INSTITUTO SUPERIOR TÉCNICO
Air Traffic Management (GTA)
First semester 2021/2022
Exam (1 hour) - 12/Feb/2022

Name: _____

Number: _____

Notes:
- Read carefully each question before answering
- The answers should be given **exclusively** on these sheets (use both sides)
- The allowed consultation is limited to **5 (five) A4** sheets of paper
- For the multiple choice questions, a wrong answer is penalized with 1/4 of the question value

1. **[1 pt]** For this question refer to the chart provided.

   The aeronautical chart provided in figure 1 is a **Non Precision final instrument approach chart RNP**.

2. **[2 pt]** For this question refer to the chart provided.

   How many different holding patterns procedures are published in this chart?

   2 (MTR and CHA).

3. A passenger regular flight is being planned using an Airbus A340-600. The contingency fuel is the standard 5%. Given the following scenario:

Structural limited TOW:	380000 kg
Structural limited LW:	265000 kg
MZFW:	251000 kg
Performance limitation at the departing runway due to obstacles:	365000 kg
DOW:	179000 kg
FOB_{RAMP}:	73000 kg
$Fuel_{TAXI}$:	1000 kg
$Fuel_{TRIP}$:	62000 kg
Passengers and personal luggage:	30540 kg
Cargo:	25000 kg

   a) **[2 pt]** At the last minute, due to a flight being canceled, there is the need to protect passengers, by adding them to this flight. Which is the additional maximum permitted payload?

Total Payload	**55540**	**Kg**
Fuel		
FOB Ramp	73000	Kg
FOB T-Off	**72000**	**Kg**
Taxi Fuel	1000	Kg
Trip Fuel	62000	Kg
Aircraft Design Limits		
MSTOW	380000	Kg
MLW	265000	Kg
MZFW	251000	Kg
Performance Limit		
Performance Limit	365000	Kg
Aircraft DOW		
DOW	179000	Kg

Calculations		
ZFW Limitation	**323000**	**Kg**
LW Limitation	**327000**	**Kg**
STOW Limitation	**380000**	**Kg**
Performance Limit	**365000**	**Kg**
ATOW	**306540**	**Kg**
MATOW	**323000**	**Kg**
Max Aditional Permited Payload	**16460**	**Kg**

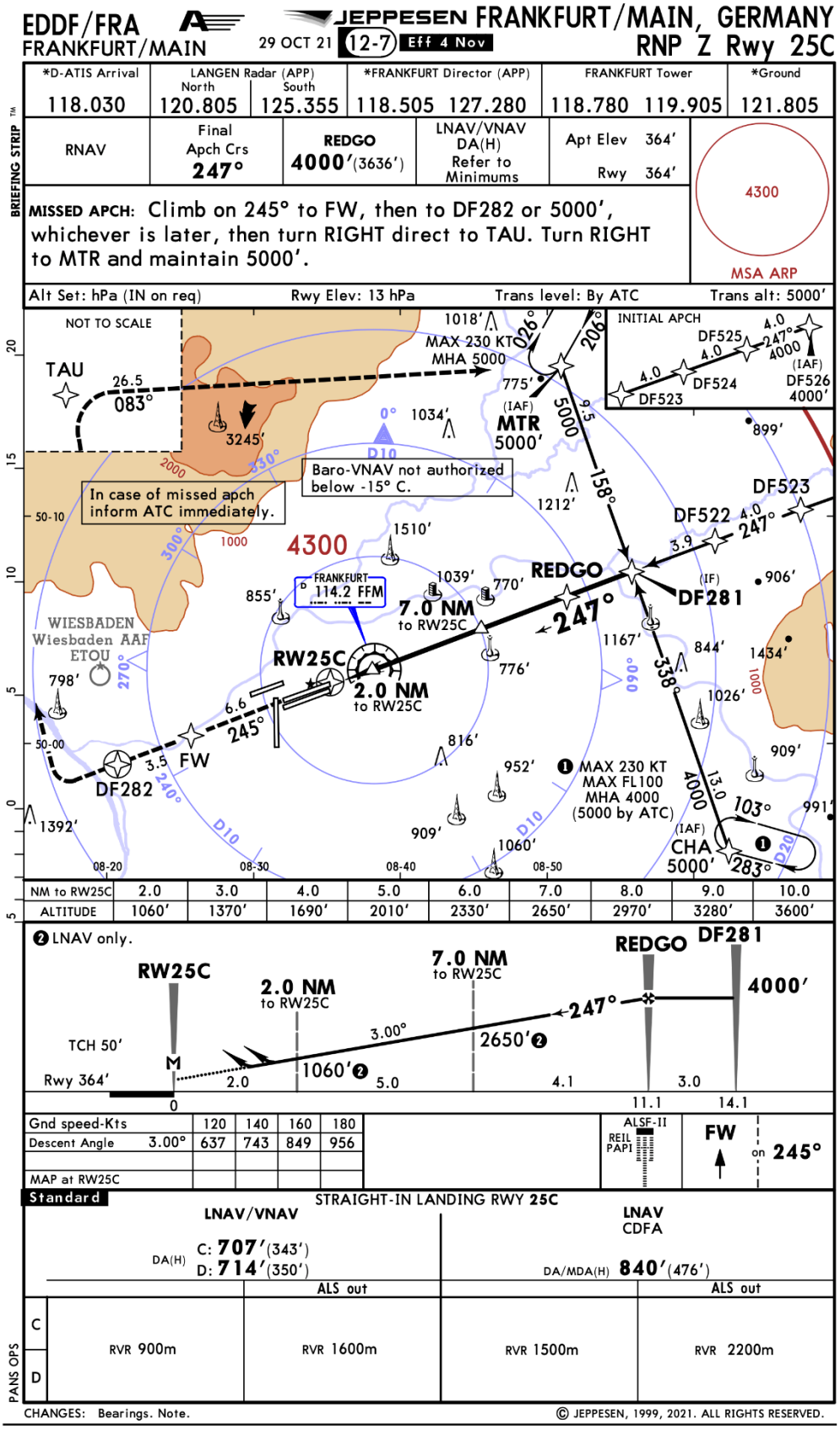
EDDF/FRA
FRANKFURT/MAIN
JEPPESEN FRANKFURT/MAIN, GERMANY
29 OCT 21 12-7 Eff 4 Nov
RNP Z Rwy 25C
*D-ATIS Arrival 118.030
LANGEN Radar (APP) North 120.805 South 125.355
*FRANKFURT Director (APP) 118.505 127.280
FRANKFURT Tower 118.780 119.905
*Ground 121.805
RNAV
Final Apch Crs 247°
REDGO 4000′(3636′)
LNAV/VNAV DA(H) Refer to Minimums
Apt Elev 364′
Rwy 364′
4300
MSA ARP
MISSED APCH: Climb on 245° to FW, then to DF282 or 5000′, whichever is later, then turn RIGHT direct to TAU. Turn RIGHT to MTR and maintain 5000′.
Alt Set: hPa (IN on req)
Rwy Elev: 13 hPa
Trans level: By ATC
Trans alt: 5000′
NOT TO SCALE
TAU
26.5
083°
3245′
In case of missed apch inform ATC immediately.
Baro-VNAV not authorized below -15° C.
MAX 230 KT
MHA 5000
MTR 5000′
INITIAL APCH
DF525
DF524
DF523
DF526 4000′
DF522
DF523
REDGO
DF281
7.0 NM to RW25C
2.0 NM to RW25C
RW25C
FRANKFURT 114.2 FFM
WIESBADEN
Wiesbaden AAF
ETOU
FW
DF282
CHA 5000′
MAX 230 KT
MAX FL100
MHA 4000
(5000 by ATC)
NM to RW25C 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0
ALTITUDE 1060′ 1370′ 1690′ 2010′ 2330′ 2650′ 2970′ 3280′ 3600′
❷ LNAV only.
TCH 50′
Rwy 364′
3.00°
1060′❷
2650′❷
4000′
Gnd speed-Kts 120 140 160 180
Descent Angle 3.00° 637 743 849 956
MAP at RW25C
ALSF-II
REIL
PAPI
FW on 245°
Standard
STRAIGHT-IN LANDING RWY 25C
LNAV/VNAV
DA(H) C: 707′(343′) D: 714′(350′)
LNAV CDFA
DA/MDA(H) 840′(476′)
ALS out
ALS out
C
D
RVR 900m
RVR 1600m
RVR 1500m
RVR 2200m
PANS OPS
CHANGES: Bearings. Note.
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Figure 1

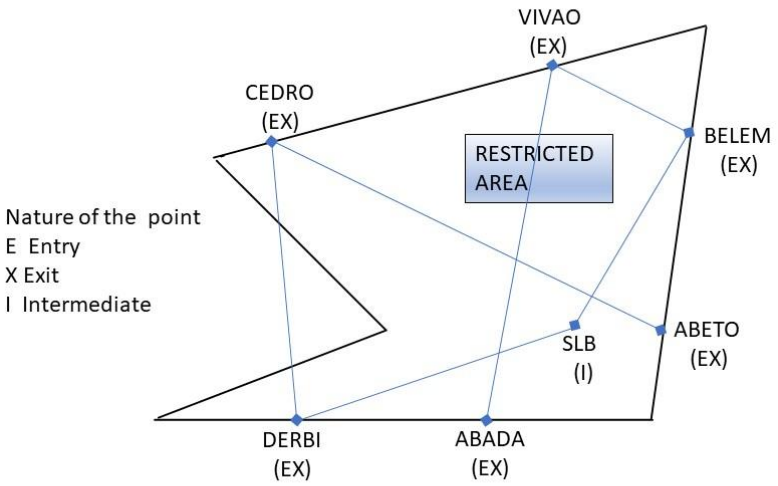
b) **[2 pt]** In reference to the approach you used on previous calculations, is there any sort of limitation and/or simplification implied, which in a rigorous and theoretical approach wouldn't be entirely correct? Explain.

Yes there is.

First, since we are increasing the payload, this implies an increase in trip fuel. Also, since the limitation is by ZFW, this limitation also change, due to that increase in trip, and thus in the total FOB at take off.

In practice, this would be an iterative process. If the payload would inclease to much, it would have been wise to perform new performance calculations, although we are covered by the contingency and conservative nature of fuel calculations.

4.



The above polygon defines the borders of a FIR where free route airspace is implemented.
Which routes will be approved by the ATC flight planning system?
Select one or more: [**1 pt**]

- ☑ ~~ABETO-CEDRO~~
- ☑ ~~BELEM-SLB-DERBI~~
- ☐ CEDRO-DERBI
- ☐ ABADA-VIVAO
- ☑ ~~VIVAO-BELEM~~

5. The following information is given about air traffic at a single runway airport.

Aircraft	Wake category	Approach speed [kts]	Mix [%]	Runway occupancy time on arrival [s]
A330	Heavy (H)	141	20	60
A320	Medium (M)	137	80	55

The length of the final approach to the runway is 9 NM.

The minimum separation requirements (in nautical miles) between successive **landing** aircraft on final approach are given by the matrix below (rows indicate leading aircraft and columns the following aircraft)

	1(H)	2 (M)
1 (H)	4	5
2 (M)	3	3

a) **[6 pt]** Suppose the runway is used for arrivals only. Find the maximum throughput capacity for **arrivals**

Time Separation (sec)

		Trailing aircraft	
leading		*1(H)*	*2(M)*
aircraft	*1(H)*	*102*	*138*
	2(M)	*77*	*79*

Probability of Leading/Trailing Pairs

		Trailing aircraft	
leading		*1(H)*	*2(M)*
aircraft	*I(H)*	*0.04*	*0.16*
	2(M)	*0.16*	*0.64*

Expected time separation	*88.9*	*sec*
Average runway capacity	*40.5*	*arrivals/h*

b) **[1 pt]** The minimum separation requirements (in seconds) between successive **departing** aircraft is 120 seconds. Suppose the runway is used for departures only. Find maximum throughput capacity for **departures**

$$\frac{3600\ s/h}{120\ s/dep} = 30\ dep/h$$

6. **[1 pt]** What is the meaning of the 'B' in ADS-B? (solution in **bold**)
   - ❏ **Broadcast**
   - ❏ Beacon
   - ❏ Band
   - ❏ The version indicator
   - ❏ none of the above

7. **[1 pt]** Concerning primary surveillance radar, select <u>all</u> true sentences (solution in **bold**)
   - ❏ For the same power, its range is larger than secondary surveillance radar
   - ❏ **For the same power, its range is smaller than secondary surveillance radar**
   - ❏ **It detects non-cooperative targets**
   - ❏ It is able to detect the shape of aircraft
   - ❏ **It is prone to occlusion by clouds**

8. Consider an airstrip aligned with heading 12 deg which can be used in both ways for landing (i.e., north-south and south-north). Assume that TORA=TODA=ASDA=LDA=2NM.

a) **[1 pt]** write the runway designators for both north-south and south-north directions

North-south: 19
South-North: 01

b) **[2 pt]** consider a VOR approach from south to north, using another VOR located 10NM to the east of the runway midpoint, to aid estimating the distance to the runway threshold. Determine the radials for the following distances to the threshold: 4NM, 8NM, and 11NM.

4NM: R246
6NM: R233
11NM: R227