd.
- 033 01 01 01: titel aangepast van 'Routes, airfields, heights and altitudes from VFR charts' naar 'Airspace, communication, visual and radio-navigation data from VFR charts'.
- 033 01 01 01 (01): 'controlled airspace' en 'uncontrolled airspace' zijn verwijderd. 'Conspicuous points' is aangepast naar 'Visually conspicuous points' en 'Navigation aids' is aangepast naar 'Radio navigation aids'.
- 033 01 01 02 (01): 'visual' toegevoegd aan waypoints en tussen haakjes (large, unique, contrast, vertical extent, etc.) toegevoegd.
- 033 01 01 02 (02): aanpassing van 'Calculate, or obtain from the chart, courses and distances' naar 'Measure courses and distances from a VFR chart'.

- 033 01 01 03 (03): aanpassing van 'Find the following data from the charts or directory: aerodrome regulations and opening hours, terrain high points and man made structures, altitudes, courses and radials, helipads (for helicopter only) and any other relevant information' naar 'Find all relevant aeronautical and regulatory information required for VFR flight planning from the aerodrome charts or aerodrome directory'.
- 033 03 01 01 (05): aanpassing van 'Calculate the required fuel for a VFR flight given expected meteorological conditions and expected delays under defined conditions' naar 'Calculate the required fuel for a VFR flight given forecast meteorological conditions'.
- 033 03 02 01 (01): aanpassing van 'Determine the fuel required for engine start and taxi by consulting the fuel usage tables and/or graphs from the flight manual taking into account all relevant conditions' naar 'Define taxi fuel'.
- 033 05 01 01 (02): aan FPL is ATS toegevoegd (ATS FPL) en 'plus decode and interpret the entries in a completed FPL' is verwijderd.
- 033 06 01 01 (01): 'from planned track and planned times' is toegevoegd.
- 033 06 01 02 (04) en (05): 'or flight progress chart' is verwijderd.
- 033 06 01 02 (05) 'assess' is aangepast in 'determine'.