



EAST AFRICAN SCHOOL OF AVIATION
EXAMINATION
SAFETY SECTION

DIPLOMA IN FLIGHT DISPATCH

FLD 37/38

FINAL EXAMINATION

SUBJECT: MASS AND BALANCE

Duration: 02 Hrs: 00 Min

DAY/DATE:

TIME:

Instructions to Candidate:

1. Total marks are 70
2. This paper consists of Ten (10) printed pages
3. Examination rules and regulations shall be adhered to
4. Answer all the questions in section one and section two

SECTION A 40 MARKS

1) Prior to departure the medium range twin jet aeroplane 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

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

2) The responsibility for determination of the mass of 'operating items' and 'crew members' included within the Dry Operating Mass lies with

- A. the commander.
- B. the authority of the state of registration.
- C. the person compiling the weighing schedule.
- D. the operator.

3) The stalling speed of an aeroplane will be highest when it is loaded with a:

- A. low gross mass and forward centre of gravity.
- B. low gross mass and aft centre of gravity.
- C. high gross mass and aft centre of gravity.
- D. high gross mass and forward centre of gravity.

4) During a violent avoidance manoeuvre, a light twin aircraft, certified to FAR 23 requirements was subjected to an instantaneous load factor of 4.2. The Flight Manual specifies that the aircraft is certified in the normal category for a load factor of -1.9 to +3.8.

Considering the certification requirements and taking into account that the manufacturer of the twin did not include, during its conception, a supplementary margin in the flight envelope, it might be possible to observe;

- A. a permanent deformation of the structure
- B. a elastic deformation whilst the load was applied, but no permanent distortion
- C. no distortion, permanent or temporary of the structure
- D. rupture of one or more structural components

5) The actual 'Zero Fuel Mass' is equal to the:

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

6) The empty mass of an aeroplane is recorded in

- A the weighing schedule and is amended to take account of changes due to modifications of the aeroplane.T

B the weighing schedule. If changes occur, due to modifications, the aeroplane must be re-weighed always.

C the loading manifest. It differs from Dry Operating Mass by the value of the 'useful load'.

D the loading manifest. It differs from the zero fuel mass by the value of the 'traffic load'.

7) The actual 'Take-off Mass' is equivalent to:

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

8) Given that the total mass of an aeroplane 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:

A 8 680 kg

B 43 120 kg

C 29 344 kg

D 16 529 kg

9) Which of the following is unlikely to have any effect on the position of the centre of gravity on an aeroplane in flight ?

A Lowering the landing gear.

B Movement of cabin attendants going about their normal duties.

C Normal consumption of fuel for a swept wing aeroplane.

D Changing the tailplane (horizontal stabiliser) incidence angle.

10) The distance from the datum to the Centre of Gravity of a mass is known as

A the lever.

B the moment.

C the index.

D the moment arm or balance arm.

11) At a mass of 1 800 kg, a helicopter equipped with a winch has a lateral CG-position of 5 cm to the left. The CG of the load suspended from the winch is at a distance of 60 cm to the right. With a winch load of 200 kg the lateral CG-position of the helicopter will be:

A 10,5 cm to the right

B 1.5 cm to the right

C 1.5 cm to the left

D 10.5 cm to the right

12) Length of the mean aerodynamic chord = 1 m

Moment arm of the forward cargo: -0,50 m

Moment arm of the aft cargo: + 2,50 m

The aircraft mass is 2 200 kg and its centre of gravity is at 25% MAC

To move the centre of gravity to 40%, which mass has to be transferred from the forward to the aft cargo hold?

A 183 kg

B 165 kg

C 104 kg

D 110 kg

13) To calculate a usable take-off mass, the factors to be taken into account include:

- A Maximum zero fuel mass augmented by the fuel burn.
- B Maximum take-off mass decreased by the fuel burn.
- C Maximum landing mass augmented by the fuel burn.
- D Maximum landing mass augmented by fuel on board at takeoff.

14) For the purpose of completing the Mass and Balance documentation, the Operating Mass is considered to be Dry Operating Mass plus

- 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.

15) For the purpose of completing the Mass and Balance documentation, the Dry Operating Mass is defined as:

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

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

- 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.

17) Determine the Landing Mass for the following single engine aeroplane.

Given:

Standard Empty Mass :1764 lbs

Optional Equipment : 35 lbs

Pilot + Front seat passenger : 300 lbs

Cargo Mass : 350 lbs

Ramp Fuel = Block Fuel : 60 Gal.

Trip Fuel : 35 Gal.

Fuel density: 6 lbs/Gal.

- A 2659 lbs
- B 2449 lbs
- C 2589 lbs
- D 2799 lbs

18) Given the following :

- Maximum structural take-off mass 48 000 kg
- Maximum structural landing mass: 44 000 kg
- Maximum zero fuel mass: 36 000 kg
- Taxi fuel: 600 kg
- Contingency fuel: 900 kg

- Alternate fuel: 800 kg
- Final reserve fuel: 1 100 kg
- Trip fuel: 9 000 kg

Determine the actual take-off mass:

- A 47 800 kg
- B 48 000 kg
- C 48 400 kg
- D 53 000 kg

19) An aeroplane is weighed prior to entry into service. Who is responsible for deriving the Dry Operational Mass from the weighed mass by the addition of the 'operational items' ?

- A The aeroplane manufacturer or supplier.
- B The commander of the aeroplane.
- C The Operator.
- D The appropriate Aviation Authority.

20) If an aeroplane is at a higher mass than anticipated, for a given airspeed the angle of attack will

- A remain constant, drag will decrease and endurance will decrease.
- B remain constant, drag will increase and endurance will increase.
- C be greater, drag will increase and endurance will decrease.
- D be decreased, drag will decrease and endurance will increase.

21) C In calculations with respect to the position of the centre of gravity a reference is made to a datum. The datum is

- A an arbitrary reference chosen by the pilot which can be located anywhere on the aeroplane.
- B calculated from the data derived from the weighing procedure carried out on the aeroplane after any major modification.
- C a reference plane which is chosen by the aeroplane manufacturer. Its position is given in the aeroplane Flight or Loading Manual.
- D calculated from the loading manifest.

22) The crew of a transport aeroplane prepares a flight using the following data: - Dry operating mass: 90 000 kg

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

The traffic load available for this flight is:

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

23) The Basic Mass of a helicopter is the mass of the helicopter without crew, :

- A without payload, with specific equipment for the mission, without the unusable fuel.
- B without specific equipment for the mission, without payload, without unusable fuel.
- C without specific equipments for the mission, without payload, with fuel on board.
- D without specific equipment for the mission, without payload, with the unusable fuel and standard equipment.

24) D With the centre of gravity on the forward limit which of the following is to be expected?

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

24) An aeroplane 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

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

25) The Dry Operating Mass of an aircraft is 2 000 kg. The maximum take-off mass, landing and zero fuel mass are identical at 3500 kg. The block fuel mass is 550kg, and the taxi fuel mass is 50 kg. The available mass of payload is:

- A 1 000 kg
- B 950 kg
- C 1 500 kg
- D 1 450 kg

26) If the centre of gravity is near the forward limit the aeroplane will:

- A require elevator trim which will result in an increase in fuel consumption.
- B benefit from reduced drag due to the decrease in angle of attack.
- C require less power for a given airspeed.
- D tend to over rotate during take-off.

27) The maximum quantity of fuel that can be loaded into an aeroplane's tanks is given as 3800 US Gallons. If the fuel density (specific gravity) is given as 0.79 the mass of fuel which may be loaded is

- A 13647 kg.
- B 11364 kg.
- C 14383 kg.
- D 18206 kg.

28) An aeroplane may be weighed

- A in an area of the airfield set aside for maintenance.
- B at a specified 'weighing location' on the airfield.
- C in an enclosed, non-air conditioned, hangar.
- D in a quiet parking area clear of the normal manoeuvring area.

29) An aeroplane must be re-weighed at certain intervals. Where an operator uses 'fleet masses' and provided that changes have been correctly documented, this interval is

- A whenever a major modification is carried out.
- B 9 years for each aeroplane.
- C 4 years for each aeroplane.
- D whenever the Certificate of Airworthiness is renewed.

30) 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?

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

31) The term 'useful load' as applied to an aeroplane includes

- A the revenue-earning portion of traffic load only.
- B the revenue-earning portion of traffic load plus useable fuel.
- C traffic load plus useable fuel.
- D traffic load only.

32) Given: Dry operating mass = 38 000 kg maximum structural take-off mass = 72 000 kg maximum landing mass = 65 000 kg maximum zero fuel mass = 61 000 kg Fuel burn = 8 000 kg Take-off Fuel = 10 300 kg

The maximum allowed take-off mass and payload are respectively :

- A 73 000 kg and 27 000 kg
- B 71 300 kg and 23 000 kg
- C 71 300 kg and 25 300 kg
- D 73 000 kg and 24 700 kg

33) While making mass and balance calculation for a particular aeroplane, the term 'Empty Mass' applies to the sum of airframe, engine(s), fixed ballast plus

- A all the oil, fuel, and hydraulic fluid but not including crew and traffic load.
- B all the consumable fuel and oil, but not including any radio or navigation equipment installed by manufacturer.
- C all the oil and fuel.
- D unusable fuel and full operating fluids.

34) What determines the longitudinal stability of an aeroplane ?

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

35) Which of the following statements is correct?

- A If the actual centre of gravity is close to the forward limit of the centre of gravity the aeroplane may be unstable, making it necessary to increase elevator forces
- B The lowest stalling speed is obtained if the actual centre of gravity is located in the middle between the aft and forward limit of centre of gravity
- C A tail heavy aeroplane is less stable and stalls at a lower speed than a nose heavy aeroplane
- D If the actual centre of gravity is located behind the aft limit of centre of gravity it is possible that the aeroplane will be unstable, making it necessary to increase elevator

36) Which is true of the aeroplane empty mass?

- 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.

37) The following data is extracted from an aeroplane's loading manifest:

Performance limited take-off mass 93500 kg

Expected landing mass at destination 81700 kg

Maximum certificated landing mass 86300 kg

Fuel on board 16500 kg

During the flight a diversion is made to an en-route alternate which is not 'performance limited' for landing.

Fuel remaining at landing is 10300 kg. The landing mass

A is 87300 kg and excess structural stress could result

B is 83200 kg which is in excess of the regulated landing mass and could result in overrunning the runway

C must be reduced to 81700 kg in order to avoid a high speed approach.

D is 87300 kg which is acceptable in this case because this is a diversion and not a normal scheduled landing.

38) The mass displacement caused by landing gear extension:

A creates a pitch-up longitudinal moment

B does not create a longitudinal moment

C creates a pitch-down longitudinal moment

D creates a longitudinal moment in the direction (pitch-up or pitch-down) determined by the type of landing gear

39) A revenue flight is to be made by a jet transport. The following are the aeroplane's structural limits:

-Maximum Ramp Mass: 69 900 kg

-Maximum Take Off Mass: 69 300 kg

-Maximum Landing Mass: 58 900 kg

-Maximum Zero Fuel Mass: 52 740 kg

The performance limited take off mass is 67 450kg and the performance limited landing mass is 55 470 kg.

Dry Operating Mass: 34 900 kg

Trip Fuel: 6 200 kg

Taxi Fuel: 250 kg

Contingency & final reserve fuel: 1 300 kg

Alternate Fuel: 1 100 kg

The maximum traffic load that can be carried is:

A 25 800 kg

B 17 840 kg

C 18 170 kg

D 13 950 kg

40) During take-off you notice that, for a given elevator input, the aeroplane rotates much more rapidly than expected. This is an indication that :

A the centre of pressure is aft of the centre of gravity.

B the centre of gravity may be towards the aft limit.

C the aeroplane is overloaded.

D the centre of gravity is too far forward.

SECTION B 30 MARKS**MASS & BALANCE PROCESS: COMPLETION OF A LOAD PLAN- LOAD SHEET & BALANCE CHART****A: FLIGHT INFORMATION**

Flight No.: EA007, Reg: 5Y-EASA, Date: 07th Oct 2019

Flight Origin: NBO, Destination: DXB.

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

B: AIRCRAFT DATA

Maximum Structural Taxi Mass 63,060 kg

Maximum Structural Take-off Mass 62,800 kg

Maximum Structural Landing Mass 54,900 kg

Maximum Structural Zero Fuel Mass 51,300 kg

Mean Aerodynamic Chord (MAC) 134.5 inches

MAC Leading edge 625.6 inches aft of datum

Maximum Passenger Load 141

C. TRAFFIC INFORMATION PASSENGERS

DOM 34,300 kg

DOI 45.0

Passengers

130

Average Passenger Mass

84 kg

Baggage

130 items at 14 kg per piece

Cargo

630 kg

Take-off Fuel Total

14,500 kg (FUEL INDEX -12.9)

Trip Fuel

8,500 kg

Question: From the above information complete a Load Plan, Load sheet and balances charts and answer.