Quiz 1 - In Class Exam (50 minutes)

Open Notes and Internet

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Instructions

Write your solutions in the spaces provided. Add any additional pages with calculations as needed. Make sure each additional page has your name.

Honor Code Pledge

The information provided in this exam is my own work. I have not received information from another person while doing this exam.

_____ (your signature/name)

Problem #1 (40 points)

The Los Angeles Airport Authority is conducting a study for possible runway length improvements to runway 24R on the North side of the airport. Airlines would like to conduct departure operations to destinations in Japan using runway 24R. Estimate the runway extension needed for runway 24R if the critical stage length needed is listed in Table 1.

In your analysis use the latest version of the Boeing documents for airport design. Add 6% to the distance calculated to account for real Air Traffic route conditions and to account for possible weather deviations from the shortest flight path.

Table 1. Critical Aircraft Used in the Re-design of LAX Runway 24R.

Origin-Destination Airport Pair	Aircraft Flying the Route
KLAX- NRT Los Angeles to Tokyo Narita (NRT)	Boeing 777-300ER with GE90-115B1 engines. Aircraft maximum design takeoff weight is 775,000 lb. Aircraft has a typical three-class configuration. The airline wants to carry an additional 57,600 lb of additional "belly" cargo in this trip.

a) Find the runway extension needed to satisfy the proposed route. State the airport design temperature, airport elevation and other environmental conditions and assumptions used in your calculations. State the figure(s) used in the aircraft manufacturer documents.

Use the Boeing Airport Compatibility document D6-58329-2 dated May 2015.

2.1.1 General Characteristics: Model 777-200LR. -300ER, 777F

CHARACTERISTICS	UNITS	777-200LR	777-300ER	777-F
MAX DESIGN TAXI WEIGHT	POUNDS	768,000	777,000	768,800
	KILOGRAMS	348,358	352,442	348,722
MAX DESIGN TAKEOFF WEIGHT	POUNDS	766,000	775,000	766,800
	KILOGRAMS	347,452	351,535	347,815
MAX DESIGN LANDING WEIGHT	POUNDS	492,000	554,000	575,000
	KILOGRAMS	223,168	251,290	260,816
MAX DESIGN ZERO FUEL WEIGHT	POUNDS	461,000	524,000	547,000
	KILOGRAMS	209,106	237,683	248,115
OPERATING EMPTY WEIGHT (1)	POUNDS	320,000	370,000	318,300
	KILOGRAMS	145,150	167,829	144,379
MAX STRUCTURAL PAYLOAD	POUNDS	141,000	154,000	228,700
	KILOGRAMS	63,957	69,853	103,737
TYPICAL SEATING CAPACITY	TWO CLASS	279 (4)	339 (6)	N/A
	THREE CLASS	301 (5)	370 (7)	N/A
MAX CARGO --LOWER DECK	CUBIC FEET	5,656 (2)	7,552 (2)	22,371 (3)
	CUBIC METERS	160.2 (2)	213.8 (2)	633.5 (3)
USABLE FUEL	U.S. GALLONS	47,890	47,890	47,890
	LITERS	181,283	181,283	181,283
	POUNDS	320,863	320,863	320,863
	KILOGRAMS	145,538	145,538	145,538

Great circle distance = 4,737 nm

Route length for planning = 5,021 nm

Airport elevation = 128 feet (airnav.com)

Mean Max. Temperature of hottest month = 23.9 deg. C (75 deg.F)

ISA temperature at 128 feet ~ 14.9 deg. C (58.8 deg. F)

LAX design temperature ~ ISA + 15 deg. C (or ISA + deg. 27 F)

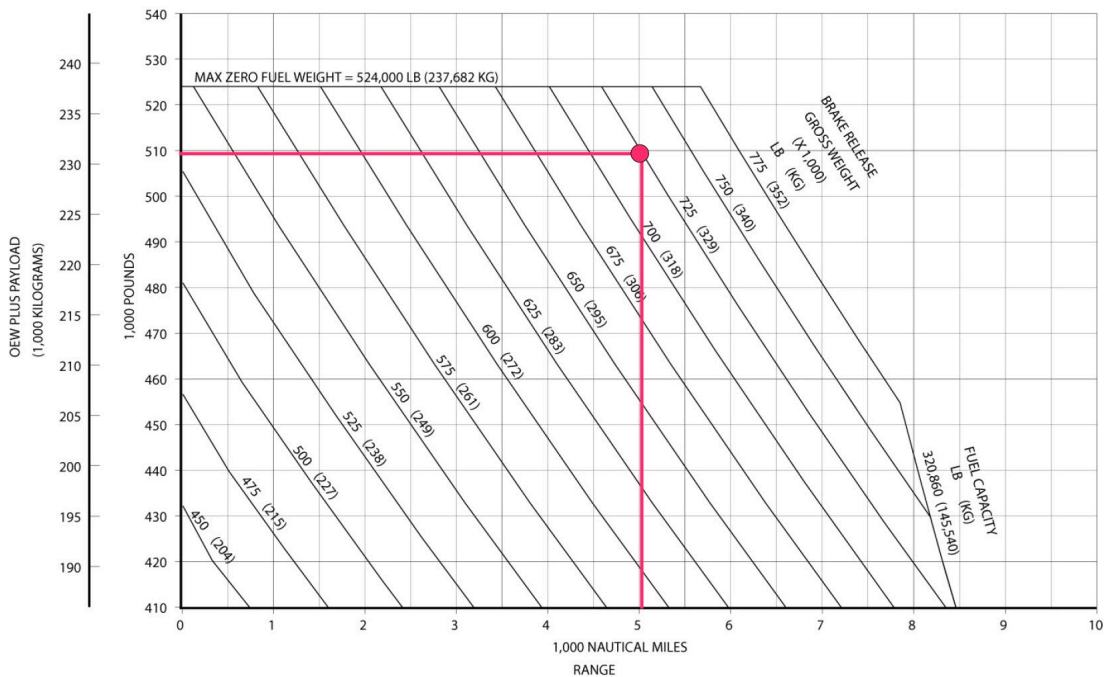Payload = 57,600 lb + 370(220) = 139,000 lb

OEW = 370,000 lb

OEW + Payload = 509,000 lb

Look at the Payload-Range diagram to estimate the desired takeoff weight (DTW). Figure 3.2.2 in Boeing Document.

DTW ~ 725,000 lb

Fuel weight ~ 216,000 lb (note this value is below the maximum usable fuel - OK)

Payload-Range Diagram for Boeing 777-300ER (source: Boeing)

Refer to Figure 3.3.10 to determine the takeoff runway length requirement. The runway length required is 9,200 feet.
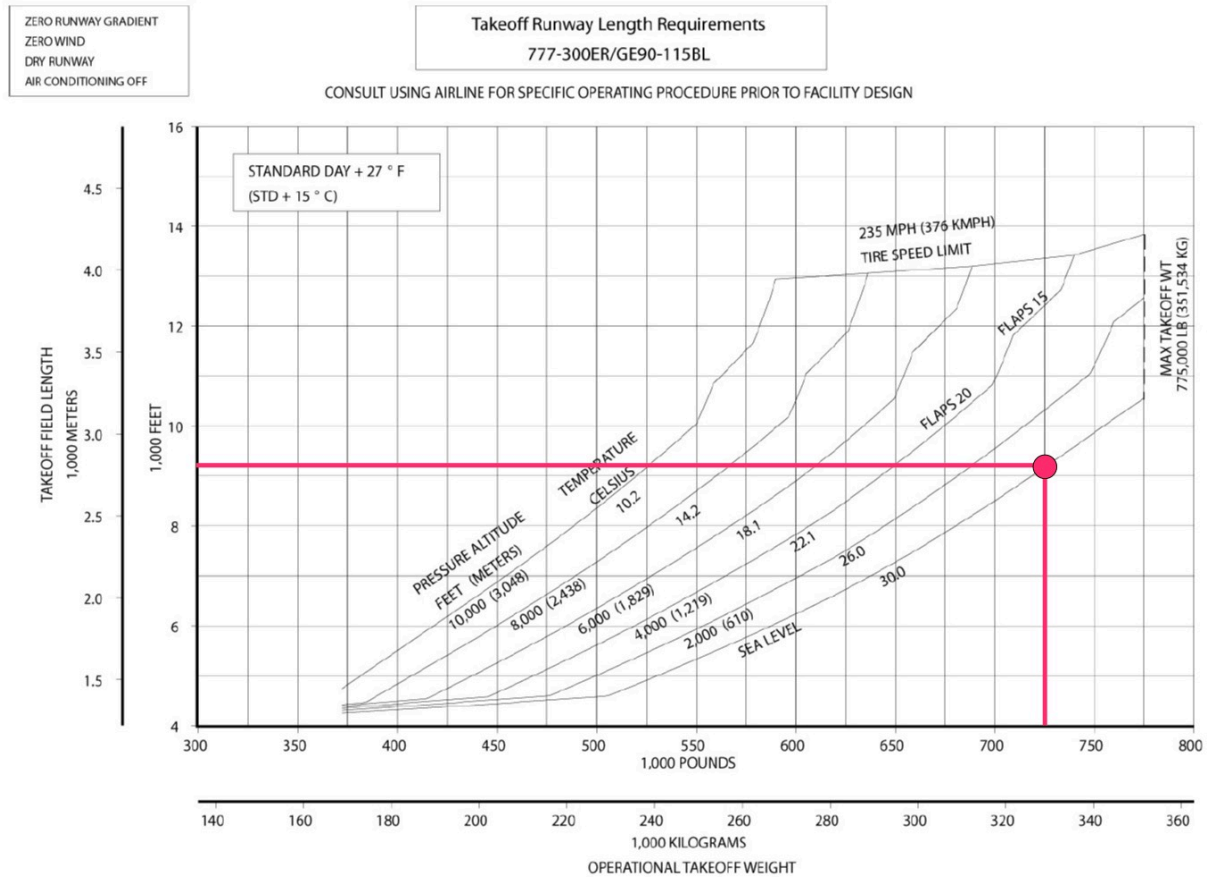
Correct for gradient 0.1% gradient

Runway is 8,926 feet long (airnav.com)

Equivalent change in centerline elevations ~ 8.93 feet

Add 10 feet for each 1 foot in change in elevation between centerline points.

New Runway Length (feet) = 9290 feet

FAR Takeoff Runway Length Requirements for Boeing 777-300ER with GE 90-115BL.

b) If the runway length design is not limited to the LAX-NRT critical route, what would be the runway length needed to operate with maximum flexibility the Boeing 777-300ER?

Runway length for maximum flexibility = 10,600 feet (corrected for gradient)

Problem # 2 (35 points) Short Answers

a) An airport with large corporate aircraft fleet is considering installing an Engineering Man-made Arresting System (EMAS). The current RSA distance is 495 feet. The critical aircraft is the Gulfstream G-III. Find the approximate length of the proposed EMAS system. State the design speed used. Can the airport install the EMAS in the space available?

EMAS Design Speed (knots) = 70 Knots (see FAA AC 150/5220-22A)

EMAS Length (feet) = 430 feet (includes 75 feet lead-in ramp) (see Figure A 2-7 in FAA AC 150/5220-22A)

b) For another airport with large corporate aircraft operations including the Gulfstream G500, find the FAA Runway Design Code (RDC).

RDC = Code C-III

c) For a general aviation airport, what is the minimum distance between two parallel runways to conduct simultaneous operations in VMC conditions?

Minimum Distance between Runways = 700 feet (see AC 150/5300-13a)

Problem #3 (25 points) - True/False

True or False

	Question	Answer
1	The width of the runway object free area for for an airport designed for a Gulfstream G500 is the same as the width of the runway safety area.	**false**
2	For the same takeoff mass and outside temperature, a Boeing 747-400 departing Miami, Florida requires less runway than departing Colorado Springs, Colorado.	**true**
3	Temperature design conditions used in runway length analysis normally exceed those contained in the International Standard Atmospheric conditions.	**true**
4	The runway length needed for small light sport utility aircraft is 1600 feet at 1,200 feet airport elevation.	**false**
5	The land area for the runway protection zone for an airport designed for a Gulfstream G500 may be as high as 79 acres.	**true**