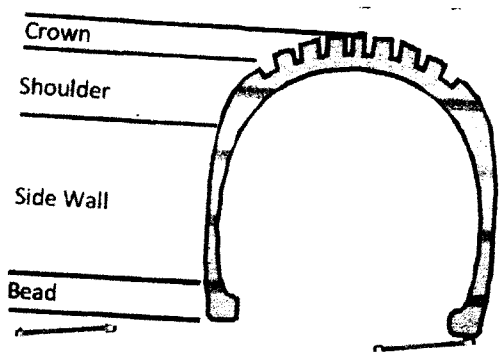
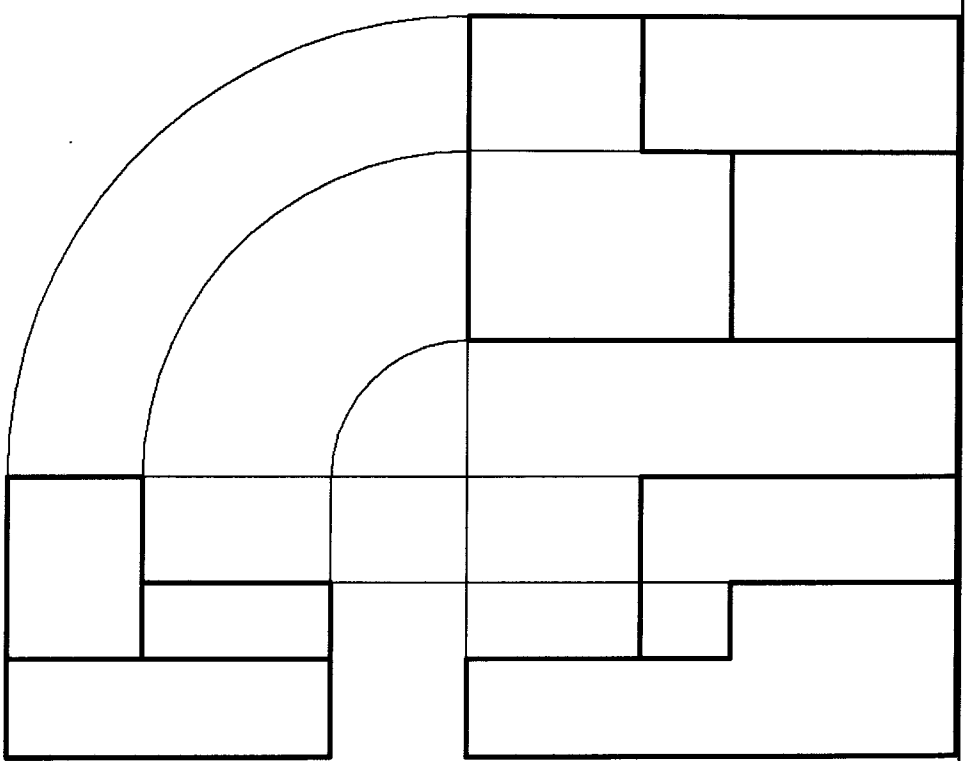
4.22 AVIATION TECHNOLOGY (450)

4.22.1 Aviation Technology Paper 1 (450/1)

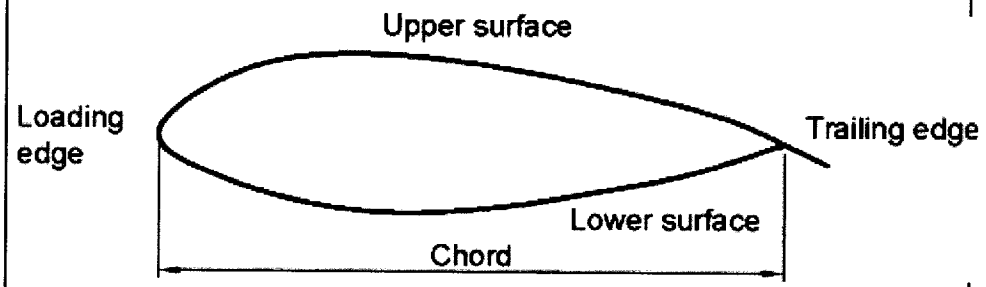
SECTION A

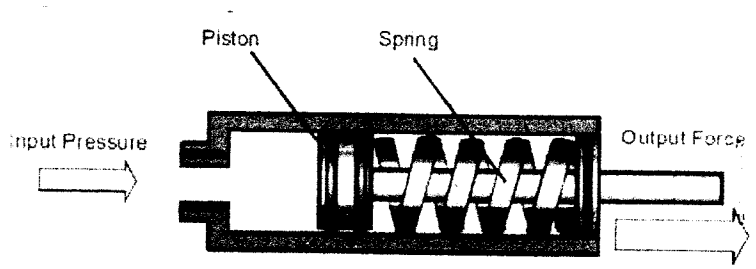
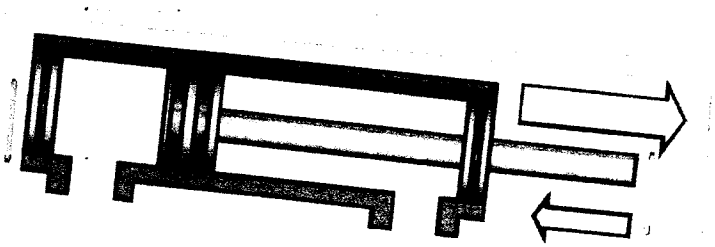
1.	(a)	Be above 16 years old (14 years old allowed to pilot a glider or balloon).	
	(b)	Be able to read, write, speak and understand English.	
	(c)	Hold a current Third-class Medical Certificate (or for glider or balloon, certify that no medical defect exists that would prevent piloting a balloon or glider.	
	(d)	Resources	
		(3 x 1 = 3 marks)	**(3 marks)**
2.	(i)	The area around the aircraft should be cleared of all non-essential ground equipment.	
	(ii)	There should be no loose objects or debris in the starting area.	
	(iii)	All refueling operations are to have been completed.	
	(iv)	Suitable fire extinguisher should be provided.	
	(v)	Ground to flight deck communication are to be established with due regard to day/night operations.	
		(Any 4 x 1 = 4 marks)	**(4 marks)**
3.	(i)	They control aircraft on the runway and in the controlled airspace immediately surrounding the airport.	
	(ii)	Tower **controllers** may use radar to locate an aircraft's position in three dimensional space, or they may rely on pilot position reports and visual observation.	
	(iii)	They coordinate the sequencing of aircraft in the traffic pattern and direct aircraft on how to safely join and leave the circuit.	
	(iv)	Aircrafts which are only passing through the airspace must also contact tower control in order to be sure that they remain clear of other traffic.	
		(Any 3 x 1= 3 marks)	**(3 marks)**
4.	(i)	With fasteners to primary or secondary structures.	
	(ii)	With fasteners on any part of the aircraft where failure might result in damage or danger to the aircraft or personnel.	
	(iii)	Where failure would permit the opening of a joint to the airflow.	
	(iv)	Where the screw is subjected to frequent removal.	
	(v)	Where the washers are exposed to the airflow.	
	(vi)	Where the washers are subject to corrosive conditions.	
	(vii)	Where the washer is against soft material without a plain washer underneath to prevent gouging the surface.	
		(Any 4 x 1 = 4 marks)	**(4 marks)**

5. (a)	(i) Form drag is the portion of parasite drag generated by the aircraft due to its shape and airflow around it. (ii) When the air has to separate to move around a moving aircraft and its components, it eventually rejoins after passing the body. (iii) How quickly and smoothly it rejoins is representative of the resistance that it creates which requires additional force to overcome. **3 x 1**	**3 marks**
(b)	(i) Skin friction drag is the aerodynamic resistance due to the contact of moving air with the surfaces of an aircraft. Every surfaces, no matter how apparently smooth has a rough, ragged surface when viewed under a microscope. (ii) The air molecules, which come in direct contact with the surface of the wing, are virtually motionless. (iii) Each layer of molecules above the surface moves slightly faster until the molecules are moving at the velocity of the air moving around the aircraft. This speed is called the free-stream velocity. **(3 x 1 = 3 marks)**	**(3 marks)**
6.	 Sketch = 2 marks Any 4 labels @ ½ = 2 marks **4 marks**	**(3 marks)**
7.	(a) The propeller itself is twisted so the blade angle changes from hub to tip. (b) The greatest angle of incidence, or the higher pitch, is at the hub while the smallest angle of incidence or smallest pitch is at the tip. (c) The reason for the twist is to produce uniform lift from the hub to the tip. (d) As the blade rotates, there is difference in the actual speed or the various portions of the blade. (e) The tip of the blade travels faster than the part near the hub, because the tip travels a greater distance than the hub in the same length of time. (f) Changing the angle of incidence (pitch) from the hub to the tip to correspond with the speed produce uniform lift throughout the length of the blade. **(6 x 1 = 6 marks)**	**(6 marks)**

8.	(a) The operation of a nose-wheel steering device such as a control wheel in the cockpit/cabin (mechanism) (b) A combination of operating a nose-wheel device- Nose wheel method (c) The selective operation of the main wheel brakes. (d) The selective operation of engine thrust and operation of main wheel brakes- Engine thrust differential (e) The operation of rudder control when taxing at high speed- Radder **(5 x 1 = 5 marks)**	**(5 marks)**
9.	(a) The surface should be cleaned, dry and free from oil and grease. (b) Corrosion salts should be removed by light abrasion and water washing. (c) Clean surfaces should be abraded or very lightly blasted using a low pressure and a non-metallic abrasive. (d) Use of appropriate etch primer should provide a key for subsequent paint coats. (e) Consult the aircraft manual for suitable primers and coatings. **(Any 4 x 1 = 4 marks)**	**(4 marks)**
10.	 Correct angle of projection – 1 Correct F.E. – 1½ Correct E.E. – 1 Correct Plan – 1½ **5 marks**	

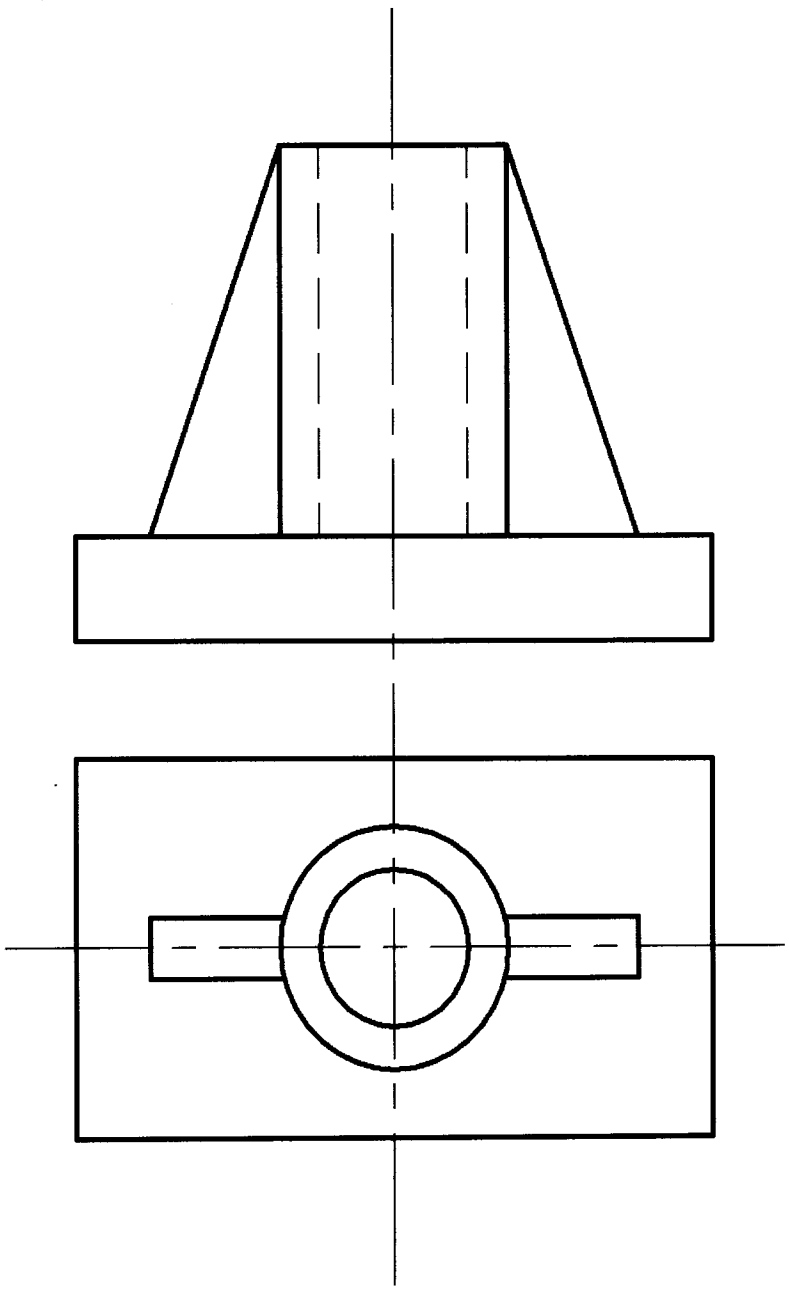
SECTION B

11. (a)	(i)	**Primary Structure:** This is the structure that is stressed, and in the event of it failing the structural integrity of the aircraft would be compressed to such a point that the aircraft could suffer a catastrophic failure.	
	(ii)	**Secondary Structure:** This is structure that is stressed but to a lesser degree and in the event of its failure the aircraft would not suffer catastrophic failure but can be limited in operation.	
	(iii)	**Tertiary Structure** This is structure that is unstressed or normally stressed and in the event of its failure would not cause a catastrophic failure.	
		(3 x 2 = 6 marks)	**(6 marks)**
(b)		 Sketch (1 x ½ = ½ = mark) Labelling (5 x ½ = 2½ marks) **Total = 3 marks**	
(c)	-	When air flows over the top surface of a wing from the leading edge (L.E.) to the trailing edge (T.E.) the distance that it has to travel is increased by the.	
	-	Camber (cure) of the surface compared with the distance that would have to travel when passing under the wing.	
	-	The air flowing over the cambered surface increases its velocity which results in a decrease in the static pressure above the wing.	
	-	The amount of lift produced is dependent on the speed of air over the wing, the camber and the surface area of the wing.	**(5 marks)**
		(5 x 1 = 5 marks)	
12. (a)	(i)	Absorb the landing load and dampen vibration.	
	(ii)	Withstand side loads when landing and taxing.	
	(iii)	Support the aircraft on ground when it is maneuvering.	
	(iv)	Provide minimum friction between the aircraft and the ground.	
	(v)	Possess a low coefficient of drag.	
	(vi)	Withstand the flight air loads.	
		(Any 4 x 1 ½ = 6 marks)	**(6 marks)**

(b) (i)	Single Acting Actuator  These activators work hydraulically in one direction only. They require a mechanical force to return them to the original position. Mostly the single acting activator makes use of a spring force.	
(ii)	Double Acting Actuator  For equal input pressure, the output force vary due to the unequal surface areas on each side of the piston. Double acting actuators operate hydraulically in both directions. As these actuators have only on ram attached to the piston, the surface area of each side of the piston varies. Sketch – (2 x 1 = 2 marks) Labeling – (8 x ½ = 4 marks) Explanation – (2 x 1 = 2 marks) **Total = 8 marks**	

13.	(i)	It uses a series of fan-like compressor blades to bring air into the engine and compress it.	
	(ii)	An entire section of the turbo jet engine performs the function, which can be compared to the compression stroke of the reciprocating engine.	
	(iii)	In this section, there is a series of rotor and stator blades.	
	(iv)	Rotor blades gather and push air backward into the engine while the stator blades serve to strengthen the flow of this air as it passes from one set of rotor blades to the next.	
	(v)	As the air continues to be forced further into the engine, it travels from the low-compression set of rotors and stators to the high-compression set.	
	(vi)	This last set puts what we might say is the final squeeze on the air.	
	(vii)	The combustion chamber receives the high-pressure air, mixes fuel with it, and burns the mixture.	
	(viii)	The hot, very high velocity gases produced strike blades of the turbine and causes it to spin rapidly.	
	(ix)	The turbine is mounted on a shaft which is connected to the compressor thus the spinning is what causes the compressor section to function.	
	(x)	After passing the turbine blades, the hot, highly accelerated gases go into the engine's exhaust section.	
	(xi)	The exhaust section of the engine is designed to give additional acceleration to the gases and thereby increases thrust.	
	(xii)	The exhaust section also serves to straighten the flow of the gases as they come from the turbine. Basically, the exhaust section is a cone mounted in the exhaust section.	
	(xiii)	The duct is also referred to as the tail pipe. The shape of the tail pipe varies, depending on the design operating temperatures and the speed performance range of the engine.	
	(xiv)	Turbojet is also air-cooled of all the air coming into the compressor section, only about 25 percent is used to produced thrust; the remaining 75 percent passes around the combustion chamber and turbine area to serve as a coolant.	
		(14 x 1= 14 marks)	**(14 marks)**

14.



Correct angle of projection – 1
9 faces @ full scale = 9 marks
Centre lines 2 x 1 = 2 marks
Hidden details – 2 x ½ = 1 mark
Line work / neatness = 1 mark
14 marks

15. (a)	(i)	Ensure adequate preflight inspection.	
	(ii)	Service aircraft with properly filtered fuel from small tanks or drums.	
	(iii)	Avoid storing aircraft with partially filled fuel tanks.	
	(iv)	Carry out proper maintenance.	
		(4 x 1 = 4 marks)	**(4 marks)**
(b)	(i)	Cumulus – heaped or piled clouds.	
	(ii)	Stratus – formed in layers , horizontal layers with uniform base	
	(iii)	Cirrus – ringlet, fibrous clouds, also high level above 20,000 feet with thin strands	
	(iv)	Nimbus – rain bearing clouds which are dark or grey	
	(v)	Alto – meaning high, also middle level clouds existing 5,000 to 20,000 feet.	
		(5 x 1 = 5 marks)	**(5 marks)**
(c)	(i)	A lightning strike can puncture the skin of an aircraft and damage communication and electronic navigational equipment.	
	(ii)	Although lightning has been suspected of igniting fuel vapours and causing an explosion, serious accidents due to lightning strikes are rare.	
	(iii)	Nearby lightning can blind the pilot rendering him or her momentarily unable to navigate either by instruments or by visual reference.	
	(iv)	Nearby lightening can also induce permanent errors in the magnetic compass.	
	(v)	Lightning discharges, even distant ones, can disrupt radio communication on low and medium frequencies.	
	(vi)	Though lightning intensity and frequency have no simple relationship to other storm parameters, server storms, as a rule, have high frequency of lightning.	
		(Any 5 x 1 = 5 marks)	**(5 marks)**