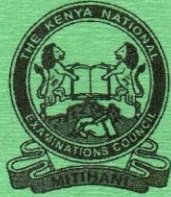


2506/302

FLIGHT MECHANICS

June/July 2018

Time: 3 hours



THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN AERONAUTICAL ENGINEERING  
(AIRFRAMES AND ENGINES OPTION)

MODULE III

FLIGHT MECHANICS

3 hours

### INSTRUCTIONS TO CANDIDATES

*The candidate should have the following for this examination:*

*Answer booklet;*

*Drawing instruments;*

*Mathematical table/Non-programmable Scientific calculator.*

*This paper consists of EIGHT questions.*

*Answer FIVE questions in the answer booklet provided.*

*Maximum marks for each part of a question are as shown.*

*Candidates should answer the questions in English.*

**This paper consists of 3 printed pages.**

**Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.**



- (a) With the aid of sketches, describe the operation of a rate of climb indicator when the aircraft is:
- (i) level;
  - (ii) descending;
  - (iii) climbing.
- (10 marks)
- (b) Outline **four** factors that gyroscopic rigidity in space depends upon. (4 marks)
- (c) Illustrate the “T” arrangement of the basic flight instruments. (3 marks)
- (d) Calculate the true airspeed of an aircraft flying at 6,000 feet and speed at sea level is 204 knots. Take sea level density  $1.225 \text{ kg/m}^3$  and  $0.66 \text{ kg/m}^3$  at 6,000 m altitude. (3 marks)

With the aid of labelled sketches:

- (a) Show the difference between blow-through and induced flow type high speed wind tunnels; (10 marks)
- (b) Describe the flow pattern of airflow at supersonic speed on a thin plate placed at a small angle of attack. (10 marks)
- (a) Differentiate between Subsonic and Supersonic flow on contracting and expanding ducts. (4 marks)
- (b) With the aid of sketches, explain why swept back wings are suitable at transonic speeds. (11 marks)
- (c) Outline **five** methods of protecting supersonic structure from heat. (5 marks)

With the aid of labelled sketches, describe the procedure for launching a spacecraft to the moon. (20 marks)

5. (a) An artificial satellite of mass 200 kg is travelling in an orbit round the equator. Given it is at a height of 36,000 km above the earth's surface calculate:
- (i) acceleration due to gravity;
  - (ii) speed of motion;
  - (iii) orbital period;
  - (iv) weight of the satellite.

(12 marks)



- (b) Calculate the circular velocity and time taken by a satellite near the earth's surface. (8 marks)
6. (a) Given the total drag of an aeroplane at 65 m/s is 4.22 kN and the power developed by the engine when it is flying at this speed is 336 kW. Calculate the efficiency of the propeller. (6 marks)
- (b) With the aid of labelled sketches, differentiate between the construction and operation of ram and pulse jet engines. (14 marks)
- (a) Outline **four** objectives of test flight in aeronautical engineering. (4 marks)
- (b) Highlight **six** major considerations during preparation phase of test flight. (6 marks)
- (c) Outline **five** checks done on each of the following manoeuvres during test flight:
- (i) climbing;
  - (ii) approach.
- (10 marks)
8. (a) When a sudden contraction is used in a horizontal pipe from 400 m to 200 m the pressure changes from 100 Kpa to 80 Kpa. If the coefficient of contraction for the jet is 0.62, find the discharge through the pipe. (10 marks)
- (b) A horizontal pipe of 200 m diameter suddenly enlarges to 300 m diameter. After some length, it suddenly reduces to 150 mm diameter. If water flowing in the pipe is 200 litres, determine the:
- (i) loss of head due to sudden enlargement;
  - (ii) loss of head due to sudden contraction.
- (10 marks)

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