24.15 AVIATION TECHNOLOGY (450)

24.15.1 Aviation Technology Paper 1 (450/1)

1. (a)
   - Ensure ground lock pins are installed.
   - Disconnect the steering.
   - Ensure hydraulic pressure is available in accumulator.
   - Ensure ground to cockpit communication - oral and visual.
   - Tow at large angles.
   - Tow at low speed.
   - Follow manufacturer's instructions. ***(Any 4 x $^{1}/_{2}$= 2 marks)***

   (b)
   - Aircraft defects during flight.
   - Oil uplifts.
   - Accumulated flight hours.
   - Flight number.
   - Centre of gravity.
   - Number of landings.
   - Remaining fuel. ***(Any 4 x $^{1}/_{2}$= 2 marks)***

2. (a)
   - ***Anti-icing***: prevention of ice formation on the aircraft surface.
   - ***De-icing***: removal of ice that has already formed on the aircraft surface.

   (2 x 1= 2 marks)

   (b)
   - Engine intakes.
   - Pitot static head.
   - Leading edge of wing, tail plane.
   - Wind screens.
   - Carburettor.
   - Propeller blade. ***(Any 4 x $^{1}/_{2}$= 2 marks***

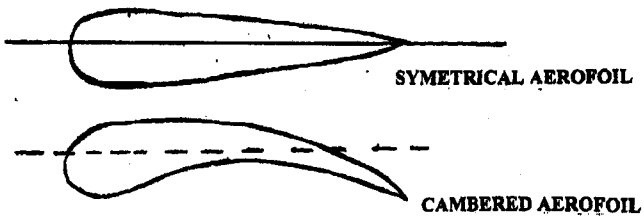
3. (a)

   Headwind
   - Reduces or decelerates forward speed of aircraft.
   - Increases generated lift.
   - Reduces the flight range. ***(Any 2 x $^{1}/_{2}$= 2 marks)***

   Tailwind
   - Increases the forward speed of aircraft or accelerates aircraft.
   - Decreases generated lift.
   - Lengthens the flight range. ***(Any 2 x $^{1}/_{2}$= 2 marks)***

   (b)
   - ***Function of Flap***: to change the camber of the wing and/or increase wing area to allow a/c to operate at lower flight speed during landing and take off.***(1 mark)***
   - ***Function of Slats***: are on the leading edge of high performance a/c wing and are used for reducing stalling speed and increasing lift at comparatively low or high angle of attack. ***(1 mark)***

   (c)



(2 marks)

4.

(a) ***Malleability:*** the ability of metal to be rolled into thin sheets without fracture.

(b) ***Conductivity***: the physical property of a material to conduct both heat and electricity, makes copper best suited for manufacture of wires and plates.

(c) ***Hardness***: ability of a metal to withstand scratching, wear and abrasion.

(3 x 1= 3 marks)

5. (a) (i) Revolutions per minute (RPM)

- At low RPM there is very little increase in thrust compared to high RPM.
- At very high RPM a very little variation of throttle will produce an increase in thrust.
- The jet will operate best at maximum RPM. ***(Any 3 x $^{1}/_{2}$=1$^{1}/_{2}$ marks)***

(ii) Aircraft Forward Speed

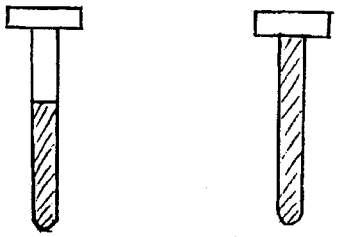
- Increase in a/c speed reduces thrust in direct proportion.
- Due to ram air intake, mass flow and velocity of the jet also increases with airspeed.
- Resultant net thrust is practically constant with airspeed.

(Any 3 x $^{1}/_{2}$= 1$^{1}/_{2}$ marks)

(b)

- ***Firing Order:*** the sequence in which the power stroke occurs in different cylinders to provide balance and eliminate vibration.
- ***Timing***: means of ensuring that the engine distributor releases the spark when the piston is at TDC after completion of compression stroke. ***(2 x 1= 2 marks)***

6. (a)



BOLT (PARTIALLY THREADED) **SCREW (FULLY THREADED)**

(2 x $^{1}/_{2}$ = 1 mark)

(b)

- Material.
- Thread type.
- Size (diameter and length).
- Type of finish.
- Shape of head. ***(Any 4 x $^{1}/_{2}$ = 2 marks)***

7. (a) ***Flashback*** is the burning of gases within the torch and is dangerous.

(1 mark)

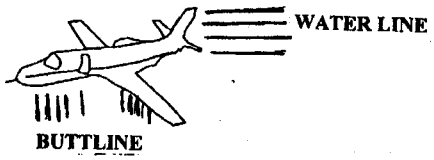
(b)

- Loose connections.
- Improper pressure.
- Overheating of torch.
- Touching the tip.
- Incorrect mixture. ***(Any 4 x $^{1}/_{2}$= 2 marks)***

8.

- Visibility: if its less than 10 km.
- Time: if after dusk or before dawn.
- Clouds: if below 7,000 ft from highest obstacle.
- Heavy precipitation: rain, haze snow mist, dust, smoke, etc.
- Heavy storm. ***(Any 3 x 1 = 3 marks)***

9.

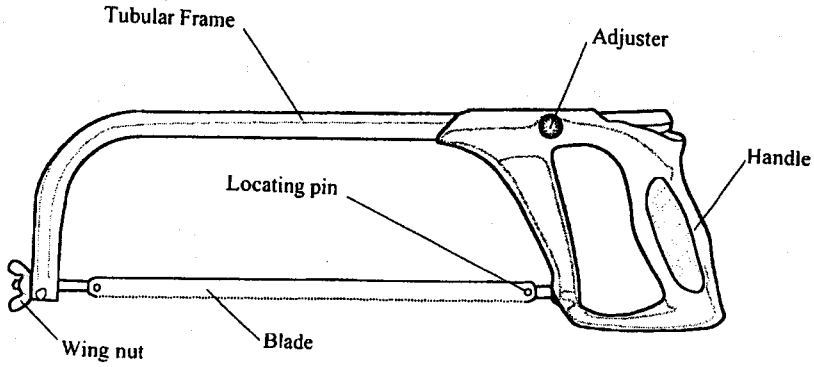


(2 marks)

Station Numbering

- ***Fuselage Stations***: These are systems numbers in inches from a reference datum.
- ***Buttock Line/Buttline:*** - This is the width measurement left and right from a reference datum
- ***Water Line***: This is the measurement of height in inches perpendicular from a horizontal plane located at a fixed reference datum. ***(3 marks)***

10.

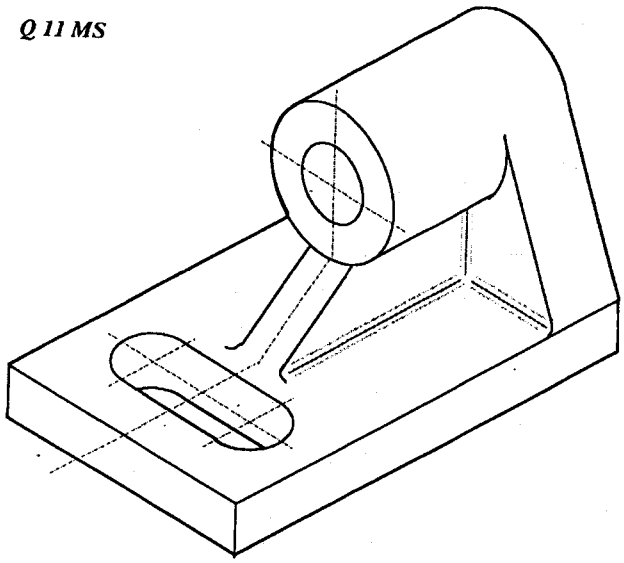


HACKSAW

(4 marks)

11.

Q 11 MS



(15 marks)

12. (a)

- ***Solid Fuel***: such as wood or coal used for external combustion engines.
- ***Liquid Fuels***: such as kerosene and gasoline used for internal combustion engines.
- ***Gaseous Fuels***: such as methane and cooking gas used for either internal or external combustion engines of the static nature. ***(3 marks)***

(b)

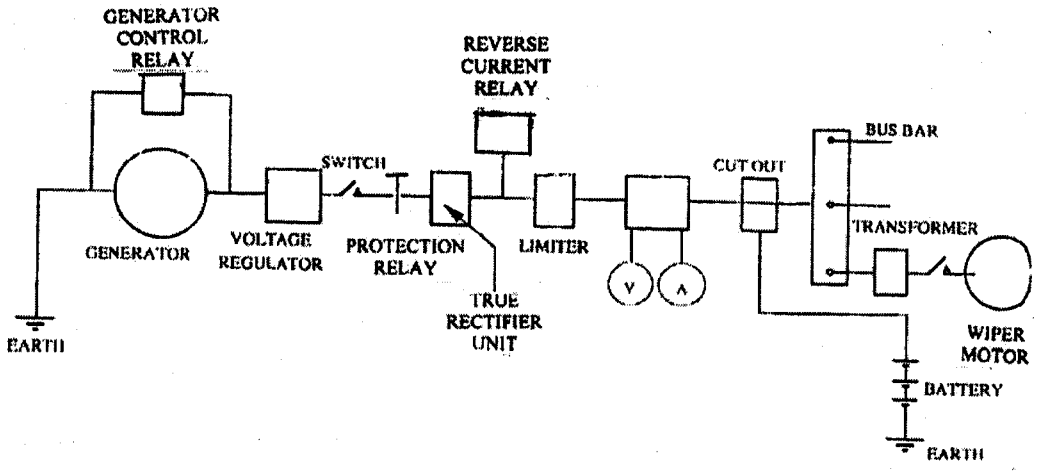
- ***Rigid Fuel Tank***: This is a fuel tight removable tank fitted in a compartment which is not fuel-tight and made of aluminium plates welded together.
- ***Bladder Fuel Cells:*** This tank is essentially a reinforced rubberized bag placed in a non-fuel tight compartment designed to structurally carry the weight of the fuel.
- ***Intergral Fuel Tank:*** This is a tank that is part of the basic structure of a wing or fuselage in that the walls of the tank form the main structure members. ***(6 marks)***

(c)

- ***Capacitance:*** The fuel quantity indicating system incorporate electric capacitance tank probes mounted internally in each fuel tank. The probes have a compensator for fuel density variations and feed signals to the cockpit panel.
- ***Drip Stick:*** This consists of a calibrated hollow stick and when the cap in the wing lower surface is drawn out fuel enters the open top of the stick when it reaches the fuel level and can be observed at a small drip hole near the cap base.
- ***Magnetic Stick***: This consists of a magnet floating on fuel and another magnet inserted in a stick. When the stick is withdrawn from the bottom of the wing surface and the level of fuel is reached the float magnet attracts the stick magnet and the quantity of fuel can be observed since the stick in calibrated in gallons.

(6 marks)

13. (a)



(9 marks)

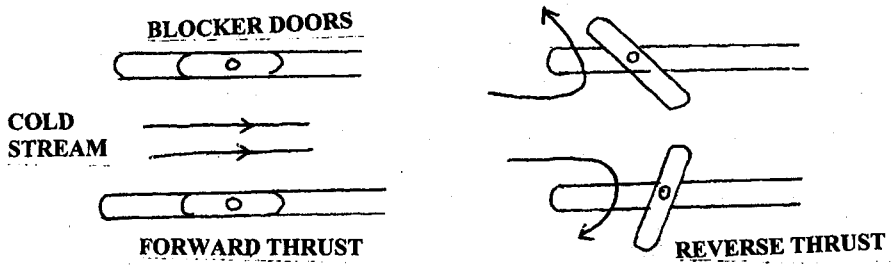
(b) ***Operation***

- Engine driven generation: A coil is rotated in a strong magnet to generate A.C. current.
- The generator control relay protects the generator from feed back.
- Voltage regulator: controls the generator output to within the close limits
- Switch to bring the generator on line.
- Protection relay to isolate in case of a fault in the system.
- True rectifier to convert the D.C. to A.C.
- Reverse current relay to prevent any current flow backwards.
- Cut out to provide battery with charge.
- Transformer to step up or step down the voltage.
- Wiper motor where current is fed to a coil placed in a strong magnet to create rotating moment known as torque. ***(6 marks)***

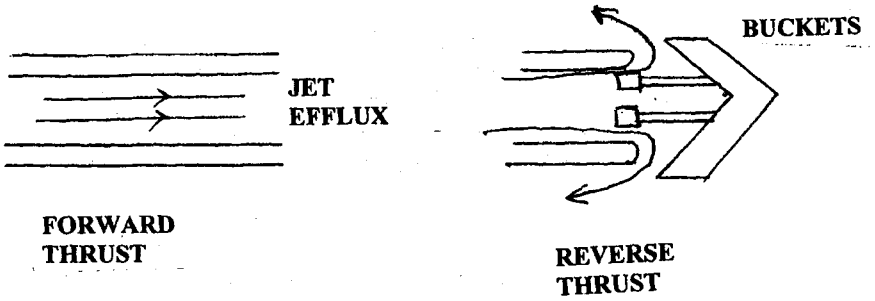
14. (a) Thrust Reverse is a means of reversing the direction of thrust on aircraft engine for the following:

- To decelerate the aircraft after landing so as to bring the aircraft to rest within remaining end of the runway without excessive use of breaks.
- To reduce the speed of the aircraft in flight, thereby allowing a rapid rate of descent during pressurization failure or combat. ***(3 marks)***

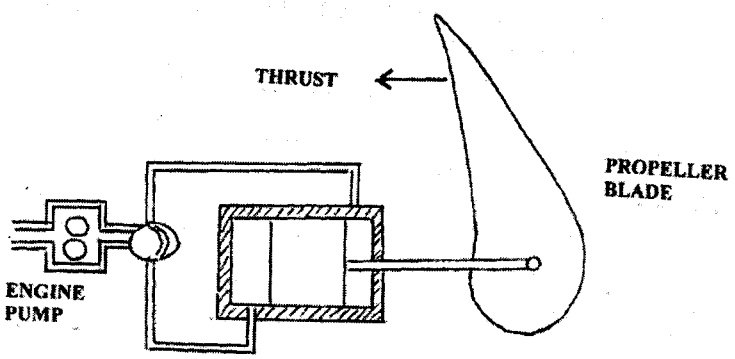
(b) (i) ***Cold Stream:*** This is achieved on front fan engines where the reverse thrust is obtained by reversing the fan (cold stream) airflow by blocker doors. When the engine is operating in forward thrust the blocker doors will flush on both sides of the engine intake. On selection of reverse thrust the actuation system moves the translating cowl rearwards and at the same time folds the blocker doors to blank off the cold stream final nozzle thus diverting the airflow through the cascade valves. ***(4 marks)***



(ii) ***Hot Stream:*** This is achieved on pure jet engines where the thrust reverse is obtained by reversing the jet efflux (hot stream) by clamshell doors. Normal operation of the engine is not affected by the system because the duets through which the exhaust gases are deflected remain closed by the doors until the reverse thrust is selected by the pilot. On selection of reverse thrust the doors rotate to uncover the ducts and close the normal as stream exit. Cascade vanes then direct the gas stream in a forward direction so that the jet thrust opposes the aircraft motion. ***(4 marks)***



(iii) ***Negative Pitch:*** This is achieved on propeller powered aircraft where the reverse thrust reversal is obtained by changing the pitch of the propeller blades. During normal operation the propeller blades accelerates large mass of air rearwards to generate thrust. On selection of the reverse thrust the propeller blades directs the oil from the control system to the propeller mechanism to reduce the blade angle to zero, the then through to negative (reverse) pitch to accelerate the large mass of air forwards to oppose the aircraft forward motion.
(4 marks)



NEGATIVE PITCH

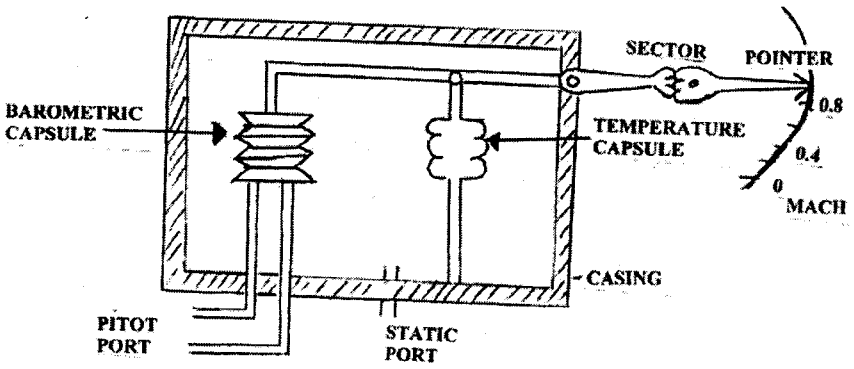
15. (a)

- Leakage test to ensure the system is air tight.
- Carry out regular system drainage checks.
- Plug to ensure no entry of foreign objects.
- Check functionality of anti-icing system.
- Ensuring there are no bends and kinks. ***(5 marks)***

(b) Machmeter consists of:

- Barometer capsule vented to pitot pressure.
- Semi-evacuated capsule sensitive to change in temperature.
- Casing vented to static pressure.
- Linkages sensitive to expansion and collapsing of both barometric and semi-evacuated capsules.
- Sector that is moved by linkages.
- A pointer that moves on a dial calibrated in mach numbers.

(3 marks)

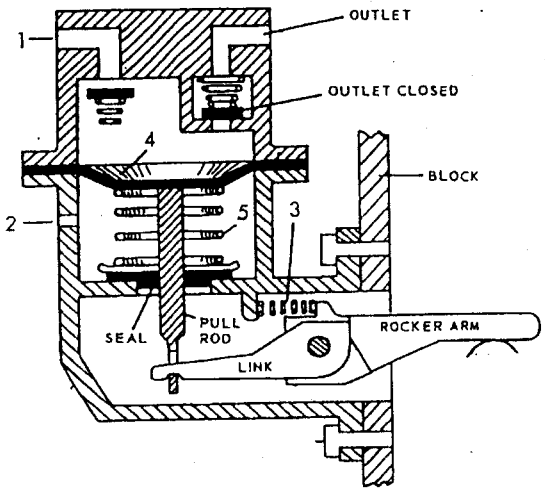


When the aircraft is stationary the capsule pressure and casing pressure are equal and the instrument reads zero. When the aircraft moves forward the pitot pressure increases because of ram effect for the capsule pressure to overcome casing pressure to expand the capsule.

Expansion of the capsule moves the linkage to move the sector to rotate the pointer to indicate forward speed. However the temp capsule adjusts the linkage to compensate for temperature. Since the temp change is directly proportional to the speed of sound the instrument reads the ratio of speed of aircraft to the speed of sound. ***(3 marks)***

24.15.2 Aviation Technology Paper 2 (450/2)

Station 1



(10 marks)

Station 3

1. Oil with copper chipping, low viscosity, no effect on magnetic chip.
2. Engine oil mixed with rubber chippings no effect.
3. Engine oil with iron filing, ferrous magnetic chips.
4. Engine oil mixed with water.
5. SAE 40 engine - no contamination. ***(10 marks)***

Station 4

(a) (ii) **K:** Mild steel.
L: Brass.
M: Aluminium.
N:Copper. ***(4 x 1 =4 marks)***

(iii) Turfness. ***(1 mark)***

(iv) The higher the number of bends, the tougher the material. ***(1 mark)***

(b) The hardest material. ***(1 mark)***

(c)

	Material	***Application***	***Reason***
	K: Mild steel	Fasteners	Turf & Malleable
	L: Brass	Bushes	Self lubrication Non-corrosive Machineable
	M: Aluminium	a/c skin	light Corrosion resistant

(3 x 1=3 marks)

Station 5

(a) (i) The water flows to the bowl continuously. ***(1 mark)***

(ii) Initially the water flows into the bowl with bubble but eventually stops flowing. ***(1 mark)***

(iii) The hole represents a vent in a fuel tank which allows free flow of fuel. ***(1 mark)***

The blocked vent does not allow flow of liquid from the tank to the system.
(1 mark)

(b) (i) The water flows to the bowl continuously. *(1 mark)*

(ii) There is introduction of air bubble, the water flows and eventually stops.
(1 mark)

(iii) System does not have a vent to allow for continuous flow of hydraulic fluid.
(1 mark)

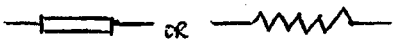
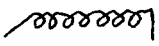
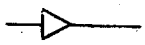
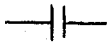
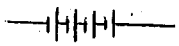
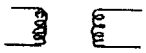
(c) Introduction of air charge allows the system to operate. *(1 mark)*

	Limitation	*Remedy*
(i)	The a/c system does not operate effectively at high altitude.	Fly at low altitude.
(ii)	System starvation.	Pressure the reservoir

(4 x $\frac{1}{2}$ = 2 marks)

Station 6

(a)

ITEM	NAME	SYMBOL	USE
A	Fixed resistor		Control of current.
B	Inductor		Acts as Rectifier
C	Silicon diode		Allow flow of current in one direction.
D	Capacitor		Stores electrical energy.
E	Battery		Provides circuit source of power.
F	Transformer		Steps current up or down.

(6 x 1$\frac{1}{2}$ = 9 marks)

(b) **A** 100Ω

D 1μF

(2 x $\frac{1}{2}$ = 1 mark)

Station 7

SCENARIO	IMMEDIATE ACTION	REASON FOR THE ACTION
1	Stop, check judge and decide	Depends on situation on runway.
2	Overtaking aircraft must keep out of way by overtaking on the left	Aircraft being overtaken has the right of way.
3	The aircraft A must stop	The aircraft B has the right of way
4	Each aircraft to turn to the right.	So that both pilots can see each other.
5	Aircraft A must give way or stop or pass behind aircraft B.	Aircraft B has the right of way being on the left side.

(2 x 5 = 10 marks)

Station 8

(a)

- The big pointer rotates very fast.
- The small pointer rotates very slowly. ***(2 x 1= 2 marks)***

(b) (i) X, Y, Z — Correct reading ***(3 x 1= 3 marks)***

(ii) Determining state of bar. ***(1 mark)***

(c) (i) Correct dial indicator reading.
(ii) Correct thickness of N by determination.
(iii) Correct thickness of W by measurement.
(iv) Correct comment. ***(4 x 1= 4 marks)***

Station 10

		Upthrust	A	B
(a)	(i)	Weight of collector can	Wc	Wc
		Weight of water collected	Wwa	Wwb
		Upthrust	Wc – Wwa	Wc – Wwb

(6 x $\frac{1}{2}$ = 3 marks)

(ii) **Density**

Calculation of volume (L x B x H)	a x b x c	a x b x c
Calculation of mass (m)	m ÷ 10	m ÷ 10
Density $\frac{M}{V}$	$\frac{M}{V}a$	$\frac{M}{V}b$

(6 x $\frac{1}{2}$ = 3 marks)

(b) ***Principle***: Buoyancy/ Archimedes. ***(1 mark)***

(c) ***Relevance***: When aircraft is flying it displaces air equal to its weight to sustain flight. ***(1 mark)***

(d) ***Take-Off:*** There will be more upthrust and density because of all the upweight.
Landing: There will be less upthrust and density during landing because of fuel consumption. ***(2 x 1= 2 marks)***