4.22 AVIATION TECHNOLOGY (450)

4.22.1 Aviation Technology Paper 1 (450/1)

1. (a) **Causes of electric shock**
   - (i) frayed cables
   - (ii) unearthed plugs
   - (iii) uninsulated connections
   - (iv) wet hands
   - (v) studded shoes
   - (vi) faulty equipment
   - (vii) wet floors
   - (viii) electric overload

   Any $4 \times \frac{1}{2} = 2$ **marks**

   (b) **Reasons for bonding**
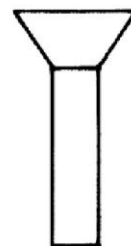   To prevent fire due to static electricity.
   $1 \times 1 = 1$ **mark**

2. (a) Mechanical property of a material is the ability to perform the duty assigned to it satisfactorily - **1 mark** while chemical property is the ability of the material to react with other materials when in contact. - **1 mark**

   (b)

   SPRING WASHER Sketch = $\frac{1}{2}$ mk Use = $\frac{1}{2}$ mk

   COUNTERSUNK RIVET Sketch = $\frac{1}{2}$ mk Use = $\frac{1}{2}$ mk

   WOODRUFF KEY Sketch = $\frac{1}{2}$ mk Use = $\frac{1}{2}$ mk

   TOTAL = 3 mks

   Uses
   - Spring washer is used for locking where there are vibrations.
   - Woodruff key is used for locking tapered shafts.
   - Countersunk rivet is used for joining metals in flush areas.

3. (a) **Environmental issues associated with the aviation industry:**
   - (i) aircraft noise is disturbance to the public.
   - (ii) air pollutants causes minor effects on the respiratory system which may lead to premature mortality depending on the extend of exposure.

   $2 \times 1 = 2$ **marks**

   (b) **Clouds with vertical development:**
   - cumulus
   - cumulonimbus.

   $2 \times \frac{1}{2} = 2$ **marks**

4. (a) **Challenges that affect performance or airlines:**
    (i)   CAA regulations in different countries
    (ii)   operating costs
    (iii)   environmental concerns in different countries
    (iv)   manpower available in different countries
    (v)   infrastructure
    (vi)   insecurity
    (vii)   safety
    (viii) natural calamities
    (ix)   stiff competition among various airlines

    Any 3 x 1 = 3 marks

    (b) Functions of

    Penetrants - seep through a flaw if it exists in a component being tested.
    Developer - reveals the existence of flaw if it exists.

    (2 x 1 = 2 marks)

5. (a) Honey - comb structures are joined by bonding/gluing.
    Engine fire wall is joined by welding/riveting.

    (2 x 1 = 2 marks)

6.   (i) Reciprocating Engine

    Generates thrust by rotating a propeller to accelerate a large mass of Air at a relatively low velocity rearwards.

    This creates a reaction according to Newtons third Law of motion for every action there is an opposite and equal reaction.

    This principle pulls or pushes the aircraft forward.

    $(2\frac{1}{2}$ marks)

        (ii) Pure Jet Engine

        Generates thrust by accelerating a small amount of air at a very High velocity rearwards.

        This creates a reaction according to Newtons Third law of motion for every action there is an opposite and equal reaction.

        This principle pulls or pushes the aircraft forward.

        $(2\frac{1}{2}$ marks)

        (5 marks)

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7.

Stress	Where applicable
Tension	Fuse lage
Compression	Landing gear
Shear	Stressed skin
Bending	Wings
Torsion	Neutral axis

(5 x 1 = 5 marks)

8.   (a)   Outline four functions of an aircraft under carriage.

Answers:

(i)   To support the aircraft in a stable altitude
(ii)   To provide mobility on the ground
(iii)   To absorb landing loads
(iv)   To dampen noise and vibration during taxing
(v)   To provide a means of steering
(vi)   To provide a means of braking

Any 4 x 1 = 4 marks

(b)   Basic principles of air navigation

(i)   The process of planning
(ii)   ––Recording
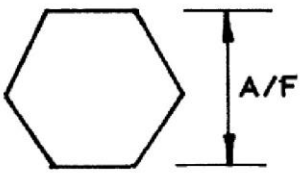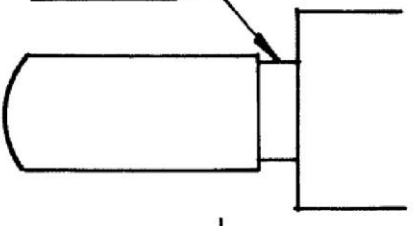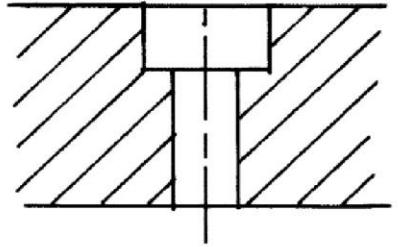(iii)   Controlling the movement of aircraft from one place to another.

(3 x 1 = 3 marks)

9.   SOLUTION

(i)   Having highly polished aircraft surfaces to reduce the thickness of the boundary layer
(ii)   Bleeding away the boundary layer through many small air inlets on the wings using vacuum pressure
(iii)   Re-energizing by mixing free stream airflow into the boundary layer air using vortex generators
(iv)   Bleeding boundary layer air away from the engine intakes that are close to the fuselage, or designing the air intakes so that it is away from the surface of the fuselage.
(v)   Painting

(5 x 1 = 5 marks)

10.

NAME	ABBREVIATION	SYMBOL
Across flats	A/F	
Undercut	U CUT	
Counterbore	C/BORE	
Centreline	₵	

4 x 1 = 4 mks

11.   (a)   Causes of 75% of air accidents

   (i)   Poor decision making
   (ii)   Ineffective communication
   (iii)   Inadequate leadership
   (iv)   Poor management
   (v)   Poor maintenance
   (vi)   Drag abuse

(Any 4 x 1 = 4 marks)

(b)   Business opportunities

(i)   General transport - in transportation of people and goods / cargo from one place to another expediently i.e within a short time
(ii)   Aerial photography - for mapping and reconnaissance
(iii)   Agricultural use - spraying pests and fertilizer in large farms
(iv)   Displays - for performing air-shows
(v)   Ambulance/emergency rescue
(vi)   Training and repair functions

(Any 3 x 2 = 6 marks)

(c)   (i)   Marshaller directs the pilot by giving signals during ground operations eg Engine start up prior to take off (taxing) after landing (parking)

(ii)   Flight engineer - supervises the working of engines, watches the aircraft instruments and equipment to ensure they function properly on long flights

(iii)   Air traffic controller - ensures expediency in aircraft movement and safety by giving instructions and information to the pilot.

(iv)   Purser - is the lead cabin attendant who keeps the account during flight and is in-charge of emergency evacuations.

12.   (a)   Outline four methods used to vary fuel flow on aircraft engine

(i)   Throttle movement
(ii)   Variation in air temperature
(iii)   Rapid acceleration (pump) by power demand
(iv)   Computerize (Computer control)

(4 x 1 = 4 marks)

(b)   The piston moves from Top Dead Centre to Bottom Dead Centre owing to the rotation of the crankshaft thus creating a partial vacuum in the carburettor.

This partial vacuum sucks air from the atmosphere through the venturi where it is accelerated through the throat of the venturi to create low pressure by Bernoullis' principle.

The low pressure sucks fuel from the float chamber in the atomised form to mix with the air to the cylinder through inlet manifold.

As the fuel level lowers in the float chamber, the float raises the needle value to allow more fuel into the chamber to raise the float and lower the needle value to limit the fuel.

(4 x 1 = 4 marks)

(c)   Types of gas turbine engine burners

(i)   Simplex burner

The simplex burner consists of a chamber which induces a swirl into the fuel and a fixed - area atomizing orifice with single manifold.

This burner gives good atomization at high fuel flows, that is at higher pressures but very unsatisfactory at low pressures required at low speeds and especially at high altitudes.

(3 marks)

(ii) The Duplex burner consists of a primary and main fuel manfold and have two independent orifices, one smaller than the other.

The smaller orifice handles the lower flows and the larger orifice deals with the higher flows as the burner pressure increases.

(3 marks)

13. (a) Arcs and radial colour range making an aircraft instruments.

(i) Red radial line - maximum and minimum limits

(ii) Yellow arc - Take off and precautionary ranges.

(iii) Green arc - Normal operating range

(iv) Red arc - Range in which operation is prohibited.

(4 marks)

(b) Graticule are lines that form the parallels of latitude and the meridians to determine any position on the earth.

(c) Step 1 : Calculate the difference between the two points = 44° 30' - 26° 30' = 18°

Step 2: Since the aircraft is travelling north, the change in latitude is 18° N

Step 3 : The change in latitude expressed in minutes alone is 60' in 1° = 18 x 60 = 1080'N

3 x 1 = 3 marks

Aircraft B

Step 1: Find the shortest distance between the two points by crossing the 180 meridian.

Step 2: The difference between 170° and 180° is 10°

Step 3: The differences between 165° and 180° is 15
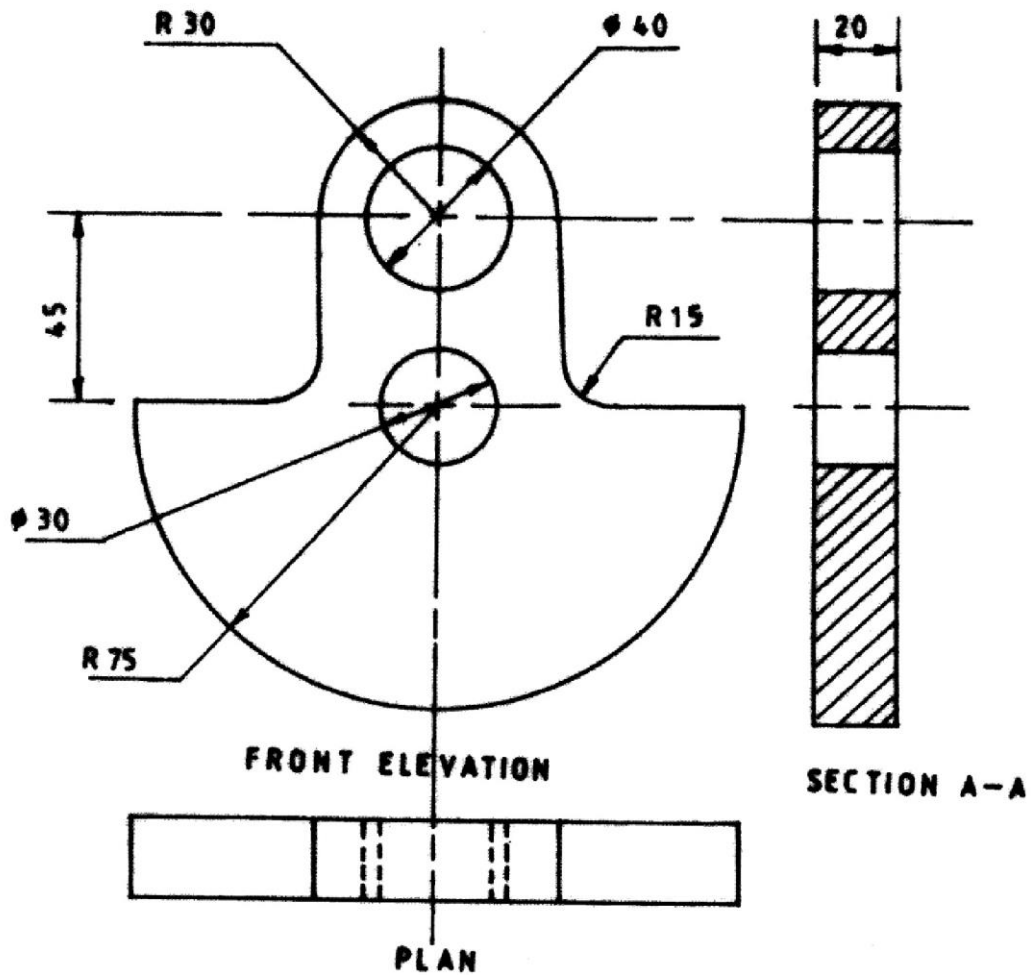
Step 4: Add the change in longitude in step 2 and 3 (10 + 15) = 25°

Step 5: Determine if movement is clockwise or anti-clockwise and

Therefore the chance is 25°E because the movement is anti-clockwise

Step 6: Convert to minutes = 25 x 60 = 1500'E

(6 x 1 = 6 marks)

FRONT ELEVATION

SECTION A-A

PLAN

R 30

⌀ 40

20

R 15

⌀ 30

R 75

45

9 faces x $\frac{1}{2}$ = 4$\frac{1}{2}$ marks

3 views x 1 = 3 marks

Correct angle of projection = $\frac{1}{2}$ mark

2 holes x $\frac{1}{2}$ = 1 mark

2 radii x $\frac{1}{2}$ = 1 mark

Hidden details 2 x $\frac{1}{2}$ = 1 mark

Hatching 3 x $\frac{1}{2}$ = 1$\frac{1}{2}$ marks

Correct scale(full size) = 1 mark

Neatness = $\frac{1}{2}$

Total 14 marks

BULKHEAD

15. (a) - Vertical structural member partitioning aircraft compartment.

- Contribute to the fuselage shape

- Provide strength and take the stresses.

- Used as firewall

Any 2 x 1 = 2

Longerons

- Longitudinal members of the fuselage

- Carry major loads (compression and tension)

- Form part of the fuselage framework

Spars

- Main lateral strong structure member of the main wings and empenhage

- Carry bending and twisting stress of the wing

- Provide attachment to the fuselage and the ribs

$$2 \times 1 = 2$$

Total 6

(b) SOLUTION

1   Actuator

2   Accumulator

3   Electric pump

4   Pressure relief valve

5   Pressure regulator

6   Selector valve

$$(6 \times \tfrac{1}{2} = 3 \text{ marks})$$

(c) Reasons why a thread cutting tap may break while in use

(i)   Using incorrect tap size
(ii)   If the hole is too small
(iii)   Trying to force a tap down a blind hole
(iv)   Turning the tap clockwise all the time
(v)   Lack of lubrication.
(vi)   Internal damage
(vii)   Tap misallignment
(viii) Material hardness

$$(5 \times 1 = 5 \text{ marks})$$