FLIGHT PERFORMANCE & PLANNING

The actual examination paper consists of twenty questions, each with a multiple choice of four answers A, B, C or D. The candidate should indicate the chosen answer by placing a cross in the appropriate box on the answer paper provided.

Time allowed 60 minutes.

The pass mark is 75%, so the minimum number of questions that must be answered correctly to obtain a pass is fifteen. Marks are not deducted for incorrect answers.

The explanation section follows the question section and each explanation is prefixed EPP (Explanation Performance & Planning).

Q1 If air density is reduced, full throttle take-off distance will be:

A - increased.

B - reduced.

C - the same because increased thrust is balanced by increased drag.

D - the same because the aircraft will accelerate quicker due to reduced drag.

Q2 The total weight of an aeroplane together with its total contents at any particular time is referred to as:

A - the gross weight.

B - zero fuel weight.

C - the loaded weight.

D - the all up weight.

Q3 An aeroplane take-off weight = 2300lb.
Calculated C of G for departure = 90.75 inches aft of the datum.
Planned fuel burn during the flight = 170lb, positioned 87 inches aft of the datum.

What is the position of the landing C of G aft of the datum?

A - 87.42 inches

B - 89.71 inches

C - 93.45 inches.

D - 91.05 inches

Q4 If air density is increased above International Standard Atmospheric conditions, the take-off distance required at full throttle compared with that for standard conditions will be:

A - the same.

B - less.

C - more.

D - the same but TORR will be increased because the surface wind will have backed and decreased.

Q5 That part of a runway available to an aircraft and capable of supporting its weight during the take-off phase is:

A - the take-off distance available (TODA)

B - the emergency distance available (EMDA)

C - the clearway.

D - the take-off run available (TORA)

Q6 In comparison to the true airspeed in still air conditions, the TAS for the best range in a strong tailwind will be:

A - the same.

B - slightly higher.

C - slightly lower.

D - significantly lower, proportional to the tailwind component.

Q7 Increasing an aeroplane's gross weight will ----**(i)**---- the speed at which the aeroplane rotates and ----**(ii)**---the V_2 speed.

Select the combination which correctly completes the above sentence.

	i	**ii**
A -	decrease	decrease
B -	increase	decrease
C -	increase	increase
D -	decrease	increase

Q8 In respect of all runway surfaces:

A - an up sloping runway will increase the take-off run required but decrease the landing distance required.

B - a down sloping runway will increase the take-off run required but decrease the landing distance required.

C - an up sloping runway will decrease the take-off run required and decrease the landing distance required.

D - a down sloping runway will decrease the take-off run required and decrease the landing distance required.

Q9 In respect of all runway surfaces:

A - an up sloping runway will decrease the take-off run required but increase the landing distance required.
B - a down sloping runway will decrease the take-off run required but increase the landing distance required.
C - an up sloping runway will increase the take-off run required and increase the landing distance required.
D - a down sloping runway will decrease the take-off run required and decrease the landing distance required.

Q10 The maximum range in a glide will be achieved by:

A - a relatively low angle of attack being maintained.
B - a negative angle of attack being maintained.
C - a relatively high angle of attack being maintained.
D - a neutral angle of attack being maintained.

Q11 When gliding for maximum range, the greater the aircraft weight:

A - the greater the angle of attack and slower airspeed.
B - the shallower the glidepath and slower airspeed.
C - the slower the airspeed and steeper glide path.
D - the steeper the glide path and higher the airspeed.

Q12 In comparison to gliding in still air conditions, the rate of descent will be ....(i).... and the distance flown will be ....(ii).... in a tailwind.

	(i)	(i)
A -	unchanged	increased
B -	increased	reduced
C -	reduced	unchanged
D -	reduced	reduced

Q13 The distance covered when gliding into wind compared with gliding in still air will result in a ....**(i)**....... distance travelled over the ground together with ....**(ii)**......... rate of descent.

	(i)	**(ii)**
A -	reduced	unchanged.
B -	unchanged	reduced.
C -	increased	unchanged.
D -	reduced	reduced

Q14 Increasing an aeroplane's gross weight will ----**X**---- the stall speed ----**Y**--- the take off run required and ---**Z**--- the landing distance required.

Select the combination which correctly completes the above sentence.

	X	**Y**	**Z**
A -	decrease	decrease	increase
B -	increase	increase	increase
C -	increase	increase	decrease
D -	decrease	decrease	decrease

Q15 Why is full flap selected during the approach and landing phase of a flight?

A - The safe flying speed is increased and a flatter approach path is achieved which improves vision.
B - The approach speed is reduced and a steeper approach path flown which improves vision.
C - Engine power is reduced and a steeper approach path flown which improves vision.
D - The approach speed is reduced and a flatter approach path flown which improves vision.

Q16 If the approach and landing speeds are increased above that recommended in the Pilot's Operating Handbook:

A - the landing distance will be unaffected on a dry runway.
B - the landing distance will be reduced due to increased braking action.
C - the landing distance will be increased.
D - the landing distance will be unaffected if the glide path angle is reduced to compensate for the higher approach speed.

Q17 Flight for maximum range in a piston engined aircraft is achieved by flying:

A - at just below the minimum drag speed.
B - at the lowest density altitude that is safely possible.
C - at that speed which provides the minimum power/ airspeed ratio.
D - at the same speed for maximum endurance + 10% and at the lowest density altitude that is safely possible.

Q18 Consider either a take-off or landing using a level runway. The same aircraft operating from a downward sloping runway would require ......(i)...... take-off distance and ......(ii)...... landing distance.

	(i)	(ii)
A -	less	a greater
B -	a greater	less
C -	a greater	a greater
D -	less	less

Q19 If a static vent became blocked at cruise level, how would this affect the barometric instruments during a subsequent climb? Select the correct response.

	ALTIMETER	**ASI**
A -	remain static	over-read
B -	remain static	under-read
C -	under-read	over-read
D -	under-read	under-read

Q20 An aircraft cruising at 3000ft is cleared to climb to 7000ft.

Refer to the table below and calculate the time taken in minutes, the fuel used in gallons and the distance flown during the climb. The temperature is standard and the wind is calm.

FUEL, TIME and DISTANCE TO CLIMB AT 2300 POUNDS

CONDITIONS

Flaps Up
Landing Gear Retracted
Full Throttle
Standard Temperature
Zero Wind

PRESS ALT FT	TEMP °C	CLIMB SPEED KIAS	RATE of CLIMB FPM	FROM SEA LEVEL		
				TIME in MINS	FUEL USED GAL	DIST NM
S.L.	15	79	720	0	0.0	0
1000	13	78	670	1	0.4	2
2000	11	77	625	3	0.7	4
3000	9	76	575	5	1.2	6
4000	7	76	560	6	1.5	8
5000	5	75	515	8	1.8	11
6000	3	74	465	10	2.1	14
7000	1	73	415	13	2.5	17
8000	-1	72	365	15	3.0	21
9000	-3	72	315	18	3.4	25
10000	-5	71	270	22	4.0	29
11000	-7	70	220	26	4.6	35
12000	-9	69	170	31	5.4	43

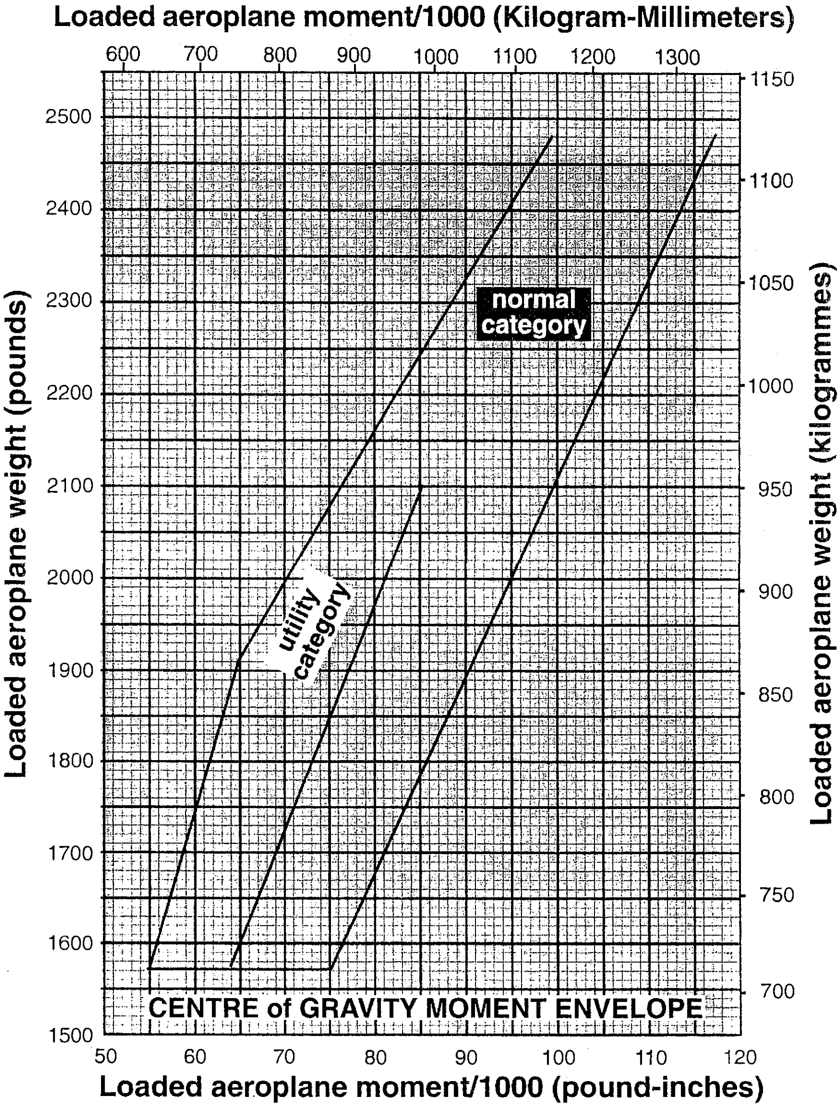
	time (min)	fuel (gal)	distance (nm)
A -	8	1.3	11
B -	10	1.8	13
C -	18	3.7	23
D -	8	1.8	11

Q21 The primary reason for making a take-off into wind is to:

(i) reduce the take-off run available (TORA).
(ii) reduce the take-off distance required.
(iii) reduce the ground speed at which the aeroplane will take off.

A - **(i)** and **(ii)** are correct.
B - **(ii)** and **(iii)** are correct.
C - **(i)**, **(ii)** and **(iii)** are correct.
D - **(i)** and **(iii)** are correct.

Q22 Refer to the diagram below.
For the Utility Category, what is the acceptable combination of both aircraft weight in pounds and moment arm in inches?

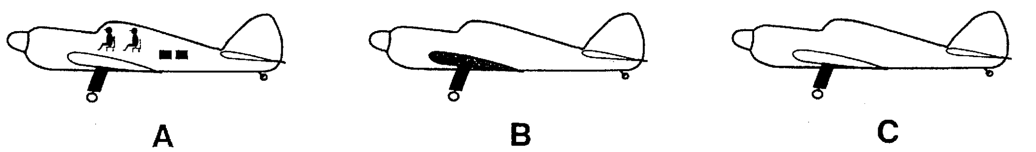


	weight	moment arm
A -	1980lb	86,000lb-inches
B -	2190lb	77,000lb-inches
C -	1880lb	70,000lb-inches
D -	2320lb	66,000lb-inches

Q23 If an aeroplane at Maximum Take-off Weight (MTOW) is loaded in a manner that positions its C of G at or beyond its aft limit; it will:

A - require extra weight in the forward baggage compartment to bring the C of G forward.
B - be difficult to flare on landing.
C - have a reduced range.
D - have a reduced pitch attitude during the cruise and require little or no flare on landing.

Q24 Illustration '**A**' below is representative of:



A - max all up weight authorised.
B - empty weight.
C - gross weight.
D - zero fuel weight.

Q25 From the table below, calculate the rate of climb for an aircraft operating at 3000ft OAT 0°C.

MAXIMUM RATE OF CLIMB AT 2450 LBS

CONDITIONS

Flaps Up
Landing Gear Retracted
Full Throttle

PRESS ALT FT	CLIMB SPEED KIAS	RATE of CLIMB - FPM			
		-20°C	0°C	20°C	40°C
S.L.	79	830	770	705	640
2000	77	720	655	595	535
4000	76	645	585	525	465
6000	74	530	475	415	360
8000	72	420	365	310	250
10000	71	310	255	200	145
12000	69	200	145	.....	.....

A - 580 fpm
B - 600 fpm
C - 650 fpm
D - 620 fpm

Q26 One effect during the cruise of operating with partial flap extension would be:
A - a reduction in rate of climb capability.
B - decreased coefficient of lift.
C - decreased coefficient of drag.
D - an increase in rate of climb capability.

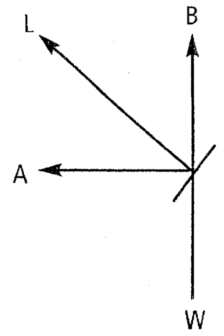
Q27 The lift produced by the wing of an aeroplane maintaining a constant true airspeed will:
A - decrease as altitude is increased.
B - increase as altitude is increased.
C - remain constant with change in altitude.
D - decrease as altitude is reduced.

Q28 A wing evenly contaminated with only a small amount of ice will result in:
A - an increase in weight and decrease in drag.
B - an increase in weight and drag and a significant lift reduction.
C - an increase in both drag and lift coefficients due to a weight increase.
D - an increase in weight and reduced rate of descent for any given engine power setting.

Q29 When climbing with a constant power setting and maintaining a constant airspeed, the lift generated by the wing of an aeroplane that opposes weight will be:
A - slightly greater than the weight.
B - less than the weight.
C - the same as the weight.
D - significantly greater than the weight

Q30 Increasing an aircraft's all up weight will:
A - increase the rate of climb.
B - decrease the rate of climb.
C - have no effect on the rate of climb.
D - have no effect on the rate of climb at lower levels but significantly reduce the RoC above 7000 ft.

Q31 Study the vector diagram below representing the forces in a turn. Which of the following represents LOAD FACTOR?



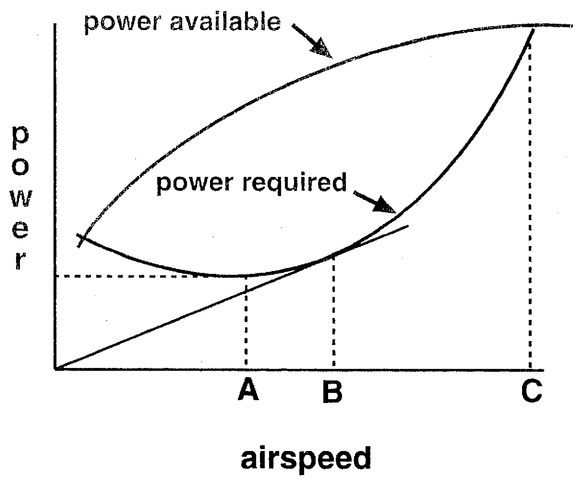
A - $\frac{B}{W}$

B - $\frac{A}{W}$

C - $\frac{L}{W}$

D - $\frac{A}{1g}$

Q32 The relationship between the power available from a piston engine and the power required for various airspeeds is illustrated by the graph below. Referring to this graph, what airspeed should be flown for maximum range?



A - **A**
B - **B**
C - **C**
D - **A** or **B**

Q33 The relationship between the power available from a piston engine and the power required for various airspeeds is illustrated by the graph in question 31. Referring to this graph, what airspeed should be flown for maximum endurance?

A - **A**
B - **B**
C - **C**
D - **A** at low altitude and **B** close to the service ceiling

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Q34 Flight for maximum endurance in a piston engined aircraft is achieved by flying:

A - at the same speed as for maximum range and at optimum throttle height.
B - at a higher speed than for maximum range and at the lowest altitude that is safely possible.
C - at a lower speed than for maximum range and at the lowest altitude that is safely possible.
D - at a lower speed than for maximum range and at the service ceiling.

Q35 Increasing an aircraft's all up weight will:

A - increase the rate of climb.
B - have no effect on the rate of climb.
C - have no effect on the rate of descent for any given aircraft configuration.
D - decrease the rate of climb.

Q36 The selected airspeed for a piston engined aeroplane to attain optimum range should be:

A - stalling speed x 1.4.

B - Vno.

C - at or just above the minimum drag speed.

D - at or just below the minimum drag speed.

Q37 During take-off, the use of wing flaps in the take-off position:

A - is primarily a safety consideration in the event of an aborted take off.

B - will provide a large increase in lift and a large increase in drag and consequently a reduction of take-off safety speed (V_2).

C - will increase lift with a small drag penalty and consequently a reduction in the stall, unstick and take-off safety speed.

D - will provide a small increase in lift and a large increase in drag and consequently a reduction of take-off safety speed.

Q38 An increase in aircraft weight amongst other things will:

A - not effect the incipient spin speed.

B - cause a decrease in the stalling speed.

C - cause a decrease in the incipient speed speed.

D - cause an increase in the stalling speed.

Q39 If an aircraft's landing weight is increased by 15%, the landing distance required will:

A - increase by 25% or the original landing distance factored by 1.25.

B - increase by 20% or the original landing distance factored by 1.20.

C - increase by 15% or the original landing distance factored by 1.15.

D - increase by 33% or the original landing distance factored by 1.33.

Q40 The Indicated Air Speed (IAS) at which an aeroplane stalls in straight and level flight will not be affected by a change of:

A - altitude.

B - wing loading.

C - weight.

D - rectified airspeed (RAS).

Q41 An aircraft wing will enter a stalled condition when:

A - the airspeed reaches a value where lift no longer equals weight.

B - the angle of attack is too great.

C - the angle of incidence achieves a critical point.

D - the angle of attack equals or just exceeds the rigging angle.

Q42 The target speed to be achieved by 50ft agl during the approach phase which will allow the aircraft to achieve a full stop landing within the measured landing distance should be not less than:

A - 1.43 x the stalling speed in the landing configuration (Vs).

B - 1.3 x the stalling speed in the landing configuration (Vso).

C - 1.25 x the stalling speed in the landing configuration (Vsl).

D - 1.50 x the stalling speed in the landing configuration (Vlo).

Q43 The effect of landing on an up sloping runway compared with a level runway will be:

A - a reduced landing distance available (LDA)

B - a reduced landing distance required.

C - none.

D - increased emergency distance available (EMDA).

Q44 A steep turn maintaining both constant altitude and airspeed will require:

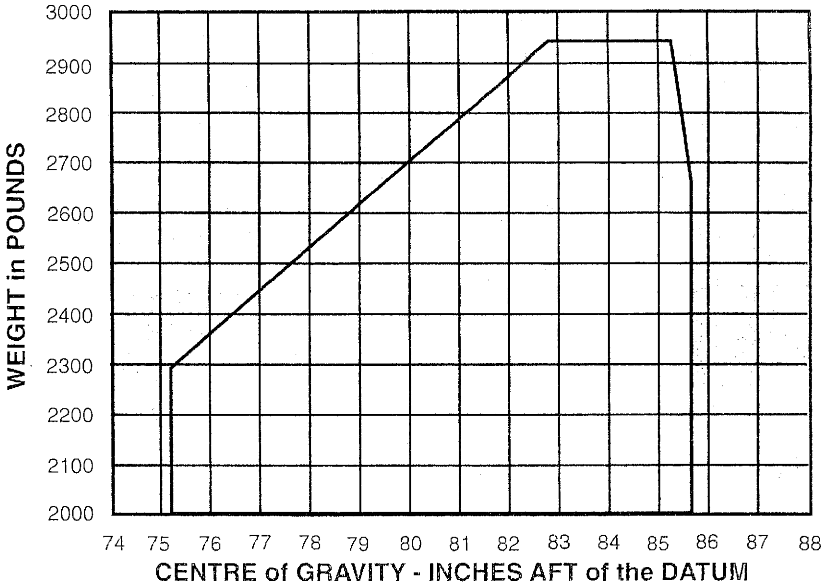
A - an increase of both power and angle of attack to maintain height.

B - the angle of attack to be increased to maintain height.

C - no adjustment of either power or angle of attack as the aircraft will remain in level flight without correction.

D - increased power to balance increased drag and maintain height.

Q45 Refer to the graph below. Which combination of aircraft gross **weight** in pounds and **C of G** position in inches aft of the datum results in a safe configuration?



weight	**C of G**
A - 2880 lb	87.2 in
B - 2750 lb	79.9 in
C - 2370 lb	85.8 in
D - 2560 lb	78.9 in

Q46 During take-off, the use of wing flaps in the take-off position:

A - will increase lift with a small increase in drag and decreased take-off run.
B - will provide a large increase in lift and a large increase in drag which does not affect the take-off run.
C - is primarily a safety consideration in the event of an aborted take off as drag generated by the flap assists retardation.
D - will provide a small increase in lift with a small drag decrease so the take-off run is reduced.

Q47 The best rate of climb is used to gain the greatest amount of height:

A - in the shortest period of time.
B - by travelling the shortest distance over the ground.
C - by travelling the longest distance over the surface.
D - by travelling at the fastest horizontal speed.

Q48 The true air speed for the best rate of climb when climbing from sea level to the service ceiling:

A - tends to increase.
B - tends to decrease.
C - remains substantially constant.
D - will be lowest at lower levels then increases up to about 5000ft above which it remains relatively constant in thinner air.

Q49 An approach to land is made into wind because:

A - it increases ground speed and decreases landing distance.
B - this provides for greater aircraft control at low airspeeds.
C - this reduces both the ground speed and ultimately the landing distance required (LDR).
D - reduces ground speed and the landing distance available (LDA).

Q50 Having inadvertently flown into the vicinity of cloud which has extensive vertical and horizontal development, accretion of wing ice is observed. Your immediate action should be.

A - climb above the cloud
B - fly into the warmer air inside the cloud.
C - make a 180° turn or descend into warmer air if terrain clearance can be maintained, or both.
D - continue on present course as clouds of extensive vertical development do not have extensive horizontal development.

Q51 A single piston engined aircraft without speed fairings is cruising at an altitude of 4000ft where the outside air temperature (OAT) is ISA + 20°C. If the throttle is set to give 2000 RPM, from the chart below, determine:

(i) the Brake Horse Power (**BHP**).

(ii) the True Air Speed in knots (**TAS**)

(iii) the fuel burned in Gallons Per Hour (**GPH**)

CRUISE PERFORMANCE

CONDITIONS
2300 Pounds

Speeds are for aircraft with speed fairings. Without speed fairings, decrease speeds by 3 kt.

PRESS ALT FT	RPM	20°C BELOW STANDARD TEMP			STANDARD TEMPERATURE			20°C ABOVE STANDARD TEMP		
		% BHP	KTAS	GPH	% BHP	KTAS	GPH	% BHP	KTAS	GPH
2000	2250	---	---	---	79	115	9.0	74	114	8.5
	2200	79	112	9.1	74	112	8.5	70	111	8.0
	2100	69	107	7.9	65	106	7.5	62	105	7.1
	2000	61	101	7.0	58	99	6.6	55	97	6.4
	1900	54	94	6.2	51	91	5.9	50	89	5.8
4000	2300	---	---	---	79	117	9.1	75	117	8.6
	2250	80	115	9.2	75	114	8.6	70	114	8.1
	2200	75	112	8.6	70	111	8.1	66	110	7.6
	2100	66	106	7.6	62	105	7.1	59	103	6.8
	2000	58	100	6.7	55	98	6.4	53	95	6.2
	1900	52	92	6.0	50	90	5.8	49	87	5.6
6000	2350	---	---	---	80	120	9.2	75	119	8.6
	2300	80	117	9.2	75	117	8.6	71	116	8.1
	2250	76	115	8.7	71	114	8.1	67	113	7.7
	2200	71	112	8.1	67	111	7.7	64	109	7.3
	2100	63	105	7.2	60	104	6.9	57	101	6.6
	2000	56	98	6.4	53	96	6.2	52	93	6.0

	BHP	**TAS**	**GPH**
A -	66	110	7.6
B -	53	92	6.2
C -	75	112	8.6
D -	83	117	8.7

Q52 Increasing an aeroplane's all up weight by will:

A - increase both the rate and angle of climb.

B - increase the manoeuvrability.

C - increase both the take-off run and the stalling speed.

D - decrease its inherent stability.

Q53 Select the statement that will result in a degraded performance and handling capability and which could result in the structural limitations being exceeded under certain flight conditions.

A - An aeroplane in the Normal Category that is constantly stalled at its maximum weight.

B - An aeroplane operated at above its maximum landing weight.

C - An aeroplane operated at Vno.

D - An aeroplane that is over weight.

Q54 The use of flaps will:

A - increase the stalling speed.

B - have no consequential affect on the stalling speed.

C - cause fluctuation of stalling speed at the stalling angle of attack due to break up of laminar flow over the trailing edge.

D - decrease the stalling speed.

Q55 Limitations relating to aeroplane certification in the Normal Category are:

A - an aeroplane maximum weight of below 5700kg restricted to no spinning or aerobatics and bank angles limited to 60°.

B - an aeroplane maximum weight of below 2300kg restricted to limited aerobatics and bank angles limited to 45°.

C - an aeroplane maximum weight of below 5700kg restricted to aerobatics and bank angles of 30°.

D - an aeroplane maximum weight of below 5000kg restricted to no aerobatics and bank angles limited to 45°.

Q56 If an aeroplane with a lift/ drag ratio of 6:1 was at 6000ft, the maximum distance it could glide in still air conditions would be:

A - 1 nautical mile.

B - 3 nautical miles.

C - 6 nautical miles.

D - 6 kilometres.

Q57 Published take-off performance data is complied from aircraft operating on:

A - an average hard surface runway and free of standing water.

B - a hard surface runway with a maximum slope in any direction of +/- 0.5° and free of standing water.

C - a tarmac surface runway with a maximum 0.5° up or down slope.

D - a level, dry, hard surface runway.

Q58 Increasing or decreasing the power setting in a single engined aeroplane changes the pitch attitude because:

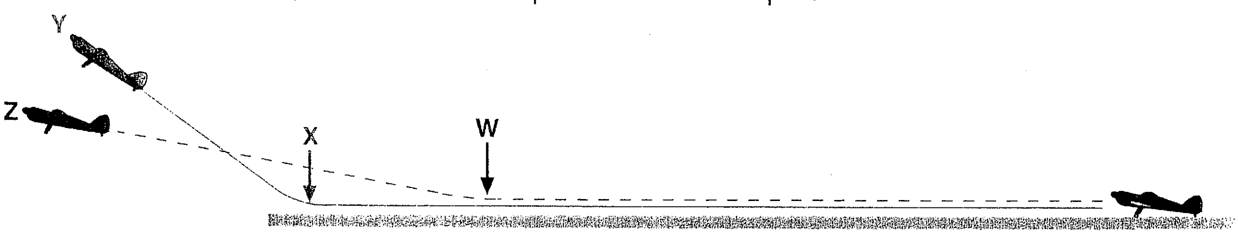
A - the gyroscopic effect of propeller torque changes.

B - the thrust line not being aligned with the drag line.

C - the spontaneous difference between profile and induced drag.

D - imbalance of the lift weight couple.

Q59 From the illustration below, select the initial climb profile with take-off flap set.



A - **W** to **Z**

B - W to X

C - **X** to **Y**

D - **X** to **Z**

Q60 During straight and level cruise, any imbalance created by increased lift causing disruption of equilibrium is compensated for by:

A - an upward force on the tailplane.

B - a power increase.

C - a downward force on the tailplane.

D - downward movement of the elevator.

Q61 When landing, if the TAS is significantly less than the ground speed, you will have:

A - a headwind.

B - a crosswind at 90°.

C - an inversion .

D - a tailwind.

Q62 The effects on the performance of an aeroplane that is overweight would be:

A - improved rate of climb and higher stall speed.

B - longer take-off run and decreased stall speed.

C - the possibility of structural damage and impaired handling.

D - reduced stall speed and TODR.

Q63 If the stalling speed of an aeroplane in the landing configuration (Vso) is 40kt, what should be the minimum approach speed.

A - 54kt

B - 52kt

C - 50kt

D - 48kt

Q64 After the power setting has been changed, it is desired to maintain the aeroplane at a constant altitude in a hands off condition. In respect of the elevator trim it:

A - should be adjusted when the speed has stabilised after the power change.

B - will not need adjusting.

C - should be adjusted at the same time as the power change.

D - should be adjusted immediately before the power change to compensate for the anticipated pitch change attitude.

Q65 If an aeroplane's Centre of Gravity is at its forward limit it will have ....**(i)**........ acceptable pitch control and ....**(ii)**....... available longitudinal stability. Select the response that will correctly complete this statement.

	(i)	(ii)
A -	maximum	minimum
B -	minimum	maximum
C -	maximum	maximum
D -	minimum	minimum

Q66 Due to decreased braking action, AIC 67/2002 (Pink 36) 7.6 states that the landing distance required when landing on very short grass that is wet should be multiplied by **(i)** and on a dry grass runway where the grass is less than 8 inches tall by **(ii)**.

	(i)	(ii)
A -	1.60	1.20
B -	1.50	1.60
C -	1.30	1.50
D -	1.50	1.20

Q67 The primary reason for not operating an A/C when its C of G is aft of the limit designated by the manufacturer is that:

A - stability may be impaired but the A/C will always be controllable.

B - the A/C will be uncontrollable in certain circumstances.

C - it will be impossible to flare out on landing.

D - it will be almost impossible to flare out on take-off.

Q68 The airspeed should be kept relatively high during a prolonged climb so that:

A - the desired altitude is reached as soon as possible.

B - the nose is kept low and visibility increased.

C - the airflow that passes over and cools the engine is adequate.

D - altitude change is achieved as close as possible to the best angle of climb.

Q69 A runway that slopes down by 2% will require a landing distance increase of:

A - 5%

B - 10%

C - 15%

D - 20%

Q70 When carburettor heat is applied on the ground or in the air, the engine speed drops:

A - because airflow in the carburettor is mechanically inhibited.

B - because fuel flow is increased to compensate for the weaker mixture due to warmer denser air.

C - because there is a power loss resulting from warmer less dense air entering the combustion chamber.

D - because fuel flow is reduced to compensate for the warmer denser air entering the combustion chamber.

Q71 If an aeroplane fitted with a fixed pitch propeller is in a steep dive, excessive engine RPM would:

A - be prevented by throttling back as required.

B - not occur owing to the propeller fly weight governor.

C - not be critical due to presence of propeller slip.

D - be governed aerodynamically by the disproportionate increase in propeller drag that resists rotation.

Q72 When loading a light aeroplane:

A - certification requirements specify that all seats and tanks are within the C of G limits so that no combination of loads can cause the C of G to be outside those limits.

B - certification requirements specify that the capacity of seats and tanks is such that even with them all filled the maximum take-off weight authorised will not be exceeded.

C - it is important to ensure that the C of G is within limits even if the take-off weight slightly exceeds the maximum take-off weight.

D - it is important to ensure that the C of G is within limits and the take-off weight does not exceed the maximum authorised take-off weight.

Q73 The required fuel load for a flight is 300 pounds. Given that the specific gravity of the fuel is 0.72, how much fuel in litres should be uplifted, presuming the tanks are empty?

A - 41.5 litres.

B - 275.0 litres.

C - 85.0 litres.

D - 189.0 litres.

Q74 Before refuelling, an aircraft had a weight of 1800 pounds and the total moments were 151200lb in aft of the datum. 310 lb of fuel were loaded which had an effective arm of 90 inches aft of the datum. The new total aft of datum moments were:

A - 179100lb in.

B - 123300lb in.

C - 189900lb in.

D - 201100lb in.

Q75 If a full complement of passengers and maximum possible baggage load are to be carried:

A - full fuel tanks must be carried.

B - the fuel load need not to be taken into account separately in the loading calculations.

C - the fuel load must not exceed 70% of the fuel tank capacity or 70% of maximum endurance whichever is less.

D - the fuel uplift may have to be restricted to prevent the maximum take-off weight being exceeded.

Q76 An oil tank containing 2 Imperial gallons of oil weighing 8.5 lb/ gal is 11 inches from the aeroplane datum point. The oil tank moment will be:

A - 46.75 lb in.

B - 187 lb in.

C - 93.5 lb in.

D - 134.5 lb in.

Q77 An aircraft with full tanks has 475 litres on board. Given that the fuel specific gravity (Sg.) is 0.722, the weight of the fuel in pounds will be:

A - 328.

B - 516.

C - 755.

D - 604.

Q78 12 Imperial gallons of fuel with a specific gravity of 0.73 weighs:

A - 87.6 lb.

B - 72 lb.

C - 120 lb.

D - 145 lb.

Q79 Aeroplane planned take-off weight = 2300 lb.
Calculated C of G for departure = 85.75 inches aft of the datum.
Planned fuel burn during the flight = 300lb, positioned 82 inches aft of the datum.

What is the calculated C of G position in inches aft of the datum for landing?

A - 98.46"

B - 86.31"

C - 75.18"

D - 64.59"

Q80 For a given fuel load, if the aircraft all up weight is increased, the range will:

A - be unchanged.

B - be increased.

C - only be reduced if flown at a higher altitude in less dense air.

D - be reduced.

Q81 Gliding for maximum range requires:

A - a high angle of attack.

B - a negative angle of attack.

C - a relatively low angle of attack.

D - a neutral angle of attack.

Q82 The primary reason for making a take-off into wind is to:

A - reduce the stalling speed during take-off.

B - reduce the TAS at which the aeroplane will take off.

C - reduce the emergency distance available in the event of an aborted take-off.

D - reduce the take-off distance.

Q83 The best rate of climb speed will achieve:

A - the maximum increase in height in the shortest distance from take-off.

B - the best obstacle clearance performance.

C - the greatest increase in altitude in a given period of time.

D - the greatest gain in height for the shortest distance travelled over the surface..

Q84 On occasions when the ambient air density is low, the resulting reduction in:

A - both lift and engine power will necessitate a longer take-off run.

B - drag permits the use of greater flap angles during the take-off phase.

C - drag more than offsets the loss of engine power resulting in greater aircraft acceleration to slightly higher take-off speeds.

D - drag and surface friction during the take-off phase will necessitate a longer take-off run.

Q85 The probable consequence of any ambient temperature increase upon air density and aircraft performance would be:

A - an increase in both air density and engine power available.

B - a decrease in both air density and engine power available.

C - a decrease in air density with an attendant increase in engine power available.

D - an increase in air density with an attendant decrease in engine power available.

Q86 The accepted indicated operating range of an aircraft vacuum system is normally:

A - 1.5 - 3.5 inches of mercury.

B - 6.5 - 8.5 inches of mercury.

C - 5.5 - 7.5 inches of mercury.

D - 3.5 - 5.5 inches of mercury.

Q87 If the barometric pressure falls after the altimeter sub-scale of an aircraft on the ground has been set, the altimeter will indicate:

A - the same altitude as when the sub-scale was set.

B - a lower altitude.

C - an increased altitude.

D - an altitude that is below mean sea level.

Q88 A heading indicated by a vacuum driven directional gyro:

A - must be aligned to true north.

B - remains aligned to magnetic north.

C - remains aligned to true north.

D - requires re-setting by the pilot at regular intervals.

Q89 The best rate of climb is achieved.

A - when climbing into wind at the best angle of climb.

B - when locked into a thermal.

C - when the mixture is full rich and the throttle fully advanced and the aeroplane maintaining cruise speed.

D - when there is a maximum excess of power above that required to maintain straight and level flight.

Q90 An aeroplane operating from a flat runway in the same wind conditions as when operating from an up-sloping runway will require a ....(**i**).... take-off distance and a ....(**ii**).... landing distance.

	(i)	(ii)
A -	longer	longer
B -	shorter	longer
C -	longer	shorter
D -	shorter	shorter

Q91 The effect on take-off performance of over-loading an aeroplane is:

A - it will accelerate slower but will have a better rate of climb.

B - it will have reduced acceleration and require a greater take-off run.

C - the maximum operating altitude will be reduced but the gliding range will be increased.

D - the landing speed will be reduced but the final approach rate of decent increased.

Q92 Compared to operating from a runway at sea level, an aeroplane operating from a runway at a high pressure altitude in the same wind conditions will require:

A - a shorter take off run and shorter landing distance.

B - a longer take off run but a shorter landing distance.

C - a shorter take off run but a longer landing distance.

D - a longer take off run and longer landing distance.

Q93 TORA plus the length of any clearway available is referred to as the:

A - EDA

B - EMDA

C - TODA.

D - LDA.

Q94 What is the gradient of a 2000ft runway having threshold elevations of 420ft and 465ft respectively.

A - 2.25%

B - 1.95%

C - 1.65%

D - 1.35%

Q95 Pressure altitude is employed as the datum for measuring aircraft performance. Given an aerodrome elevation as 930ft amsl and a QFE of 994hPa, what is the aerodrome pressure altitude?

1hPa or 1mb = 30ft

A - 1500ft

B - 360ft

C - 1244ft

D - 1623ft.

Q96 If an aircraft's take-off weight is increased by 10%, the take-off distance required to a height of 50ft will:

A - increase by 25% or the original take-off distance factored by 1.25.

B - increase by 30% or the original take-off distance factored by 1.30.

C - increase by 15% or the original take-off distance factored by 1.15.

D - increase by 20% or the original take-off distance factored by 1.20.

Q97 The take-off distance safety factor, mandatory for all public transport flights is recommended by the CAA to be applied to all flights. After all other variable factors have been taken into account when calculating the take-off distance required, that figure should be increased by:

A - 25% or the original take-off distance factored by 1.25.

B - 33% or the original take-off distance factored by 1.33.

C - 45% or the original take-off distance factored by 1.45.

D - 20% or the original take-off distance factored by 1.20.

Q98 Flight for maximum range in a piston engined aircraft is achieved by flying:

A - at just above the minimum drag speed.

B - at the lowest density altitude that is safely possible.

C - just below that speed which provides the maximum power/ airspeed ratio.

D - at the same speed for maximum endurance + 10% and at the lowest density altitude that is safely possible.

Q99 Under what conditions is carburettor icing likely to occur?

A - When climb power is selected and the throttle butterfly is fully open.

B - At high altitude in very cold air before the fuel is correctly leaned for the cruise.

C - During cruise power settings when the throttle butterfly is half open.

D - During descent power setting or idle when the throttle butterfly opening is minimal.

Q100 Refer to Appendix M:

Pressure Altitude SEA LEVEL

OAT ISA +10

Calculate the take-off distance to reach a 50ft screen height assuming a take-off weight of 3300 LBS.

A - 2800 FEET

B - 1700 FEET

C - 1200 FEET

D - 2300 FEET

PERFORMANCE and PLANNING PRACTICE ANSWER SHEET

	A	B	C	D
1				
2				
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	A	B	C	D
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	A	B	C	D
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	A	B	C	D
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100				

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PERFORMANCE and PLANNING
ANSWER SHEET

	A	B	C	D
1	X			
2	X			
3				X
4		X		
5				X
6			X	
7			X	
8	X			
9		X		
10	X			
11				X
12	X			
13	X			
14		X		
15		X		
16			X	
17			X	
18	X			
19		X		
20	X			
21		X		
22			X	
23			X	
24				X
25				X

	A	B	C	D
26	X			
27	X			
28		X		
29		X		
30		X		
31			X	
32		X		
33	X			
34			X	
35				X
36			X	
37			X	
38				X
39			X	
40	X			
41		X		
42		X		
43		X		
44	X			
45				X
46	X			
47	X			
48	X			
49			X	
50			X	

	A	B	C	D
51		X		
52			X	
53				X
54				X
55	X			
56			X	
57				X
58		X		
59		X		
60			X	
61				X
62			X	
63		X		
64	X			
65		X		
66	X			
67		X		
68			X	
69		X		
70			X	
71	X			
72				X
73				X
74	X			
75				X

	A	B	C	D
76		X		
77			X	
78	X			
79		X		
80				X
81			X	
82				X
83			X	
84	X			
85		X		
86				X
87			X	
88				X
89				X
90		X		
91		X		
92				X
93			X	
94	X			
95	X			
96				X
97		X		
98	X			
99				X
100		X		

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FLIGHT PERFORMANCE & PLANNING EXPLANATIONS

EPP1(A)

If air density is reduced, the engine will develop less power, giving reduced acceleration because the power developed depends upon the weight of the fuel air mixture burned.

The propeller will develop less thrust for a given RPM, and a greater airspeed will be required to generate the lift necessary to become airborne.

Although the drag factor will be reduced, this does not off-set the increased take-off distance required due to reduced engine power, propeller thrust, and increased take-off speed.

L	=	$C_L \frac{1}{2} \rho V^2 S$
L	=	**Lift**
CL	=	**Coefficient of Lift which is the product of aerofoil design and angle of attack**
ρ	=	**Air density**
V	=	**TAS**
S	=	**Wing area**

It may be seen from the above formula (Bernoulli's Theorem) that if density (ρ) is reduced, **V** (TAS) must be increased to generate the same amount of lift.

Propeller thrust may be substituted for **L** (Lift) in the formula which is also reduced. In other words:

Propeller thrust = $C_L \frac{1}{2} \rho V^2 S$

A longer take-off run will be required because of both the reduced acceleration and the increased TAS required to generate the lift necessary to become airborne.

EPP2(A)

The total weight of an aeroplane together with its total contents at any particular time is referred to as the gross weight.

EPP3(D)

Find the the total moment at take off:

= weight x moment arm = 2300lb x 90.75in
= 208725lb in

Find the moment of the fuel used:

= weight x moment arm = 170lb x 87in
moment = 14790lb in

From the take-off moment, subtract the fuel used moment to give the landing moment.

= (208725 – 14790)lb in = 193935lb in.

From the take-off weight subtract the fuel burn to give the landing weight.

= (2300 – 170)lb = 2130lb

Divide the landing moment by the landing weight to give the distance of the landing weight from the datum which is the landing C of G position.

$$\frac{193935\text{lb in}}{2130\text{lb}} = 91.05 \text{ inches aft of the datum.}$$

EPP4(B)

At take-off power, if air density is increased, the weight of fuel/air mixture entering the engine for any given throttle setting will be greater. Engine power and propeller thrust developed, together with lift generated for a given airspeed will all increase. Take-off distance will be reduced because the aeroplane will accelerate at a greater rate and the lift required for take-off will be generated at a lower airspeed. See EPP1.

EPP5(D)

See fig P1.

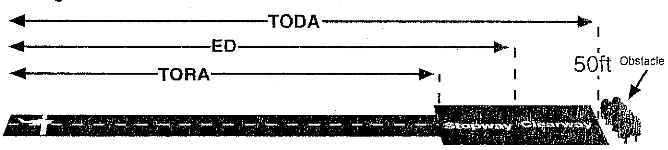

fig P1

Take-off run available (TORA)
The length of runway declared available and suitable for the ground run of an aeroplane taking off.

Take-off Distance Available (TODA).
The length of TORA plus the length of the clearway if provided.

Accelerate Stop Distance Available. (ASDA)
The length of TORA plus the length of the stopway, if provided.

Landing Distance Available. (LDA)
The length of runway which is declared available and suitable for the ground run of an aeroplane landing.

EPP6(C)

See fig P2.

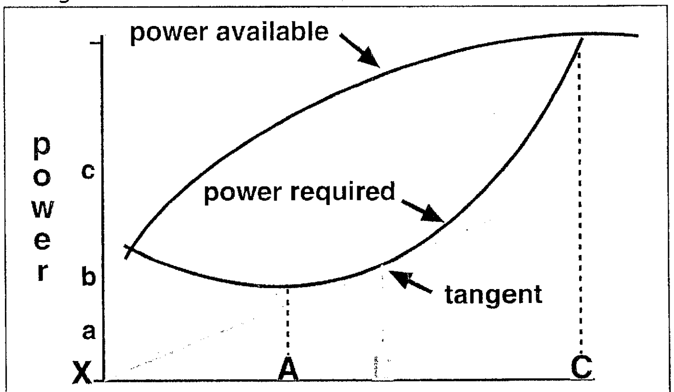

fig P2

During the cruise in a tailwind, the aircraft ground speed is increased by a factor equal to the tailwind.

Power required is that needed to overcome drag at a given airspeed but drag is high at both fast and slow flight. This is because induced drag decreases and parasite drag increases with increased airspeed so minimum drag will occur somewhere in between fast and slow flight.

The speed for range is that resulting in the greatest distance covered for the least amount of fuel burned.

= specific fuel consumption (SFC)

$$= \frac{\text{speed nm}}{\text{hr}} \times \frac{1\text{hr}}{\text{fuel burned (gals)}}$$

$$= \frac{\text{nm}}{\text{gal}}$$

SFC is proportional to Power.
SFC is proportional to Speed.

Therefore, Power is proportional to Speed giving a Power/ Speed ratio.

The best speed for Range will occur where this ratio is smallest, defined by a tangent to the Power Required curve drawn from the point of origin **X** and defined by airspeed 'B'. This is the minimum drag speed or that speed at which the combined values of induced and parasite drag are smallest.

X - A on the horizontal axis represents the minimum flight speed (endurance speed) and the power required for endurance speed is represented by **'a'** on the vertical axis.

Airspeed **X - B** (speed for range) is approximately 80% faster than **X - A** but the additional power required for this speed increase is quite small represented by ' **b'** on the vertical axis.

*Airspeed **X - B** will provide the greatest distance for the least* amount of fuel. In a tailwind however, there is a trade off between ground speed and specific fuel consumption and generally the aircraft is flown at a slightly slower airspeed in a tailwind.

EPP7(C)

If weight is increased, the lift must be increased proportionately to maintain the aeroplane airborne.

Given that lift generated is proportional to airspeed, (see EPP1 Bernoulli's Theorem) for a given angle of attack, the airspeed must be increased to produce more lift to balance the increased aeroplane weight. Hence the speed at which the aeroplane will lift off will increase as will the stalling speed.

V_S = stalling speed.

V_2 (take-off safety speed) is a function of V_S.

V_2 is a target speed to be attained by a height of 50ft.

$V_2 = V_S \times 1.2$ and used to the point where acceleration to flap retraction speed is initiated. If the stalling speed is increased by virtue of increased weight, V_2 must increase proportionately.

EPP8(A)

In respect of all runway surfaces, an up sloping runway would cause an aeroplane taking off to accelerate at a lower rate which would require an increased take-off run than when departing from a flat runway under similar conditions.

An aeroplane landing on a up sloping runway would require a decreased landing distance than when landing on a flat runway under similar conditions.

In both instances, it is gravity that acts to either inhibit acceleration during take-off or reduce the aeroplane's inertia during landing.

The reverse would apply to a down sloping runway.

EPP9(B)

Sloping runway:

An uphill slope increases the take-off ground run and a down hill slope decreases the take-off ground run. However, the TODR is never factored in respect of down sloping runways but the take-off distance will be increased by 10% for each 2% of uphill slope (a factor of x 1.1).

The landing distance required (LDR) will be increased when landing on a down sloping runway as a potential energy factor due to gravity will remain that sustains inertia after touch down.

An up sloping runway will cause gravity to act against inertia. When compared to the LDR for a flat runway with a similar surface under similar conditions, the LDR on an up sloping runway will be reduced.

EPP10(A)

See fig P3.

The efficiency of a wing depends upon the lift/ drag ratio: the greater that ratio, the more efficient the wing.

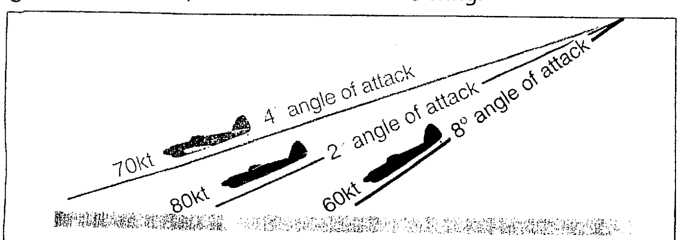

fig P3

The best lift/ drag ratio is achieved at an angle of attack that produces the greatest lift for the smallest drag penalty. This will occur at a relatively low angle of attack.

The horizontal distance travelled in a glide:

= lift/ drag ratio x vertical descent.

If a wing for a given angle of attack has a lift drag ratio of 12-1, in a glide, for every 1000ft the aircraft descends, it will travel:

12 x 1000ft = 12000ft or approximately 2nm.

If the angle of attack is either above or below the optimum figure, both the lift/ drag ratio and airspeed would be affected.

If the angle of attack was increased, lift would be increased giving a reduced sink rate, so the aeroplane would remain airborne longer, but would travel less distance as the airspeed would be lower due to increased drag.

If the angle of attack was decreased, airspeed would increase but lift would be reduced and the aeroplane would descend at a greater rate. In both instances the distance flown would be reduced.

An aeroplane will glide furthest at an airspeed which results in an angle of attack that gives the best lift/ drag ratio. This would be a relatively low angle of attack.

EPP11(D)

See EPP10 and fig P3.

In a glide, an aeroplane follows an inclined flight path considered here in still air conditions. Forward motion is sustained by utilising a component of weight and effect of gravity to replace propeller thrust. In a glide, the aircraft sustains a constant velocity, hence, thrust must be equal to drag otherwise the aircraft would either accelerate or slow down. Lift balances the remaining component of weight and the aircraft remains in equilibrium following an inclined flight path.

When gliding for range, the best lift/ drag ratio must be sustained, normally achieved at about a 4° angle of attack, and identified by a particular airspeed for a given weight.

Given a lift-drag ratio of 10:1, the aeroplane will travel 10nm horizontally for every 1nm it descends.

If weight is increased, the glide path is steepened to increase both airspeed and lift while maintaining the same angle of attack and lift-drag ratio.

EPP12(A)

When gliding in a tailwind, the aeroplane is being transported over the surface at a rate equal to the moving body of air plus its true airspeed (TAS).

The TAS will be the same as gliding in still air together with the same rate of descent because the latter is time and not distance based. However, the ground speed will be increased as will the distance flown.

EPP13(A)

The glide will be made at the same airspeed and rate of descent taking the same time to reach the ground irrespective of wind conditions.

The ground speed into wind will be less than in still air conditions so the distance travelled over the ground will be reduced. Because of the reduced ground speed, the glide path will also be steeper.

EPP14(B)

If weight is increased, the lift must be increased proportionately to maintain the aeroplane airborne.

Given that lift generated is proportional to airspeed, (see EPP1 Bernoulli's Theorem) for a given angle of attack the airspeed must increase to produce more lift to balance the increased weight. Hence, the speed at which the aeroplane stalls will also increase. The speed at which an aeroplane becomes airborne is a factor of the stalling speed so take-off speed is increased together with the take-off run required.

Approach and Landing speeds are also factors of the stall speed in the landing configuration. Hence, approach and landing speeds are increased along with inertia. After touch down, the ground roll is increased as flaps and brakes have to absorb the increased inertia.

EPP15(B)

When flap is extended during an approach, the required pitch attitude is reduced (flatter) and a steeper approach path is flown both of which provide improved forward vision .

Full flap settings on most light aircraft are between 30° and 40°.

Landing flap when extended will increase:

(i) the wing angle of attack

(ii) the upper camber of the wing

(iii) with some types of flap, the wing area.

Any one of the above will increase the coefficient of lift represented as a component of **CL** in Bernoulli's Theorem:

$$L = C_L \tfrac{1}{2} \rho V^2 S$$

Landing flap also aids in slowing the aeroplane after touch down.

The lift required to oppose weight will be generated at a lower indicated airspeed, so the aeroplane will stall at a lower indicated airspeed.

As the approach speed is a factor of stall speed in the landing configuration (V_{SO} x 1.3%) the approach speed will be reduced. The primary reason for using flap is to reduce the landing distance required.

EPP16(C)

Increased, due to increased inertia.

See EPP14.

EPP17(C)

See fig P4.

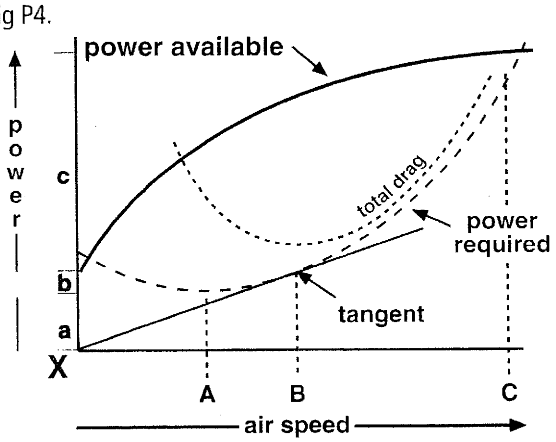

fig P4

For a given airspeed, power required is that needed to overcome drag, but drag is high at both fast and slow flight.

This is because induced drag is high at slow speed and parasite drag is high at high airspeed hence, minimum drag will occur somewhere in between fast and slow flight.

The speed for range is that resulting in the greatest distance covered for the least amount of fuel burned.

= specific fuel consumption (SFC).

$$SFC = \frac{\text{speed nm}}{\cancel{\text{hr}}} \times \frac{1\cancel{\text{hr}}}{\text{fuel burned (gals)}}$$

$$SFC = \frac{\text{nm}}{\text{gal}}$$

SFC is proportional to Power.

SFC is proportional to Speed.

Therefore, Power is proportional to Speed giving a power/ speed ratio.

The best speed for range will occur where the **power/ speed ratio is smallest** which corresponds with the minimum drag speed, defined by a tangent to the **power required** curve drawn from the point of origin **X** in fig P4. Minimum drag is where the combined value of induced and parasite drag is smallest.

As power required is that necessary to overcome drag at a given airspeed, airspeed **B** also defines the smallest power/ airspeed ratio and the best speed for range.

Airspeed **B** is approximately 70% faster than airspeed **A** (endurance speed) but the additional power required for this speed increase is quite small represented by distance **b** on the vertical power axis indicating that induced drag reduces at a greater rate than parasite drag increases between speeds **A** and **B**.

However, engine efficiency must also be considered. An aircraft piston engine is normally most fuel efficient at about 65% power which may give an airspeed approximately 5% to 10% faster than that for minimum drag.

EPP18(A)

A down-sloping runway would cause an aeroplane taking off to accelerate at a greater rate which would require a shorter take-off run than when departing from a flat runway under similar conditions.

An aeroplane landing on a down-sloping runway would require a greater landing distance than when landing on a flat runway under similar conditions.

In both instances, it is gravity that acts to either assist acceleration, during take-off, or sustain the aeroplane's inertia and oppose braking action during landing.

EPP19(B)

See fig P5.

Altimeter

The outside of the partially evacuated (Aneroid) capsule within the altimeter body senses atmospheric pressure which, due to decreasing pressure, will expand during a climb and contract during a descent. The partially evacuated capsule is prevented from collapsing by leaf spring action. Any capsule movement due to atmospheric pressure change is transmitted via mechanical linkage to dials on the instrument face.

If the static pressure source became blocked in level cruise trapping the pressure at that level within the gas tight casing, during a subsequent climb or descent, the altimeter indication would remain static indicating the altitude at which the static vent became blocked.

Airspeed Indicator

An airspeed indicator employs both static and pitot pressure and is the only light aircraft instrument to employ both.

Pitot pressure sensed by the pitot tube is the product of two different pressures:

1 Dynamic pressure due to the forward motion of the aeroplane.

2 Static or atmospheric pressure.

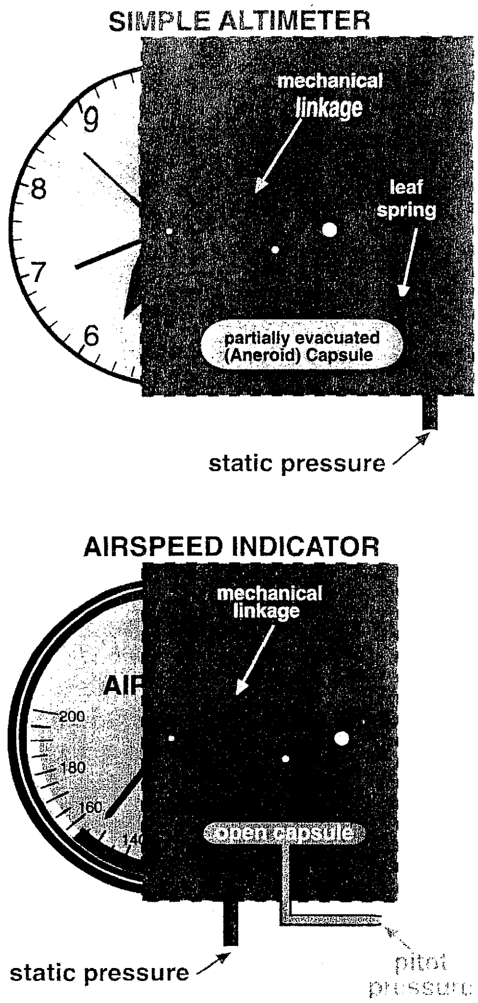

fig P5

Pitot pressure (combined dynamic pressure + static pressure) is fed to the inside of the capsule, while static pressure is fed to the inside of the instrument casing surrounding the capsule.

The effect of static pressure as a component of pitot pressure on the inside of the capsule is neutralised by static pressure acting on its outside, therefore any expansion or contraction of the capsule will be due solely to the value of dynamic pressure.

As dynamic pressure is the product of airspeed (Dynamic pressure = $\frac{1}{2}\rho V^2$, (where **V** = TAS), any movement of the capsule will be proportional to airspeed.

Should the static vent become blocked in level cruise, during a subsequent climb static pressure (as an element of pitot pressure) sensed inside the capsule would decrease, while that sensed by the outside of the capsule would remain static at a greater pressure, resulting in a partial capsule collapse. This would cause a lower airspeed to be indicated on the instrument face. The ASI would therefore under-read.

During a subsequent descent, static pressure (as an element of pitot pressure) sensed inside the capsule would increase, while that sensed by the outside of the capsule would remain static at a lower pressure, resulting in a partial capsule expansion. This would cause a higher airspeed to be indicated on the instrument face. The ASI would therefore over-read.

EPP20(A)

See fig P6.

The performance table values for each level are compiled as if climbing from sea level. Any intermediate climb data must be extracted by interpolation.

Enter the performance table at the altitude to which the aircraft must climb and note the values of time, fuel used and distance

FUEL, TIME and DISTANCE TO CLIMB AT 2300 POUNDS

CONDITIONS

Flaps Up
Landing Gear Retracted
Full Throttle
Standard Temperature
Zero Wind

PRESS ALT FT	TEMP °C	CLIMB SPEED KIAS	RATE of CLIMB FPM	FROM SEA LEVEL		
				TIME in MINS	FUEL USED GAL	DIST NM
S.L.	15	79	720	0	0.0	0
1000	13	78	670	1	0.4	2
2000	11	77	625	3	0.7	4
3000	9	76	575	5	1.2	6
4000	7	76	560	6	1.5	8
5000	5	75	515	8	1.8	11
6000	3	74	465	10	2.1	14
7000	1	73	415	13	2.5	17
8000	-1	72	365	15	3.0	21
9000	-3	72	315	18	3.4	25
10000	-5	71	270	22	4.0	29
11000	-7	70	220	26	4.6	35
12000	-9	69	170	31	5.4	43

fig P6

flown. From these values, subtract the values of time, fuel used and distance flown at the altitude from which the climb is commenced.

	Time in MINS	Fuel used GAL	Dist NM
7000ft	13	2.5	17
3000ft	5	1.2	6 –
3000ft - 7000ft	**8**	**1.3**	**11**

EPP21(B)

Taking off into wind is a safety consideration. it:

(a) reduces the ground speed at which the aeroplane will become airborne.

(b) reduces the length of runway required for the take-off ground run.

(c) will in the event of an aborted take-off, increase the amount of runway remaining and reduce the stopping distance required.

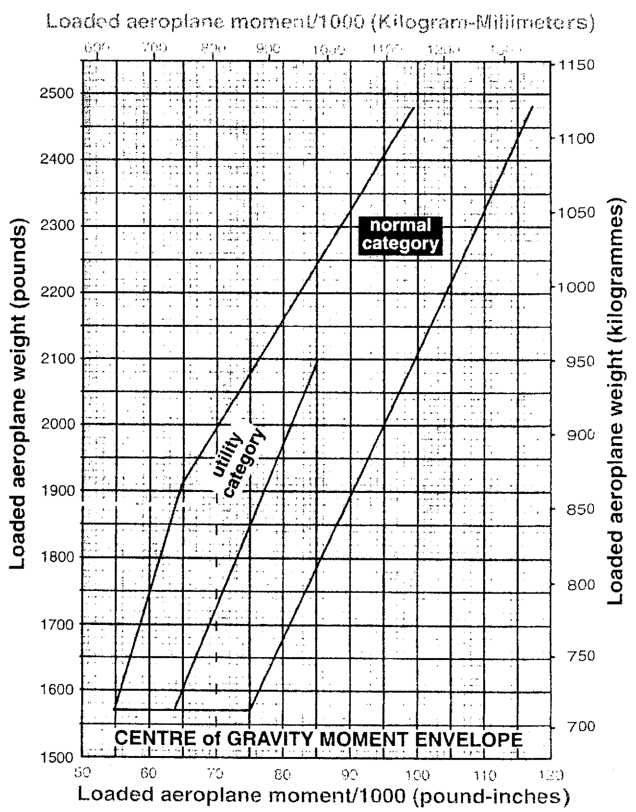

fig P7

EPP22(C)

See fig P7.

The question specifies the Utility Category so the intersection of weight and moment must fall to the left and below the top of the the flight envelope centre line.

The only combination to fall within these parameters is 1880lb at 70,000lb inches.

Had the question specified the Normal Category, an intersection anywhere within the flight envelope would suffice.

EPP23(C)

If the C of G is too far aft, not only will the aeroplane be unstable, abnormal downward elevator deflection to maintain the correct pitch attitude will be necessary producing increased drag. Consequently, engine power must be increased for any given airspeed resulting in a higher rate of fuel consumption and reduced range.

EPP24(D)

Zero fuel weight is the basic empty weight of an aeroplane plus the crew, passengers, cargo, unusable fuel and engine oil. Illustration '**A**' has no fuel in the wings.

EPP25(D)

See fig P8.

MAXIMUM RATE of CLIMB AT 3000 FEET

CONDITIONS

Flaps Up
Landing Gear Retracted
Full Throttle

PRESS ALT FT	CLIMB SPEED KIAS	RATE of CLIMB - FPM			
		-20°C	0°C	20°C	40°C
S.L.	79	830	770	705	640
2000	77	720	655	595	535
4000	76	645	585	525	465
6000	74	530	475	415	360
8000	72	420	365	310	250
10000	71	310	255	200	145
12000	69	200	145	.....	.....

fig P8

Pressure altitudes in the performance table are at 2000ft intervals so interpolation is required to calculate the maximum rate of climb at 3000ft with an outside air temperature (OAT) of 0°C.

Enter the table at 2000ft. Move across to the 0°C column and note the rate of climb 655fpm.

Enter the table at 4000ft. Move across to the 0°C column and note the rate of climb 585fpm.

To find the rate of climb at 3000ft, add the values of rate of climb extracted and divide by 2.

$$= \frac{655 + 585}{2} = 620\text{fpm}$$

EPP26(A)

Any flap deployment in the cruise will increase the coefficient of drag, disrupting equilibrium. Increased power will be required to sustain the cruise airspeed which will reduce the excess power available and subsequent climb capability. See EPP89.

EPP27(A)

When altitude is increased, atmospheric pressure and therefore air density ρ will decrease.

From the formula below (Bernoulli's Theorem) if air density ρ on the right hand side of the formula is reduced, '**Lift**' will also be reduced.

$L = C_L \frac{1}{2} \rho V^2 S$

L = **Lift**

C_L = **Coefficient of Lift, which is the ppoduct of aepofoil design and angle of attack**

ρ = **Aip density**

V = **TAS**

S = **Wing apea**

EPP28(B)

Any ice by virtue of its presence will increase aircraft weight. Lift will be significantly reduced because ice having a very rough surface will disrupt the boundary layer close to the wing surface and increase drag. This in turn will disrupt the smooth laminar airflow necessary for the generation of lift.

EPP29(B)

See fig P9.

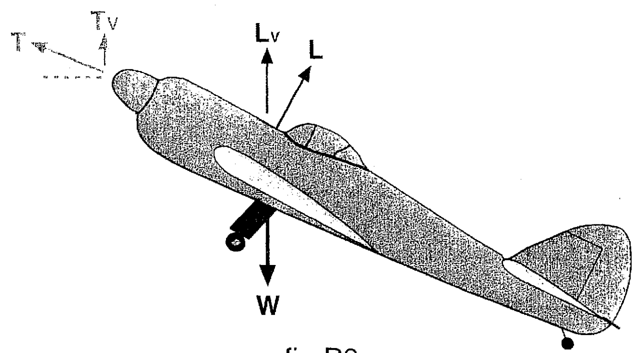

fig P9

When climbing at a constant rate, an aeroplane follows an inclined flight path during which a balance of opposing forces (equilibrium) acting on the aeroplane must be maintained.

Lift (**L**) generated by the wings acts upwards and backwards at 90° to the chord line which may be represented vectorially by '**L**' where the vertical component of lift (**Lv**) opposes weight '**W**' but is smaller than '**W**'.

Thrust (T) acting in the direction of the flight path may also be represented vectorially where its vertical component (Tv) is seen to oppose '**W**'.

The sum of the vertical components of Lift (**Lv**) and Thrust (Tv) are equal to and opposite Weight (**W**)

Lv + Tv = **W** so the vertical component of Lift (**Lv**) generated by the wing must be less than '**W**'.

EPP30(B)

At any given airspeed, an increase in aircraft weight will require an increased angle of attack to generate the lift necessary to balance weight. This will increase drag requiring more power to balance drag and sustain airspeed. Consequently the excess power available will be reduced which will reduce the rate of climb performance. See EPP89.

EPP31(C)

See fig P10.

Another way of understanding the LOAD FACTOR is to appreciate that when the total lift required to be generated by the wings is equal to the aeroplane's weight then the LOAD FACTOR equals 1.

When an aircraft banks, the total lift required to be generated by the wings is greater than the weight, so the LOAD FACTOR will be greater than 1.

The LOAD FACTOR may be expressed as a fraction by dividing the total LIFT by the WEIGHT.

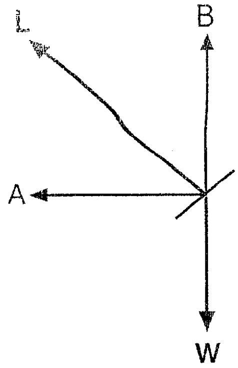

fig P10

The vector diagram in the question represents the forces acting on an aeroplane in a level turn where:

B = vertical component of lift.

W = weight which is equal to and opposite B.

A = the horizontal component of lift or centripetal force that opposes centrifugal force in a turn.

L = the total lift generated by the wings which is also the resultant of **A** - **B**.

LOAD FACTOR $= \frac{L}{W}$

EPP32(B)

See fig P11.

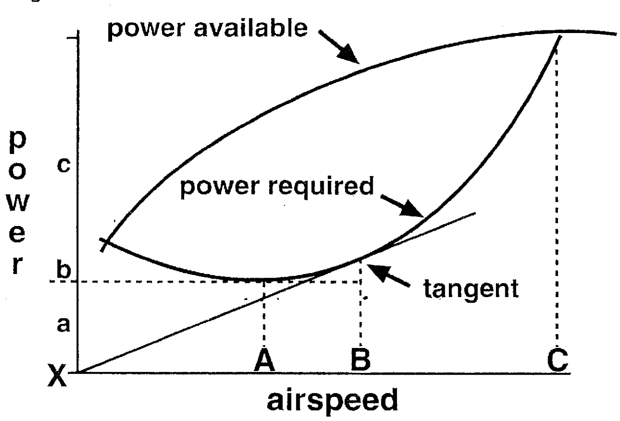

fig P11

Power required is that needed to overcome drag at a given speed but drag is high at both fast and slow flight. This is because induced drag decreases and parasite drag increases with increased airspeed so minimum drag will occur somewhere in between fast and slow flight represented by the tangent at **B**.

The speed for range is that resulting in the greatest distance covered for the least amount of fuel burned.

= specific fuel consumption (SFC).

$$= \frac{\text{speed nm}}{\text{hr}} \times \frac{1\text{hr}}{\text{fuel burned (gals)}} = \frac{\text{nm}}{\text{gal}}$$

SFC is proportional to Power

SFC is proportional to Speed

Therefore Power is proportional to Speed giving a:

Power/ Speed ratio.

The best speed for Range will occur where this ratio is smallest, defined by a tangent to the Power Required curve drawn from the point of origin **X**.

Considering the modified graph fig P11:

X - A represents the minimum flight speed (endurance speed) and the power required is represented by the distance '**a**' on the vertical axis.

X - B (speed for range) is approximately 70% faster than **X -A** but the additional power required for this speed increase is quite small represented by the distance '**b**' on the vertical axis.

The further power increase required to achieve airspeed **C** is considerable, represented by the distance '**c**' on the vertical axis.

Airspeed **X - B** will provide the best power/ speed ratio and consequently the greatest distance for the least amount of fuel burned.

EPP33(A)

See fig P12.

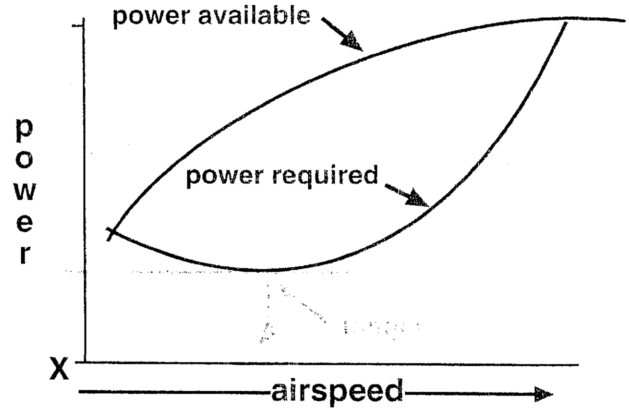

fig P12

Endurance is the maximum time an aeroplane can remain airborne with a given quantity of fuel.

The speed for maximum endurance is that at which the engine is developing the minimum power to maintain the aeroplane airborne, giving a low rate of fuel consumption.

At lower altitudes in higher density (ρ) air, the minimum lift required will be generated at a lower airspeed than at higher levels.

L = $\frac{1}{2}\rho V^2 S$ where **V** = true airspeed.

In order to sustain flight, the best speed for endurance will occur where the power required to overcome drag is minimum. This will occur where a horizontal line forms a tangent with the power required curve defined by airspeed **A**.

EPP34(C)

See EPP33.

EPP35(D)

At any given airspeed, an increase in aircraft weight will require an increased angle of attack to generate the lift necessary to balance weight. This will increase drag, requiring more power to balance drag and sustain the target airspeed. Consequently the excess power available will be reduced which will reduce the rate of climb performance. See EPP89.

EPP36(C)

See EPP17.

During the cruise, an aeroplane will achieve the maximum range at a speed that is about 5% to10% faster than that speed giving the optimum lift/ drag ratio.

Although the optimum lift/ drag ratio gives the most lift for the least amount of drag, it must be considered that a piston engine is most fuel efficient at power settings in the order of 65%. This will produce an airspeed that is above the minimum drag speed and an angle of attack that is below that for the best lift/ drag ratio.

EPP37(C)

See EPP46

Flap settings may be divided into two categories which are take-off flap and landing flap.

Take off flap involves relatively small flap settings in the order of 0° - 20°. Extra lift is generated with a relatively small drag penalty resulting in a slower take-off airspeed and shorter take off distance required.

Flap when extended will increase:

(i) the wing angle of attack

(ii) the upper camber of the wing

(iii) with some types of flap, the wing area.

(i) and (ii) above will increase the coefficient of lift as each is an element of **CL** in Bernoulli's Theorem whilst (iii) wing area, is represented by **S** in Bernoulli's Theorem:

$$L = C_L \frac{1}{2} \rho V^2 S$$

Increasing the camber will increase the airflow velocity and pressure reduction over the wing's upper surface.

Increasing the wing area will increase the total amount of lift generated.

The lift required to oppose weight will be generated at a lower indicated airspeed, so the aeroplane will stall at a lower indicated airspeed.

Vs = stalling speed in the take-off configuration.

V2 is a target speed to be attained by a height of 50ft.

V2 (take-off safety speed) is a function of the stalling speed in the take-off configuration. = Vs x 1.2

If the stalling speed is decreased by virtue of flap extension, **V2** must decrease proportionately. **V2** is also used as the point from which it is considered safe to accelerate the aeroplane to flap retraction speed.

EPP38(D)

If weight is increased, the lift must increase proportionately to maintain the aeroplane airborne.

Given that an aerofoil will always stall at the same angle of attack and the lift generated is proportional to airspeed, (see EPP1 Bernoulli's Theorem) for a given angle of attack the airspeed must be increased to produce more lift to balance the increased aeroplane weight.

Consequently, the speed at which the aeroplane stalls will be greater.

EPP39(C)

One factor governing the landing distance required is the aeroplane's speed at a height of 50ft over the runway; normally 1.3 x the stalling speed in the landing configuration.

If the weight is increased then the stalling speed will increase proportionately and consequently, the approach speed. For a weight increase of 15%, the landing distance required will increase by approximately the same factor, e.g. 15%.

EPP40(A).

Change of density ρ affects both lift and IAS equally. See EPP19.

With altitude increase, the true airspeed (**TAS**) at which an aeroplane stalls increases but indicated airspeed (**IAS**) remains unchanged.

IAS is derived from dynamic pressure = $\frac{1}{2} \rho V^2$ and
Lift = $\frac{1}{2} \rho V^2 S$ both having variables of ρ and **V**.

As density ρ decreases with ascent, the aeroplane must increase **V** (**TAS**) to generate the same amount of lift and indicate the same airspeed.

IAS remains the same because **V** representing **TAS** in the dynamic pressure formula has increased, compensating for ρ which has decreased.

Although the **TAS** at which the aeroplane stalls will increase with altitude, the **IAS** at which it stalls is unaffected by altitude change.

EPP41(B)

The angle of attack at which the laminar flow over the wing is disrupted and the centre of pressure moves rapidly rearward always occurs at the same angle of attack.

Therefore, irrespective of airspeed, a wing will stall if the angle of attack is too great.

EPP42(B)

See EPP14 and EPP15.

The stalling speed in the landing configuration (Vso) x 1.3

EPP43(B)

An aeroplane landing on a up sloping runway would require a decreased landing distance than when landing on a flat runway under similar conditions.

It is gravity that acts to reduce the aeroplane's inertia and assist braking action during landing.

The reverse would apply to a down sloping runway.

EPP44(A)

See EPP31.

Maintaining a constant altitude in a steep turn will require an increased angle of attack and increased power.

Increasing the angle of attack will generate the lift required to compensate for the increased load factor (weight) produced by the bank angle and rate of turn.

Increasing power will balance the larger drag factor resulting from the increased angle of attack.

EPP45(D)

See fig P13.

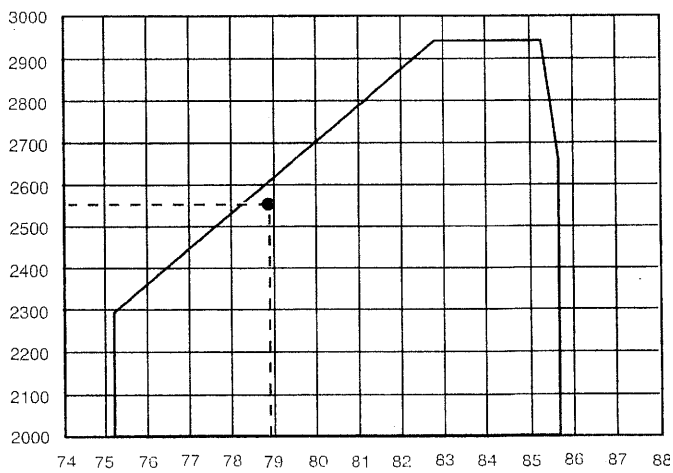

fig P13

The white area represents the weight and balance flight envelope. The only intersection of parameters that falls within the flight envelope is weight 2560lb with a C of G position 78.9 inches aft of the datum.

EPP46(A)

See fig P14 and EPP 37.

Flap settings may be divided into two categories which are take-off flap and landing flap.

Take off flap involves relatively small flap settings in the order of 0° - 20°. Extra lift is generated with a relatively small drag penalty resulting in a slower take-off airspeed and shorter take off distance required.

Landing flap normally involves flap settings between 20° and 40° that create a large drag increase with a relatively small lift increase over and above that generated by take-off flap settings.

The result will be a slower approach speed and shorter landing distance required.

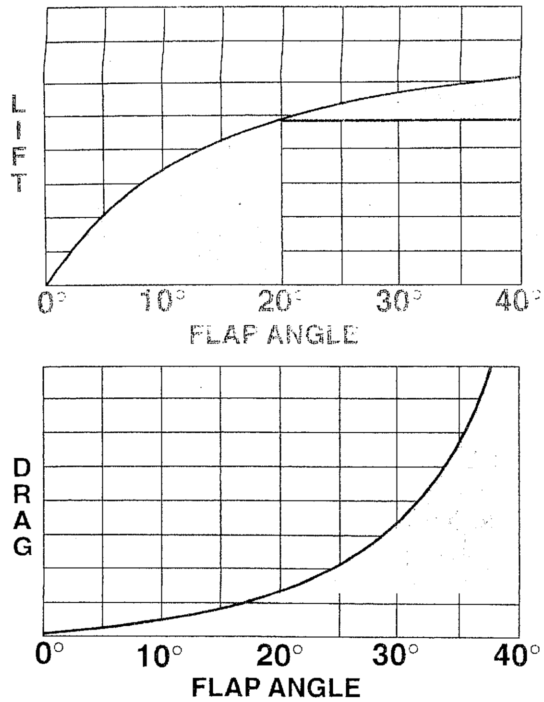

fig P14

EPP47(A)

At full engine power, the best 'angle of climb' or the best 'rate of climb' are both determined by airspeed as laid down in the relative aeroplane operating manual.

The best 'angle of climb' is achieved with a greater pitch attitude and slower airspeed than the best rate of climb and is used to gain the most altitude in the shortest possible distance travelled.

$$\textbf{Best angle of climb} = \frac{\text{altitude increase}}{\text{distance travelled}}$$

Best 'rate of climb' is achieved with a smaller pitch attitude and slightly higher airspeed than the best angle of climb and is used to gain the most altitude in the shortest period of time.

$$\textbf{Best rate of climb} = \frac{\text{altitude increase}}{\text{time}}$$

EPP48(A)

Climbing is usually achieved at a constant indicated airspeed (IAS) but with increased altitude, density decreases affecting IAS.

IAS is the product of dynamic pressure = $\frac{1}{2}\rho \mathbf{V}^2$ where **V** is TAS.

If density ρ decreases with altitude then the value of dynamic pressure and IAS can only be maintained by increasing **V** or TAS.

Hence during a climb, the value of TAS increases in order to maintain dynamic pressure and a constant indicated airspeed.

EPP49(C)

For any approach airspeed, a landing made into wind reduces the ground speed by a factor proportional to the headwind component. Any reduction in ground speed will reduce the ground roll required because the aircraft's inertia is reduced.

EPP50(C)

A cloud of extensive vertical and horizontal development could be a cumulonimbus cell or large cumulus, both of which are capable of producing ice accretion outside the cloud but to a greater extent, inside.

Any ice accretion will increase weight and disrupt the smooth airflow over lift producing surfaces, inducing stall at lower angles of attack and higher airspeeds.

If Inadvertent flight into icing conditions occurs, the safest course of action would be to make a 180° turn because there weren't any icing conditions where you just came from. Alternatively, descend into warmer air if terrain clearance permits.

EPP51(B)

See fig P15.

CRUISE PERFORMANCE

CONDITIONS
2300 Pounds
Speeds are for aircraft with speed fairings. Without speed fairings, decrease speeds by 3 kt.

PRESS ALT FT	RPM	20°C BELOW STANDARD TEMP			STANDARD TEMPERATURE			20°C ABOVE STANDARD TEMP		
		% BHP	KTAS	GPH	% BHP	KTAS	GPH	% BHP	KTAS	GPH
2000	2250	---	---	---	79	115	9.0	74	114	8.5
	2200	79	112	9.1	74	112	8.5	70	111	8.0
	2100	69	107	7.9	65	106	7.5	62	105	7.1
	2000	61	101	7.0	58	99	6.6	55	97	6.4
	1900	54	94	6.2	51	91	5.9	50	89	5.8
4000	2300	---	---	---	79	117	9.1	75	117	8.6
	2250	80	115	9.2	75	114	8.6	70	114	8.1
	2200	75	112	8.6	70	111	8.1	66	110	7.6
	2100	66	106	7.6	62	105	7.1	59	103	6.8
	2000	58	100	6.7	55	98	6.4	53	95	6.2
	1900	52	92	6.0	50	90	5.8	49	87	5.6
6000	2350	---	---	---	80	120	9.2	75	119	8.6
	2300	80	117	9.2	75	117	8.6	71	116	8.1
	2250	76	115	8.7	71	114	8.1	67	113	7.7
	2200	71	112	8.1	67	111	7.7	64	109	7.3
	2100	63	105	7.2	60	104	6.9	57	101	6.6
	2000	56	98	6.4	53	96	6.2	52	93	6.0

fig P15

Enter the table on the left hand side at 4000ft and move down the second column (RPM) to 2000RPM. The top line specifies that the last three data columns are for the temperature ISA +20°C so from 2000RPM read off the data from the last three columns.

% BHP	KIAS	GPH
53	95	6.2

Note: See question. 3kt must be deducted from the airspeed as speed fairings are not fitted so KIAS = 92.

Temperatures must be in relation to ISA.

EPP52(C)

See EPP 38.

For a given set of atmospheric conditions, increasing the all up weight will require an increase in lift to maintain the aeroplane airborne which is achieved by increasing the angle of attack. As an aeroplane always stalls at the same angle of attack, the speed at which the aeroplane will stall must increase.

A greater airspeed will also be required during take-off for the aeroplane to become airborne resulting in a greater take-off distance required to attain take-off safety speed.

EPP53(D)

An aeroplane operated at above its maximum all up weight will have a degraded performance and handling capability which could result in the structural limitations being exceeded under certain flight conditions.

EPP54(D)

A flap when extended will increase:

(i) the wing angle of attack

(ii) the upper camber of the wing

(iii) with some types of flap, the wing area.

(i) and (ii) above will increase the coefficient of lift as each is an element of **C_L** in Bernoulli's Theorem whilst (iii) wing area is represented by **S** in Bernoulli's Theorem:

$$L = C_L \tfrac{1}{2} \rho V^2 S$$

Increasing the camber will increase the airflow velocity and pressure reduction over the wing's upper surface.

Increasing the wing area will increase the total amount of lift generated.

The lift required to oppose weight will be generated at a lower airspeed, so the aeroplane will stall at a lower airspeed.

EPP55(A)

Aeroplanes certificated in the Normal Category have a maximum weight of below 5700kg and are restricted to stalls, no aerobatics manoeuvres and maximum bank angles of 60°.

EPP56(C)

Distance flown in a glide: see EPP10.

When calculating glide distances, assume 1nm = 6000ft:

Distance = lift/ drag ratio x vertical descent.
= 6 x 6000ft
= 36000ft
= approximately 6nm.

EPP57(D)

A level, dry hard surface runway.

From that data, degradation of aeroplane take-off performance due to type of runway surface, slope, surface contamination and meteorological conditions etc. is compiled by factoring the level, dry hard surface runway data.

EPP58(B)

See fig P16.

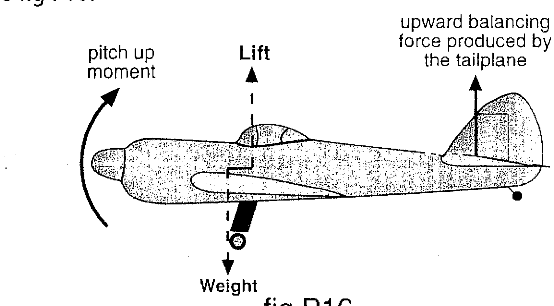

fig P16

A design feature of thrust and drag lines is that they are not coincidental and a couple is set up that creates a pitching moment about the lateral axis.

This is generally balanced by the lift/ weight couple, together with forces generated by the the tailplane. If power is altered, the thrust / drag couple is altered, setting up a pitching moment about the lateral axis which will be either nose up or nose down depending on whether the thrust line is above or below the drag line and whether power is increased or decreased.

EPP59(B)

W to **Z**. See fig P17 and EPP.

With take-off flap set, although the aeroplane will become airborne at a lower indicated airspeed and require a shorter take-off ground run, drag will be increased.

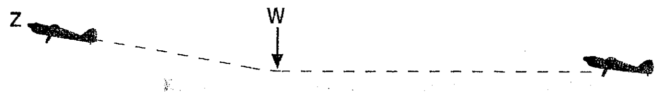

fig P17

Because of increased drag, the climb performance will be degraded and the aeroplane will climb at a reduced rate compared with a flapless take-off.

EPP60(C)

See fig P18.

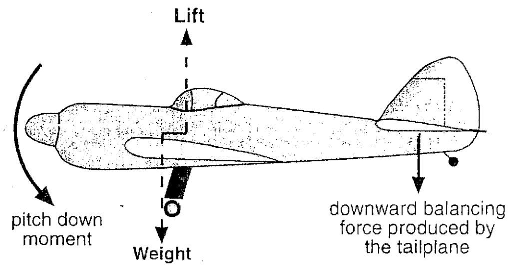

fig P18

If lift is increased during the cruise, equilibrium will be disrupted and a nose down pitching moment established because the tailplane will no longer balance the increased lift/ weight couple.

This is compensated for by increasing the downward force produced by the tailplane by moving the elevator up.

EPP61(D)

If the TAS is greater than the ground speed, then the landing must be with a headwind component.

If there was a tailwind component, the TAS would be less than the ground speed.

EPP62(C)

The aircraft could be difficult to control under certain circumstances, particularly if the C of G was close to or worse, beyond its aft limit. In turbulent conditions or during certain manoeuvres, wing loading could exceed structural limitations resulting in primary structural damage.

EPP63(B)

On approach, the minimum target indicated air speed at 50ft above the runway should be:

the stalling speed (Vso) x 1.3.

= 40kt x 1.3

= **52 kt**.

EPP64(A)

Any power alteration at a constant altitude will disrupt the thrust/ drag couple causing a pitch change. (see EPP58 and EPP60).

This will require a further change of pitch attitude to maintain altitude, which is achieved by elevator adjustment.

The change of inertia produced by power and pitch alteration must be allowed to stabilise before the physical force applied to the elevator is removed by elevator trim adjustment.

EPP65(B)

See fig P19.

All forces act through the centre of gravity (C of G) which if at its most forward limit will provide the largest moment between the C of G and the tailplane.

Pitch control would be at a minimum because a larger elevator deflection would be required to produce the same pitch change compared to the elevator deflection required if the C of G was further aft.

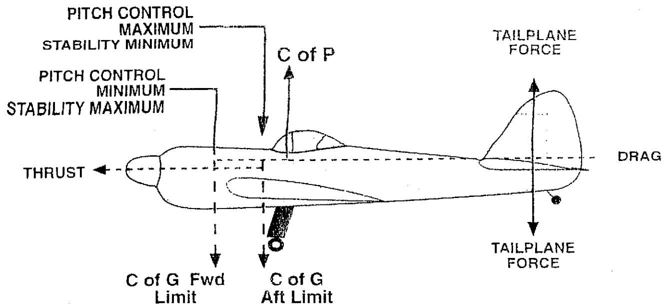

fig P19

Given that the elevator has a limited range of movement, the range of available control would be correspondingly reduced.

Because larger control displacement would be required to produce a given pitch change, it must follow that the aeroplane would be inherently more stable, being resistant to any pitch change.

At the C of G forward limit, acceptable pitch control would be minimum and longitudinal stability maximum.

EPP66(A)

If the grass is under 8 inches long and wet, the landing distance should be factored by 1.3

If the grass is very short and wet, the surface will be more slippery affecting brake efficiency so the landing distance should be factored by 1.6.

AIC 67/2002 (Pink 36) 7.6 Note 1.

EPP67(B)

See fig P19 and EPP65.

If the C of G is aft of its design limit, the distance between the C of G and C of P will be reduced, resulting in a smaller lift/ weight couple.

Although any displacement from the desired pitch attitude may be corrected by elevator movement, the elevator becomes more sensitive as the C of G to elevator moment arm is reduced. A small elevator movement will produce a larger than normal change in pitch attitude.

If the C of G is aft of its designed limit, the aeroplane's static stability will be seriously impaired, causing a significant decrease in its ability to right itself after, for instance, a gust disturbance.

In some situations, the aeroplane may be uncontrollable.

EPP68(C)

During a climb employing high engine power settings, the engine will produce larger than normal amounts of heat.

The airspeed should be kept relatively high to ensure an adequate cooling airflow over the engine to maintain cylinder head and oil temperatures within operating limits.

EPP69(B)

A guide line for the landing distance required is that it will increase by a factor of 10% for each 2% of downhill slope.

AIC 67/2002 (Pink 36) 7.5.1

EPP70(C)

The application of carburettor heat will cause warmer, less dense air to enter the carburettor and combustion chamber.

Engine power developed depends upon the weight of fuel/ air mixture entering the combustion chamber. As warmer air is less dense, its weight will be reduced and the mixture enriched. Ultimately, the engine will develop less power indicated by a lower RPM.

EPP71(A)

See fig P20.

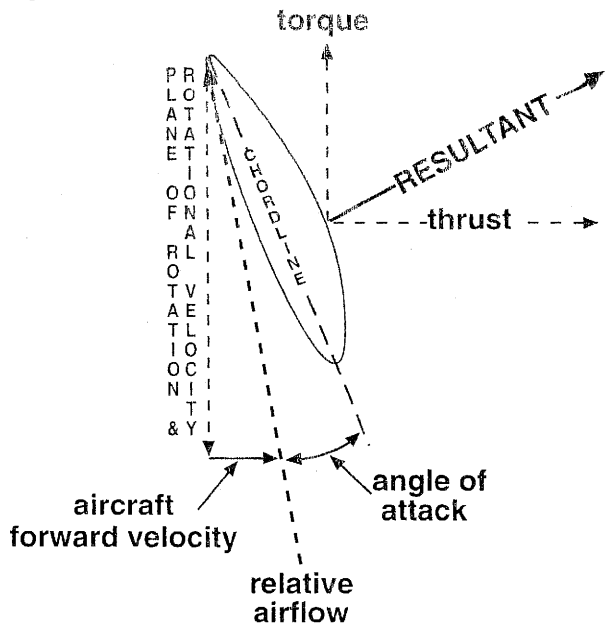

fig P20

In a steep dive, the propeller RPM would increase due to the increase of aircraft forward velocity which in turn, would reduce the propeller angle of attack subtended by its chord line and relative airflow.

If the angle of attack is reduced, then drag is reduced allowing the propeller under the influence of the airflow passing through it to rotate faster. This will be the case for any power setting but excessive RPM may be prevented by reducing engine power to idle.

EPP72(D)

Factors that determine an aeroplane's performance are both its weight and position of its centre of gravity (C of G).

The C of G displacement and maximum authorised take Off weight (MTOW) are elemental to the Certificate of Airworthiness.

If exceeded, the MTOW would cause the rate of climb, angle of climb, range and endurance to be reduced. In addition, the take-off distance required would increase and the weight may cause structural loads to exceed the design capability of the aeroplane.

The C of G is the point through which the aeroplane's total weight is seen to act. The distribution of weight is of vital importance since the C of G position affects the aeroplane's longitudinal stability and handling capability.

When loading the aeroplane, the C of G must be within its forward and aft limits to ensure sustained stability and adequate elevator deflection for all phases of the flight.

EPP73(D)

See fig P21.

Fuel load 300 lb. Sg. 0.72

To convert weight to volume:

Using your CRP circular slide rule, set 300 (30) on the rotating inner scale under 72 on outer Imperial Sp.G. scale.

Below the km-m-ltr index on the fixed outer scale, read off 189 (ltr) on the rotating inner scale.

EPP74(A)

See fig P22.

The C of G datum (not the C of G itself) is a position on the fore and aft axis from which the 'moment arm' to the position of any added item of load is measured. This may be either forward or aft of the datum.

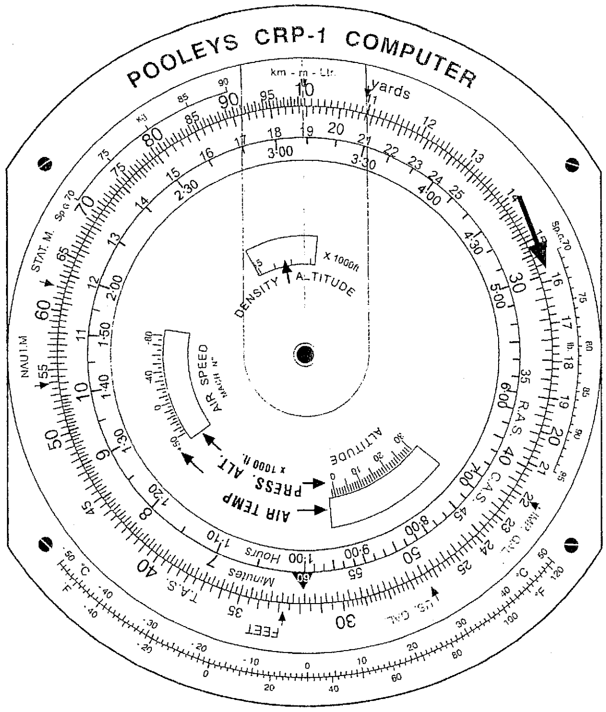

fig P21

The item '**weight**' multiplied by the '**moment arm**' = **moment**

This is normally expressed in pounds inches (lb in).

Moments aft of the datum are given a positive (+) value and those forward of the datum a negative (–) value.

When all of the moments have been calculated, their positive and negative values are added algebraically.

The sum of the moments is divided by the total weight to give the distance of the C of G from the datum remembering that + is aft of the datum and – is forward.

All that is required in this question is to find the total moment which requires the fuel weight to be multiplied by its moment arm (310 lb x 90 in) to give the fuel moment (27900 lb in).

Add the fuel moment (27900 lb in) to the aeroplane moment (151200 lb in) to give the total moment 179100lb in.

You are not required to find the position of the C of G.

The usual method is to use a tabular form to solve weight and balance calculations.

	Weight	x	Moment Arm	=	Moment
Aeroplane	1800lb		unknown	=	+151200lb in
Fuel	310lb		90in	=	+ 27900lb in
Total	2110lb			=	+179100lb in

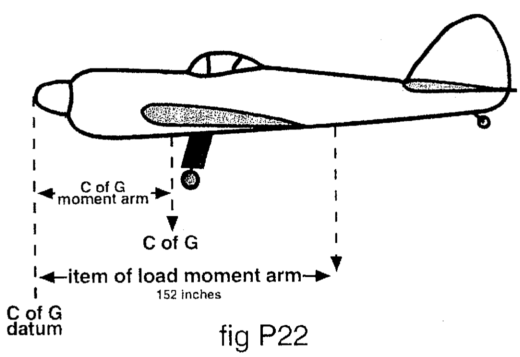

fig P22

EPP75(D)

If an aeroplane is to carry maximum passengers and baggage, full tanks may cause the aeroplane's maximum weight to be exceeded. Should this occur, the fuel load must be restricted and if required, an intermediate fuel stop made.

EPP76(B)

To calculate the oil weight:

Oil load = 2 Imp gal x 8.5 lb/gal = 17 lb.

	Weight	x	Moment Arm	=	Moment
Oil	17 lb	x	11 in	=	187 lb in

EPP77(C)

See fig P23.

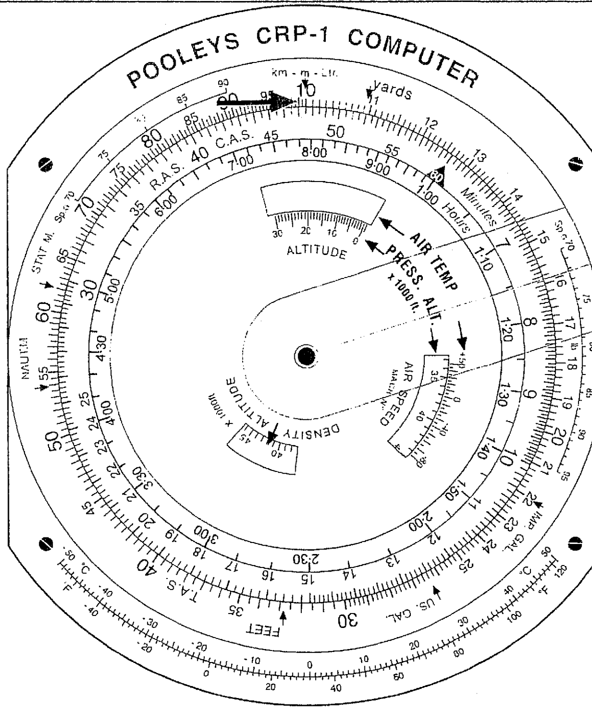

fig P23

Fuel load 475 litres. Sg 0.722.

To convert volume to weight:

Using your CRP circular slide rule, set 475 on the rotating inner scale below the litres index at 12 o'clock on the fixed outer scale.

Below .722 on the outer Imperial Sp.G. scale, read off 755 lb (approximately) on the rotating inner scale.

EPP78(A)

See fig P24.

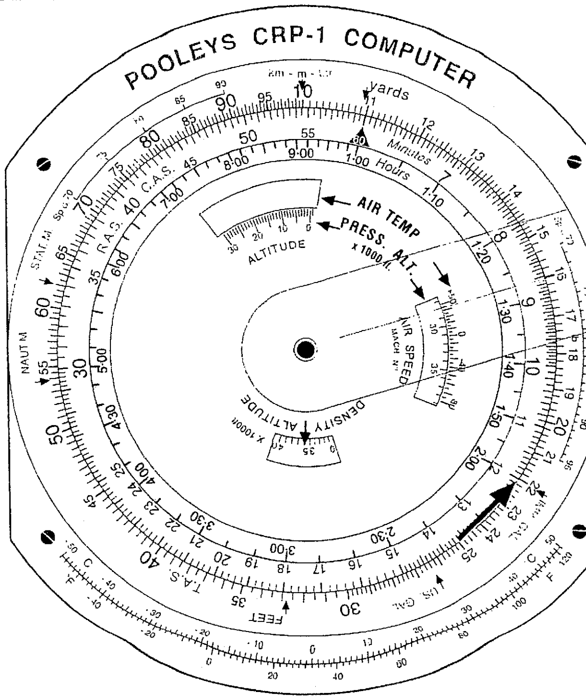

fig P24

Fuel load 12 Imp gal. SG 0.73.
To convert volume to weight:
Using your CRP circular slide rule, set 12 on the rotating inner scale below the Imp/gal index on the fixed outer scale.
Below .73 on outer Imperial Sp.G. scale, read off 87.6 (approximately) on the rotating inner scale.
A simple arithmetic method would be to multiply the number of gallons by 10 which gives the weight of 12 gallons of water because the specific gravity of water = 1, then by .73 the specific gravity of the fuel.

= 12 x 10 x .73 = **87.6**

EPP79(B)

Find the the total aeroplane moment at take off:

= weight x moment arm = 2300lb x 85.75 in
= 197225 lb in

Find the moment of the fuel used:

= weight x moment arm = 300lb x 82 in
moment = 24600lb in

From the take-off moment, subtract the fuel burn moment to give the landing moment.

= (197225 – 24600) lb in = 172625 lb in.

From the take-off weight subtract the fuel burn to give the landing weight.

= (2300 – 300)lb = 2000lb

Divide the landing moment by the landing weight to give the distance of the landing weight from the datum which is the landing C of G position.

$$\frac{172625\text{lb in}}{2000\text{lb}} = 86.31 \text{ inches aft of the datum.}$$

EPP80(D)

If the all up weight is increased, the angle of attack must be increased to generate extra lift to balance weight which will also increase drag.

Power must be increased to balance the increased drag factor at any given airspeed which in turn will increase the rate of fuel consumption and consequently reduce the operating range.

EPP81(C)

See fig P25.

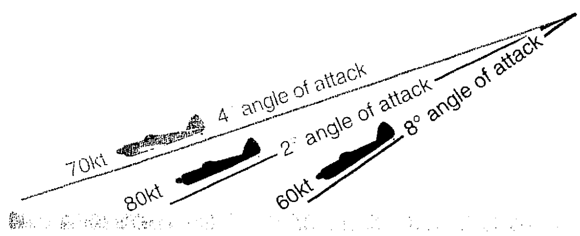

fig P25

In a glide, an aeroplane follows an inclined flight path, considered here in still air conditions. Forward motion in a glide is sustained by utilising a component of weight and effect of gravity to replace propeller thrust. During a balanced glide, the aircraft sustains a constant velocity hence, thrust must be equal to drag otherwise the aircraft would either accelerate or slow down. Lift balances the remaining component of weight and the aircraft remains in equilibrium following an inclined flight path.

When gliding for range, the best lift drag ratio must be sustained, normally achieved at about a 4°angle of attack, and identified by a particular airspeed for a given aeroplane weight.

If the angle of attack is increased reducing airspeed, the glide path will be steepened and the range shortened. If the angle of attack is reduced, increasing airspeed, again, the glide path is steepened and range reduced.

Gliding for range requires an angle of attack that achieves the best lift/ drag ratio, which is a relatively shallow angle of attack.

EPP82(D)

An aeroplane will become airborne at a given airspeed.

Taking off into wind will reduce the ground speed at which that airspeed is reached, which in turn will reduce the take off distance required.

EPP83(C)

At full engine power, the best 'angle of climb' or the best 'rate of climb' are both determined by airspeed as laid down in the relative aeroplane operating manual.

The best 'angle of climb' is achieved with a greater pitch attitude and slower airspeed than the best rate of climb and is used to gain the most altitude in the shortest possible distance travelled.

$$\textbf{Best angle of climb} = \frac{\text{altitude increase}}{\text{distance travelled}}$$

Best 'rate of climb' is achieved with a smaller pitch attitude and slightly higher airspeed than the best angle of climb and is used to gain the most altitude in the shortest possible time.

$$\textbf{Best rate of climb} = \frac{\text{altitude increase}}{\text{time}}$$

EPP84(A)

The amount of lift generated, engine power and propeller thrust developed, all depend on air density (ρ). The lower the density, the lower the values of lift, power and thrust.

Lift = = $C_L \frac{1}{2} \rho V^2 S$

If (ρ) is reduced, **V** (true airspeed) must be increased to develop the same amount of lift. The aeroplane will have to accelerate to a greater airspeed in order to take off which will increase the take-off distance required.

The power developed by an engine is proportional to the weight of fuel air mixture burned. If air density is reduced, the weight of fuel/ air mixture entering the combustion chamber will be reduced and the engine will develop less power. Acceleration will be reduced, further increasing the take off distance required.

EPP85(B)

As air temperature increases, the air will expand decreasing its density.

$$\textbf{Density} = \frac{\text{weight}}{\text{given volume}}$$

A reduction of air density will reduce the weight of a given volume of air.

Weight = volume x density.

Engine power developed is proportional to the weight of fuel/ air mixture burned but the volume of air entering an engine at a given throttle setting remains constant.

If air density is reduced, the weight of air/ fuel mixture entering a combustion chamber will be reduced and the engine will develop less power.

EPP86(D)

Both the Artificial Horizon and Direction Indicator Gyros are vacuum driven.

An engine driven vacuum pump draws air through a filter upstream of the gyro onto buckets that form the outside of the gyro rotor. The reaction to the air striking the buckets is rotation of the gyro.

A vacuum pressure gauge on the instrument panel indicates the system vacuum in inches of mercury. The operating range is normally 3.5 to 5.5 inches of mercury, represented by a green arc on the instrument face. See TEC110 page 190.

EPP87(C)

The altimeter works on the principle of pressure change with change of altitude.

The effect of atmospheric pressure falling after the sub-scale has been set will be the same as if the aeroplane had increased altitude, where the pressure would be less than at the surface.

The altimeter will indicate an increase in altitude.

EPP88(D)

See fig P26.

SIMPLE GYROSCOPE

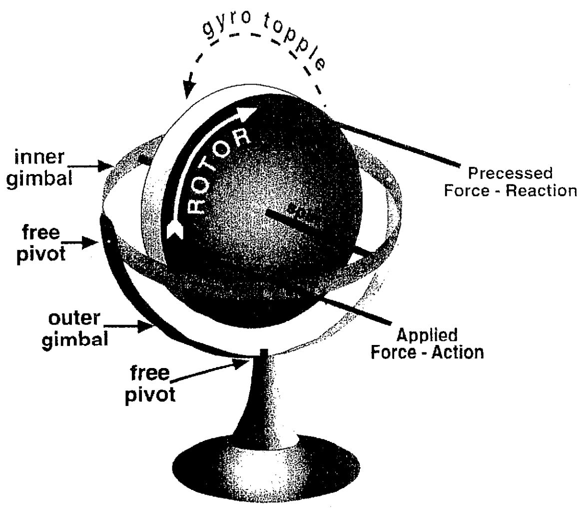

fig P26

A directional gyro is not of its own accord north seeking and is normally manually synchronised with the magnetic compass.

The gyro itself has inertia, which is the tendency of any rotating body if undisturbed to maintain its plane of rotation, usually referred to as having rigidity in space. When the rotor in fig P26 is spinning about its axis, the direction of this axis will remain fixed in space regardless of how the base of the gyroscope moves about it.

Precession

When a force is applied to the side of a rotating body, it will tend to turn about an axis that is displaced 90° around the circumference of the gyro rom the point where the force was applied. The 90° displacement being in the direction of gyro rotation. Imagine a bicycle wheel spinning vertically on a horizontal pole that you are holding at both ends. Any attempt to push either end of the pole forward, as if steering the bicycle wheel, will cause the wheel to topple to one side, causing one hand to move up and the other to move down.

Frictional forces in the gyro system act in the same way as an applied force and cause the gyro to precess or drift, in the order of about 3° every fifteen or twenty minutes.

Inertia keeps the gyro referenced to a fixed point in space above the surface of the Earth. However, the Earth is rotating under the gyro, which gives the gyro an APPARENT motion relative to its fixed point in space, referred to as 'apparent drift'.

Because of precession and apparent drift, the directional gyro must be reset by the pilot at regular intervals.

EPP89(D)

See fig P27.

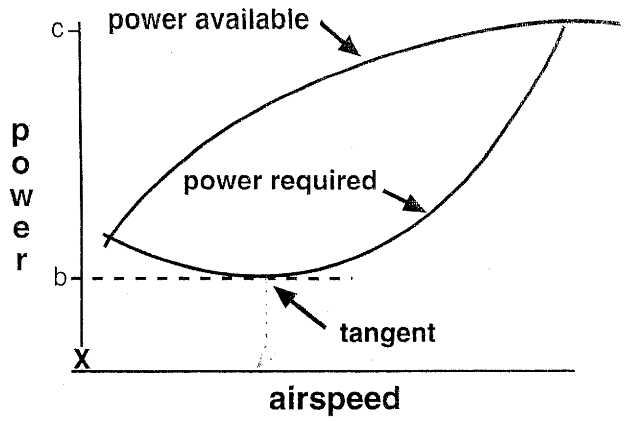

fig P27

The best rate of climb is determined by airspeed as laid down in the relative aeroplane operating manual.

Best rate of climb $= \frac{\text{height}}{\text{time}}$

The best rate of climb is achieved at that airspeed and power setting for straight and level flight at which there is the maximum excess engine power available which would be the speed for endurance or the slowest safe flight speed. When full power is applied, the aircraft will climb at the best rate of climb.

For any given airspeed on the horizontal axis, there will be a specific amount of excess engine power available, reducing as air speed is increased. The horizontal tangent (**b**) to the power required curve represents the best speed for endurance defined by airspeed A. Excess power at airspeed A on the speed axis, is represented by '**b - c**' on the power axis. If full power is applied at airspeed 'A' , the aeroplane will climb at the best rate of climb.

EPP90(B)

An up-sloping runway would cause an aeroplane taking off to accelerate at a slower rate, which would require a longer take-off run than when departing from a flat runway under similar conditions.

An aeroplane landing on an up-sloping runway would require a shorter landing distance than when landing on a flat runway under similar conditions.

In both instances, it is gravity that acts to either inhibit acceleration, during take-off, or reduce the aeroplane's inertia and assist braking action during landing.

The take-off run from a flat runway will be shorter and the landing distance longer compared with operating from an up-sloping runway in the same wind conditions.

EPP91(B)

See EPP72.

For a given set of atmospheric conditions, increasing the all up weight will cause the aeroplane to accelerate at a slower rate. A greater airspeed will also be required during take-off for the aeroplane to become airborne. As the stall speed will also be higher, the take-off safety speed which is a factor of the stall speed will be increased. A lower rate of acceleration and higher take-off safety speed will result in longer take-off run.

EPP92(D)

Aerodrome Altitude:

If an aerodrome is high or hot, both the TODR and LDR will increase. See fig P28.

Aerodynamic and engine performance both deteriorate with an increase in either pressure altitude and/ or temperature above ISA because of the lower air density. At full throttle, an engine will develop less power and the lift at any true airspeed will also

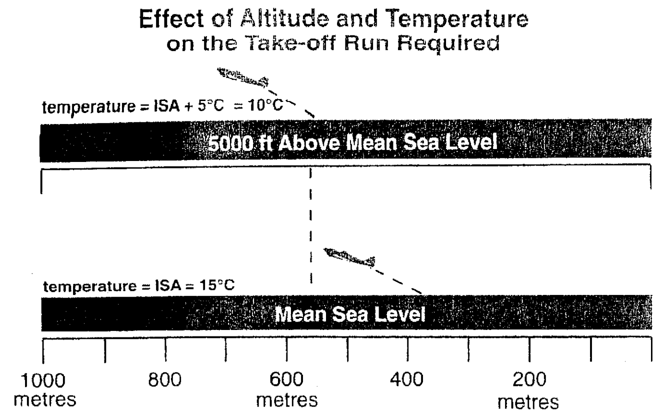

fig P28

be reduced. During take-off, an aeroplane's acceleration will be degraded and the unstick speed increased both of which culminate in a longer take-off run.

Because any lift required to overcome weight will be generated at a higher true airspeed, for any give weight, the approach speed will be increased requiring a longer landing distance.

Aerodrome pressure altitude equates to the height shown on an altimeter on the ground with the sub-scale set at 1013 hPa. If the take-off performance chart does not include data for aerodromes above sea level or temperatures above ISA (15°C) at sea level, the following guide lines extracted from *AIC 67/2002 Pink 36* should be used:

Altitude increase:
Take-off distance will be increased by 10% for each 1000 ft Increase in aerodrome altitude above sea level (a factor of x 1.1).

Temperature increase:
take-off distance will be increased by 10% for each 10°C increase in ambient temperature above ISA (a factor of x 1.1).

EPP93(C)

See EPP5 and fig P1.

EPP94(A)

To calculate a runway gradient:

$$= \frac{\text{higher threshold - lower threshold}}{\text{runway length}} \times \frac{100\%}{1}$$

$$= \frac{(465 - 420)\text{ft}}{2000\text{ft}} \times \frac{100}{1} = \mathbf{2.25\%}$$

EPP95(A)

Pressure altitude is based upon the ISA mean sea level pressure of 1013hPa.

To calculate the pressure altitude where 1hPa = 30ft.

$$= \text{aerodrome elevation} + [(\text{standard pressure - QFE}) \times \frac{30\text{ft}}{1\text{m}}$$

$$= 930\text{ft} + [(1013\text{hPa} - 994\text{hPa}) \times \frac{30\text{ft}}{1\text{hPa}}]$$

$$= 930\text{ft} + [19 \times 30\text{ft}]$$

$$= 930\text{ft} + 570\text{ft}$$

= **1500ft pressure altitude**

Note: If the QFE is greater than 1013hPa then the pressure altitude will be less than the aerodrome elevation amsl..

EPP96(D)

For every 10% increase in aeroplane weight, the take-off distance required to a height of 50ft at the original weight should be increased by 20% or multiplied by a factor of 1.20.

For every 10% increase in aeroplane weight, the landing distance required from a height of 50ft at the original weight should be increased by 10% or multiplied by a factor of 1.10.

EPP97(B)

Safety factors: *it is recommended that at least the public transport safety factors should be applied for all flights. Unless otherwise specified in the aeroplane's manual, handbook or supplement, as a factor of 1.33 of take-off is recommended and should be applied after the application of the corrections for all other variables.*

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EPP98(A)

See EPP17 fig P4

EPP99(D)

See fig P29

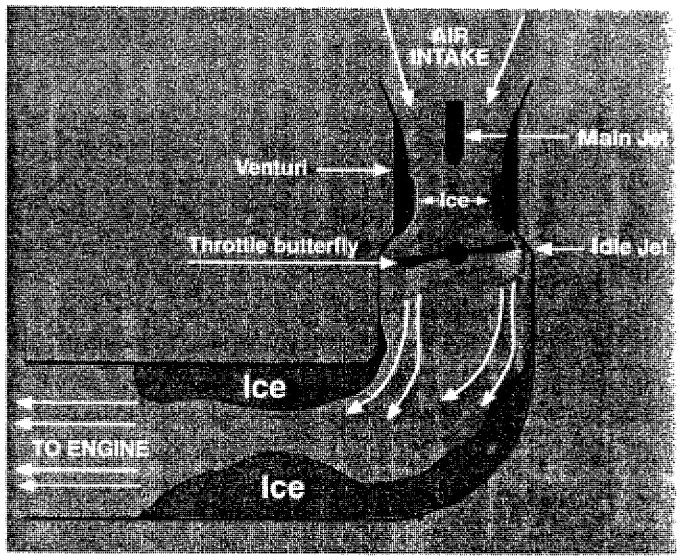

fig P29

A carburettor venturi causes the air passing through it to increase in velocity which results in a pressure drop. Any pressure reduction will produce adiabatic cooling of the air that in turn, through conduction will lower the temperature of the carburettor venturi. When air is cooled, its relative humidity increases.

Fuel entering the venturi is vapourised (changes state by evaporation). This will require the fuel in its liquid state to gain (latent) heat in order to evaporate.

The fuel takes latent heat from both the air passing through the venturi and the carburettor body setting up a cooling process that may lower the temperature of the carburettor body and the airflow within it by as much as 30°C.

The temperature reduction may achieve two things.

1 The air temperature may be reduced to below its dewpoint initiating condensation.
2 The carburettor body temperature may be reduced to below 0°C.

Should both 1 and 2 occur, water vapour in the air that is in contact with the sub-zero carburettor body will SUBLIMATE into ice, forming around and downstream of the throttle butterfly, choking off the airflow to the engine.

Sublimation is the process of changing state directly from a gas to a solid: In this case, from water vapour directly to ice, missing out the water droplet (liquid) state.

Conditions most favourable to carburettor icing are:

1 Warm weather and high humidity, as this will provide an abundant supply of water vapour. The greater the relative

humidity, the smaller the temperature drop required to reach the dewpoint.

Low power settings when the throttle butterfy is partially closed creating large airflow velocity increase and pressure reduction.

EPP100(B)

See fig P30

Enter the graph at the bottom at 25°C which is ISA +10 and move up to intercept the Mean Sea Level (SL) line. Move to the right to the reference line then follow the approximate curved path downward and to the right to intercept the vertical 3300 pounds line which is the aircraft weight. Next move horizontally to the right through the wind component reference line as there is nil wind. At the obstacle height reference line, follow the mean curve of the lines up to the right and read off the distance in feet to clear a 50 FT obstacle = 1700 FT

Refer to the table above the graph to find the take-off speeds. The aircraft take-off weight is 3300 LBS so interpolate between 3200 LBS and 3400 LBS to give a rotation (unstick) speed of 71 KTS (rounded up) and 81 KTS at 50 FT.

TAKE-OFF DISTANCE - FLAPS UP

ASSOCIATED CONDITIONS:

POWER..TAKE-OFF POWER SET BEFORE BRAKE RELEASE

MIXTURE.....................................FULL RICH
FLAPS..UP
LANDING GEAR..........................RETRACT AFTER POSITIVE CLIMB ESTABLISHED
COWL FLAPS.............................OPEN
RUNWAY.....................................PAVED LEVEL DRY SURFACE

EXAMPLE:

OAT...25 C
PRESSURE ALTITUDE...MSL
TAKE-OFF WEIGHT.......................................3300 LBS
WIND COMPONENT..0 KTS

TOTAL DISTANCE OVER 50FT OBSTACLe....1700 FT
TAKE-OFF SPEED AT ROTATION.....................71 KTS
SPEED AT 50 FT..81 KTS

WEIGHT POUNDS	TAKE-OFF SPEED	
	ROTATION	50 FT
	KNOTS	KNOTS
3650	73	84
3600	72	83
3400	71	82
3200	70	80
3000	68	78
2800	65	75

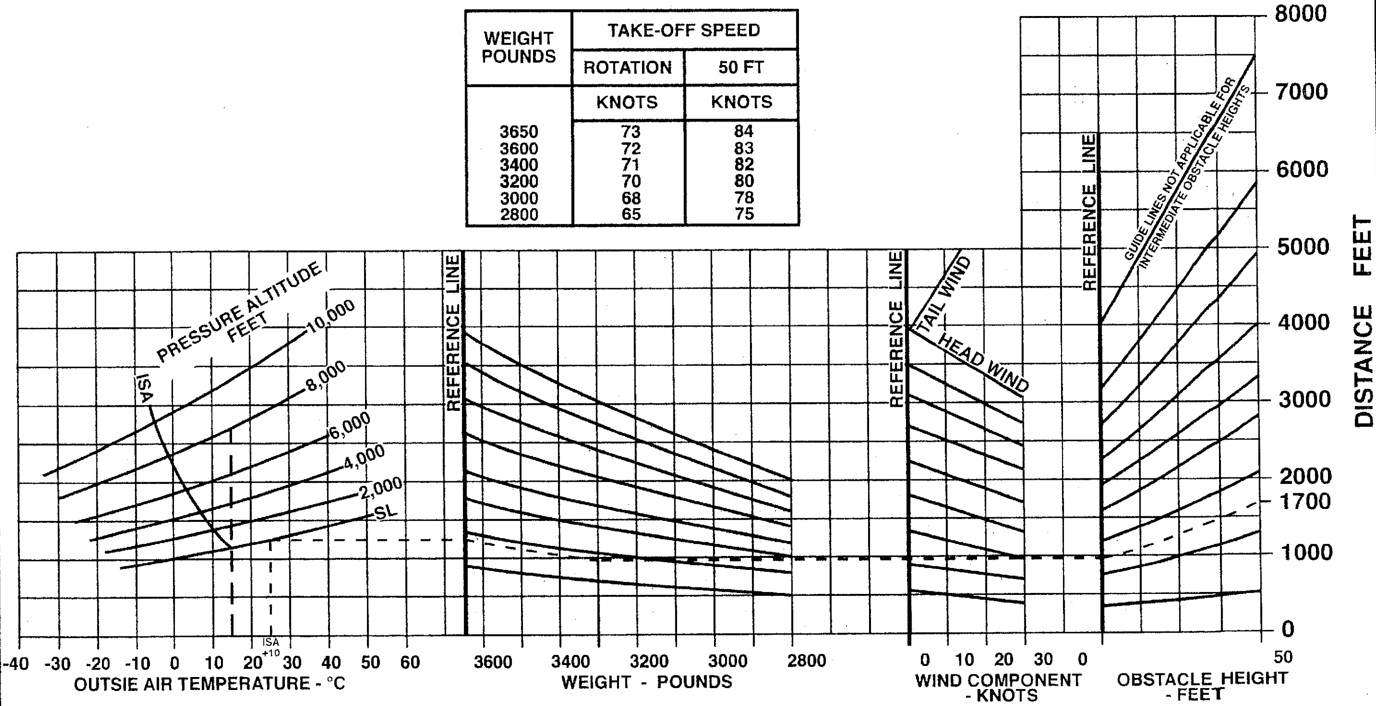

fig P30

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