



# **EAST AFRICAN SCHOOL OF AVIATION FINAL EXAMINATION**

**IATA/SAFETY SECTION**

**SUBJECT: MASS AND BALANCE**

**Stream: Flight Dispatch 23**

**Duration: 2Hrs**

**DATE: 15<sup>th</sup> Nov 2016**

**TIME: 0900AM –1100PM.**

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**Instructions to Candidate:**

- 1. This paper consist of two sections**
- 2. Answer all the questions in both sections**
- 3. Examination rules and regulations should be adhered to.**
- 4. Maximum marks are indicated on each question**
- 5. Total marks= 70**

**STUDENT'S NAME: -----**

**STUDENT'S NUMBER: -----**

## SECTION 1 :

**1. The actual 'Take-off Mass' is equivalent to:**

(1Mark)

- A* Actual Zero Fuel Mass plus the traffic load
- B* Dry Operating Mass plus the take-off fuel
- C* Actual Landing Mass plus the take-off fuel
- D* Dry Operating Mass plus take-off fuel and the traffic load

**2. The Zero Fuel Mass and the Dry Operating Mass**

- A* differ by the mass of usable fuel.
- B* differ by the value of the traffic load mass.
- C* are the same value.
- D* differ by the sum of the mass of usable fuel plus traffic load mass.

**3. Given the following :**

- Maximum structural take-off mass 66 000 kg
- Maximum structural landing mass: 58 000 kg
- Maximum zero fuel mass: 51 000 kg
- Dry operating mass: 31000kg
- Taxi fuel: 600 kg
- Contingency fuel: 2100 kg
- Alternate fuel: 1700 kg
- Final reserve fuel: 1 200 kg
- Trip fuel: 9 000 kg

**Determine the maximum take-off mass and the maximum allowed traffic load respectfully:**

(1Mark)

- A* 57 800 kg and 45000kg
- B* 51 700 kg and 14000kg
- C* 53 200 kg and 31000kg
- D* 65 000 kg and 20000kg

**4. The actual 'Zero Fuel Mass' is equal to the:**

(1Mark)

- A* Basic Empty Mass plus the fuel loaded.
- B* Actual Landing Mass plus trip fuel.
- C* Dry Operating Mass plus the total traffic load.
- D* Operating Mass plus the entire traffic load.

**5. Prior to departure the medium range twin jet airplane is loaded with maximum fuel of 20100 litres at a fuel density (specific gravity) of 0.78. Using the following data -**

- Performance limited take-off mass 67200 kg
- Performance limited landing mass 54200 kg
- Dry Operating Mass 34930 kg
- Taxi fuel 250 kg
- Trip fuel 9250 kg
- Contingency and holding fuel 850 kg
- Alternate fuel 700 kg

**The maximum permissible traffic load is**

(1Mark)

- A* 16470 kg
- B* 18040 kg
- C* 12840 kg
- D* 13090 kg.

**6** On an airplane without central fuel tank, the maximum Zero Fuel Mass is related to:

- A* Maximum Structural Take-Off Mass
- B* Wing loaded trip fuel.
- C* Variable equipment for the flight.
- D* The bending moment at the wing root

**7. The position of the center of gravity can always be determined by:**

- A* Dividing the total moment by the total mass
- B* Subtracting the total moment from the total mass
- C* Subtracting the total mass from the total moment
- D* Dividing the total mass by the total moment

(1Mark)

**8. The crew of a transport airplane prepares a flight using the following data:**

- Dry operating mass: 90 000 kg
- Block fuel: 30 800 kg
- Taxi fuel: 800 kg
- Maximum take-off mass: 145 000 kg

The traffic load available for this flight is:

(1Mark)

- A* 55 000 kg
- B* 55 800 kg
- C* 25 800 kg
- D* 25 000 kg

**9. What determines the longitudinal stability of an airplane?**

(1Mark)

- A) The relationship of thrust and lift to weight and drag
- B) The dihedral, angle of sweepback and the keel effect
- C*) The location of the centre of gravity with respect to the neutral point
- D) The effectiveness of the horizontal stabilizer, rudder and rudder trim

**10: The weight of an airplane, which is in level non accelerated flight, is said to act:**

- A Vertically through the centre of pressure
- B Vertically through the centre of gravity
- C* Always along the vertical axis of the airplane
- D Vertically through the datum point

**11. The crew of a transport airplane prepares a flight using the following data:**

- Block fuel: 40 000 kg
- Trip fuel: 29 000 kg
- Taxi fuel: 800 kg
- Maximum take-off mass: 170 000 kg
- Maximum landing mass: 148 500 kg
- Maximum zero fuel mass: 112 500 kg
- Dry operating mass: 80 400 kg

The maximum traffic load for this flight is:

(1Mark)

- A* 32 100 kg
- B* 32 900 kg
- C* 18 900 kg
- D* 40 400 kg

**12. Which is true of the airplane empty mass?**

(1Mark)

- A* It is a component of dry operating mass.
- B* It is dry operating mass minus fuel load.
- C* It is dry operating mass minus traffic load.
- D* It is the actual take-off mass, less traffic load.

**13. The mass of an airplane is 1950 kg. If 450 kg is added to a cargo hold 1.75 metres from the loaded centre of gravity (cg). The loaded cg will move by:** (1Mark)

- A 33 cm.
- B 40 cm.
- C 30 cm.
- D 34 cm.

**14. Which of the following is not true regarding a certified transport category aircraft of less than 10 passengers** (1Mark)

- A May accept verbal mass from or on behalf of each passenger while computing traffic load
- B May estimate total mass of the passengers and add a predetermined constant to account for carryon bag
- C May estimate the cargo mass and add predetermined constant to cater for errors
- D May compute actual mass of passengers and baggage through actual weighing

**15. For a large aircraft where the main and nose landing gears retract forward, the effect on the CG on lowering the gear is:** (1Mark)

- A to move forward
- B to remain static
- C to move forward then aft
- D to move aft

**16. The mass displacement caused by landing gear extension:** (1Mark)

- A creates a pitch-down longitudinal moment
- B creates a pitch-up longitudinal moment
- C creates a longitudinal moment in the direction (pitch-up or pitch-down) determined by the type of landing gear
- D does not create a longitudinal moment

**17. With the centre of gravity on the forward limit which of the following is to be expected?** (1Mark)

- A A tendency to yaw to the right on take-off
- B A decrease in range
- C A decrease in the landing speed
- D A decrease of the stalling speed

**18. The maximum zero fuel mass is a mass limitation for the:** (1Mark)

- A allowable load exerted upon the wing considering a margin for fuel tanking
- B total load of the fuel imposed upon the wing
- C strength of the wing root
- D strength of the fuselage

**19. Which of the following is unlikely to have any effect on the position of the centre of gravity on an airplane in flight ?** (1Mark)

- A Lowering the landing gear.
- B Movement of cabin attendants going about their normal duties
- C Normal consumption of fuel for a swept wing airplane
- D Changing the tail plane (horizontal stabilizer) incidence angle

**20. Given that the total mass of an airplane is 112 000 kg with a centre of gravity position at 22.62m aft of the datum. The centre of gravity limits are between 18m and 22m. How much mass must be removed from the rear hold (30 m aft of the datum) to move the centre of gravity to the middle of the limits:** (1Mark)

- A 8 680 kg
- B 43 120 kg
- C 29 344 kg

*D* 16 529 kg

**21. For the purpose of completing the Mass and Balance documentation, the Operating Mass is considered to be Dry Operating Mass plus** (1Mark)

- A** Ramp Fuel Mass
- B** Trip Fuel Mass
- C** Ramp Fuel Mass less the fuel for APU and run-up.
- D** Take-off Fuel Mass.

**22. For the purpose of completing the Mass and Balance Documentation, the Dry Operating Mass is defined as:** (1Mark)

- A** The total mass of the airplane ready for a specific type of operation excluding all usable fuel and traffic load.
- B** The total mass of the airplane ready for a specific type of operation excluding all usable fuel
- C** The total mass of the aero plane ready for a specific type of operation excluding all traffic load
- D** The total mass of the airplane ready for a specific type of operation excluding crew and crew baggage

**23. An additional baggage container is loaded into the aft cargo compartment but is not entered into the load and trim sheet. The airplane will be heavier than expected and calculated take-off safety speeds** (1Mark)

- A** will give reduced safety margins.
- B** will not be achieved.
- C** will be greater than required.
- D** are unaffected but V1 will be increased

**24. An airplane is weighed and the following recordings are made:**  
nose wheel assembly scale 5330 kg  
left main wheel assembly scale 12370 kg  
right main wheel assembly scale 12480 kg  
If the 'operational items' amount to a mass of 1780 kg with a crew mass of 545 kg, the empty mass, as entered in the weight schedule, is (1Mark)

- A** 32505 kg
- B** 30180 kg
- C** 28400 kg
- D** 31960 kg

**25. After weighing a helicopter the following values are noted:**

**forward point: 350 kg**  
**aft right point: 995 kg**  
**aft left point: 1 205 kg**

**What is the longitudinal CG-position in relation to the datum situated 4 m in front of the rotor axis, knowing that the forward point is at 2.5 m forward of the rotor axis and the aft points are 1 m aft of the rotor axis?**

(1Mark)

- A** 4.52 m
- B** 4.09 m
- C** 4.21 m
- D** 4.15 m

**26. With respect to airplane loading in the planning phase, which of the following statements is always correct ?**

**LM = Landing Mass, TOM = Take-off Mass, MTOM = Maximum Take-off Mass  
ZFM = Zero Fuel Mass, MZFM = Maximum Zero Fuel Mass, DOM = Dry Operating Mass**

**(1Mark)**

- A** LM = TOM - Trip Fuel
- B** MTOM = ZFM + maximum possible fuel mass
- C** MZFM = Traffic load + DOM
- D** Reserve Fuel = TOM - Trip Fuel

**27. Which is true of the airplane empty mass?**

**(1Mark)**

- A** It is a component of dry operating mass.
- B** It is dry operating mass minus fuel load.
- C** It is dry operating mass minus traffic load.
- D** It is the actual take-off mass, less traffic load

**28. Total mass: 7500 kg. Centre of gravity (cg) location station: 80.5**

**Aft cg limit station: 79.5. How much cargo must be shifted from the aft cargo compartment at station 150 to the forward cargo compartment at station 30 in order to move the cg location to the aft limit?**

**(1Mark)**

- A** 65.8 kg.
- B** 68.9 kg.
- C** 73.5 kg.
- D** 62.5 kg.

**29. An airplane is to depart from an airfield at a take-off mass of 302550 kg. Fuel on board at take-off (including contingency and alternate of 19450 kg) is 121450 kg. The Dry Operating Mass is 161450 kg. The useful load will be**

**(1Mark)**

- A** 19650 kg
- B** 121450 kg
- C** 39105 kg
- D** 141100 kg

**30. The following results were obtained after weighing a helicopter :**

- mass at front point: 300 kg**
- mass at right rear point : 1 100 kg**
- mass at left rear point : 950 kg**

**It is given that the front point is located 0.30 m left of the longitudinal axis and the rear points are symmetrically located 1.20 m from this axis.**

**The helicopter's lateral CG-position relative to the longitudinal axis is:**

**(1Mark)**

- A** 4 cm left
- B** 11 cm right
- C** 11 cm left
- D** 4 cm right

**31. At a given mass the CG position is at 15% MAC. If the leading edge of MAC is at a position 625.6 inches aft of the datum and the MAC is given as 134.5 inches determine the position of the CG in relation to the datum.**

**(1Mark)**

- A** 228.34 inches aft of datum
- B** 645.78 inches aft of datum
- C** 20.18 inches aft of datum
- D** 605.43 inches aft of datum

**32. The floor limit of an aircraft cargo hold is 5 000 N/m<sup>2</sup>. It is planned to load-up a cubic container measuring 0,4m of side. It's maximum gross mass must not exceed: (assume  $g=10\text{m/s}^2$ )** (1Mark)

- A** 32 kg
- B** 320 kg
- C** 80 kg
- D** 800 kg

**33. The maximum load per running metre of an airplane is 350 kg/m. The width of the floor area is 2 metres. The floor strength limitation is 300 kg per square metre. Which one of the following crates (length x width x height) can be loaded directly on the floor?** (1Mark)

- A** A load of 400 kg in a crate with dimensions 1.2 m x 1.2 m x 1.2 m.
- B** A load of 500 kg in a crate with dimensions 1.5 m x 1 m x 1m.
- C** A load of 400 kg in a crate with dimensions 1.4 m x 0.8 m x 0.8 m.
- D** A load of 700 kg in a crate with dimensions 1.8 m x 1.4 m x 0.8 m.

**34. A location in the airplane which is identified by a number designating its distance from the datum is known as:** (1Mark)

- A** Station.
- B** Moment.
- C** MAC.
- D** Index.

**35. Loads must be adequately secured in order to:** (1Mark)

- A** Avoid unplanned centre of gravity (cg) movement and aircraft damage.
- B** Avoid any centre of gravity (cg) movement during flight.
- C** Prevent excessive 'g'-loading during the landing flare.
- D** Allow steep turns.

**36. The following data applies to an airplane which is about to take off:** (1Mark)

**Certified maximum take-off mass 141500 kg**  
**Performance limited take-off mass 137300 kg**  
**Dry Operating Mass 58400 kg**  
**Crew and crew hand baggage mass 640 kg**  
**Crew baggage in hold 110 kg**  
**Fuel on board 60700 kg**

**From this data calculate the mass of the useful load.**

**(1Mark)**

- A** 17450 kg
- B** 78900 kg
- C** 78150 kg
- D** 18200 kg

**37. The mass and balance information gives :**

**Basic mass : 1 200 kg ; Basic balance arm : 3.00 m**

**Under these conditions the Basic centre of gravity is at 25% of the mean aerodynamic chord (MAC). The length of MAC is 2m.**

**In the mass and balance section of the flight manual the following information is given :**

<b>Position</b>	<b>Arm</b>
<b>front seats :</b>	<b>2.5 m</b>
<b>rear seats :</b>	<b>3.5 m</b>
<b>rear hold :</b>	<b>4.5 m</b>
<b>fuel tanks :</b>	<b>3.0 m</b>

**The pilot and one passenger embark; each weighs 80kg. Fuel tanks contain 140 litres of petrol with a density of 0.714. The rear seats are not occupied. Taxi fuel is negligible.**

**The position of the centre of gravity at take-off (as %MAC) is :** (1Mark)

- A** 29 %
- B** 34 %
- C** 45 %
- D** 22 %

**38. The centre of gravity of an airplane is that point through which the total mass of the airplane is said to act. The weight acts in a direction** (1Mark)

- A** at right angles to the flight path
- B** governed by the distribution of the mass within the airplane.
- C** parallel to the gravity vector
- D** always parallel to the airplane's vertical axis

**39. In mass and balance calculations which of the following describes the datum? (1Mark)**

- A** It is the most forward position of the centre of gravity.
- B** It is the most aft position of the centre of gravity.
- C** It is the distance from the centre of gravity to the point through which the weight of the component acts.
- D** It is the point on the airplane designated by the manufacturers from which all centre of gravity measurements and calculations are made.

**40. The maximum floor loading for a cargo compartment in an airplane is given as 750 kg per square metre. A package with a mass of 600 kg. is to be loaded. Assuming the pallet base is entirely in contact with the floor, which of the following is the minimum size pallet that can be used?** (1Mark)

- A** 30 cm by 200 cm
- B** 40 cm by 300 cm
- C** 40 cm by 200 cm
- D** 30 cm by 300 cm

## **SECTION 2 :**

From the provided annex-A and the below information, complete a Load sheet and balance chart then give the c.g condition at zero fuel mass and takeoff mass.

### **A: FLIGHT INFORMATION**

Flight No.: KQ222 Reg: 5Y-KKL, Date: 15Sep2016, Flight Origin: NBO

Destination: DXB.

Message recipients: DXBKRKL & DXBKDKQ, Message to send: CPM

### **B: AIRCRAFT DATA**

Basic Empty Mass= **92,500kg**; Basic Empty index=+ 95.5

Crew 2/09 = **1,100kg**; Crew index effect= + 1.5

Crew bags= **600kg**; Crew bags index effect= +0.5

Pantry = **4,500kg**; Pantry index effect= - 1.0

01 Extra crew= **100kg**; Extra crew index effect= -0.5

Stretcher used on board = **1,200kg**; Stretcher index effect= +0.5

03 Deadheading crew = **300kg** index effect -0.8

Ramp/Block fuel= **50,500kg**, Taxi fuel=**500kg** and Trip fuel = **40,000kg**.

The takeoff fuel index effect from the fuel table is +6 Index Units



**C: TRAFFIC INFORMATION; PASSENGERS**

**241** passengers are on board in the following category; Males are **120**, females are **110**, children are **10** and an infant is only **01**.

As per the airline books average mass per passenger category is M=**80**kg, F=**70**kg, C= **50**kg and I=**10**kg.

Each passenger excluding infants is allowed **20**kg of check-in baggage that will be loaded belly and **10**kg per head as cabin/carry-on baggage.

When loading checked-in baggage, it's been confirmed that a single AKE can carry a max baggage mass of **700**kg and the empty AKE weighs **80**kg

The passengers are said to seat in the aircraft cabin as follows; Front first cabin treated as first class cabin = **18** pax, second cabin treated as the business cabin= **42** Pax, middle cabin treated as the second economy = **70** pax and the rest = **111**pax in the rear cabin with the only infant found in the rear cabin

**D: TRAFFIC INFORMATION; CARGO AND MAIL**

Refer to the attached annex of a "loading Instructions/report" for traffic information pertaining cargo and mail

**END**