

To the Performance Student

Due to the recent changes made to the CASA regulations it has become necessary to make some amendments to the answers to some of the questions in the Performance Study Guide.

We apologise for the inconvenience, but please find attached a number of replacement pages.

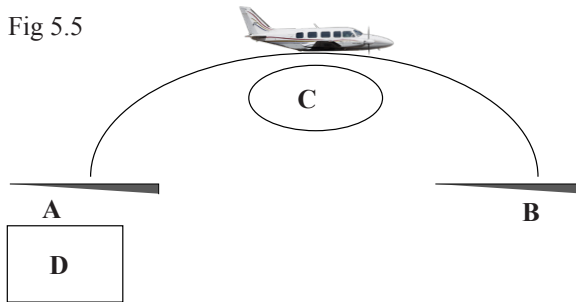
All the best with your studies.

Bob

Establishing the take-off weight limit for a particular flight.

In the examination, as in practice, the requirement is often for the aircraft to depart a given aerodrome at the maximum permissible weight. Establishing this weight correctly is therefore vital.

The diagram used to assist our thinking and also help to keep the big picture in mind, is called the "beetle" diagram, see Fig 5.5 below. Before we do anything else we must find the four weights, **A**, **B**, **C** and **D**.



[A] Represents the take-off weight limit at the departure aerodrome. This figure considers only the runway data and conditions prevailing at **A** ignoring everything else. It will be the take-off structural limit of 2950kg or the performance limit as obtained from the "P" Chart. [T/O chart.]

[B] represents the maximum landing weight permitted at the destination. This figure considers only the runway data and conditions prevailing at **B** ignoring everything else. It will be the structural landing weight limit of 2725kg, or the performance limit as determined from the landing weight 'P' chart.

NOTE: If a TAF is used for the landing weight chart, it should consider:-

- (a) the longest suitable runway
- (b) no wind

Note:
In all exercises in this examination assume the pilot and all passengers weigh 77 kg unless otherwise stated.

[C] represents the weight of trip fuel in kg that will be consumed during the flight [i.e. the fuel burn-off from A to B.]

[D] This represents the weight in kg of all usable fuel in the tanks *at take-off* from the departure aerodrome. For the ECHO air transport it will include:

Trip fuel + Contingency fuel + Final Reserve Fuel + Holding + Margin.

If minimum fuel is to be carried, **D** would be equal to
Trip fuel (kg) x 1.1 + Final Reserve Fuel + Holding.

[There would be no margin if minimum fuel was carried]

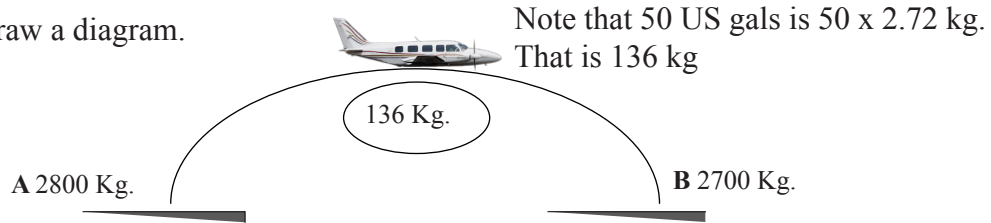
Taxi fuel is **not** included since we are concerned with the aircraft weight at TAKE-OFF.

Here is an example of the method.

If departure is with minimum fuel, and the trip fuel is 50 US gallons, find the maximum permissible take-off weight if the performance take-off limit (from the P Chart) is 2800 kg, and the performance landing weight limit (from the P Chart) is 2700 kg [Fig 5.6].

STEP 1 - Draw a diagram.

Fig 5.6



191kg Departure is with minimum fuel so fuel on board at take-off is:
 $136 \times 1.1 + 41 \text{ kg} = 190.6\text{kg}$.

The maximum take-off weight will always be controlled by one of three possible cases.

- (1) Considering only the take-off at A, you can depart at 2800 kg.
- (2) Considering only the landing at B, you can depart at $2700 + 136 = \underline{2836 \text{ kg}}$ i.e. you would burn off 136 kg on the way, and be right on maximum landing weight of 2700 kg when you land.
- (3) Considering only the zero fuel weight limit, you could load the aircraft to 2630 kg, (maximum allowable zero-fuel weight see Supplement Page 18 para 3) and then add the weight of all the fuel on board at take-off: $2630 + 191 = \underline{2821 \text{ kg}}$.

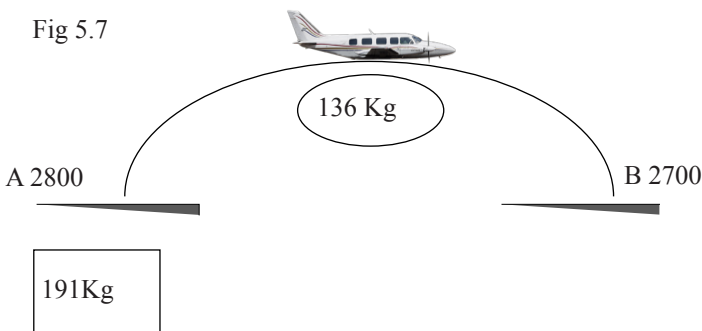
If you always check these three possibilities, the smallest one will control the take-off weight for a particular flight. In this case, the maximum take-off weight is the least of :-

Take-off limit	2800 kg
Landing limit + burn-off	2836 kg
2630 + all fuel at take-off	2821 kg

2800 kg is the smallest, so the maximum take-off weight for this flight is **2800 kg**

Your working is set out as shown in Fig 5.7

Fig 5.7



MTOW at A is the least of :-

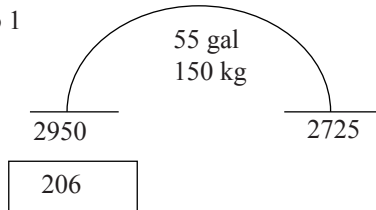
Take-off limit	2800 kg
Landing limit + burn-off	2836 kg
2630 + all fuel at take-off	2821 kg

2800 kg is the maximum take-off weight.

ANSWERS TO TOPIC 5 EXERCISES.

EXERCISE 5.1

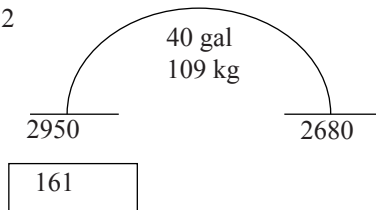
No 1



Max take-off weight is the least of:
 Take off limit ----- 2950
 Landing Wt + Burn-off
 2725 + 150 ----- 2875
 Zero Fuel WT + All fuel
 2630 + 272 ----- 2902

The maximum take-off weight is 2875 kg

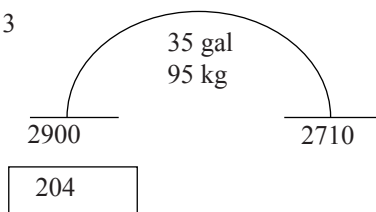
No 2



Max take-off weight is the least of:
 Take off limit ----- 2950
 Landing Wt + Burn-off
 2680 + 109 ----- 2789
 Zero Fuel WT + All fuel
 2630 + 161 ----- 2791

The maximum take-off weight is 2789 kg

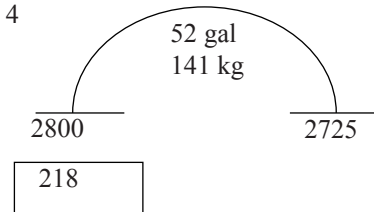
No 3



Max take-off weight is the least of:
 Take off limit ----- 2900
 Landing Wt + Burn-off
 2710 + 95 ----- 2805
 Zero Fuel WT + All fuel
 2630 + 204 ----- 2834

The maximum take-off weight is 2805 kg

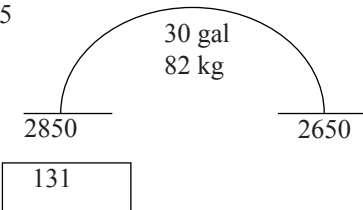
No 4



Max take-off weight is the least of:
 Take off limit ----- 2800
 Landing Wt + Burn-off
 2725 + 141 ----- 2866
 Zero Fuel WT + All fuel
 2630 + 218 ----- 2848

The maximum take-off weight is 2800 kg

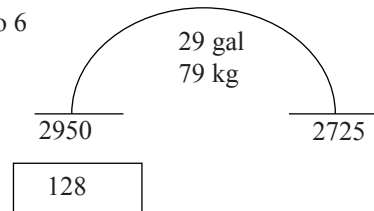
No 5



Max take-off weight is the least of:
 Take off limit ----- 2850
 Landing Wt + Burn-off
 2650 + 82 ----- 2732
 Zero Fuel WT + All fuel
 2630 + 131 ----- 2761

The maximum take-off weight is 2732 kg

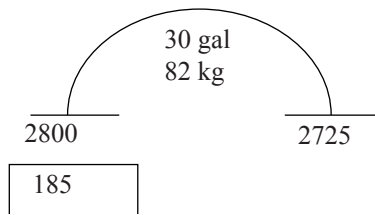
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Max take-off weight is the least of:
 Take off limit ----- 2950
 Landing Wt + Burn-off
 2725 + 79 ----- 2804
 Zero Fuel WT + All fuel
 2630 + 128 ----- 2758

The maximum take-off weight is 2758 kg

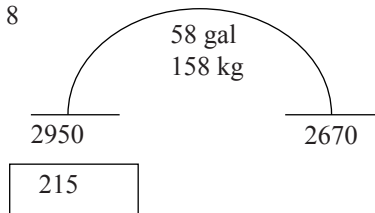
No 7



Max take-off weight is the least of:
 Take off limit ----- 2800
 Landing Wt + Burn-off
 2725 + 82 ----- 2807
 Zero Fuel WT + All fuel
 2630 + 185 ----- 2815

The maximum take-off weight is 2800 kg

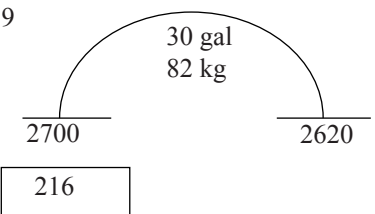
No 8



Max take-off weight is the least of:
 Take off limit ----- 2950
 Landing Wt + Burn-off
 2670 + 158 ----- 2828
 Zero Fuel WT + All fuel
 2630 + 215 ----- 2845

The maximum take-off weight is 2828 kg

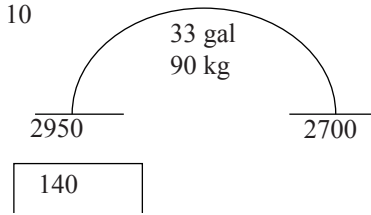
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Max take-off weight is the least of:
 Take off limit ----- 2700
 Landing Wt + Burn-off
 2620 + 82 ----- 2702
 Zero Fuel WT + All fuel
 2630 + 218 ----- 2848

The maximum take-off weight is 2700 kg

No 10

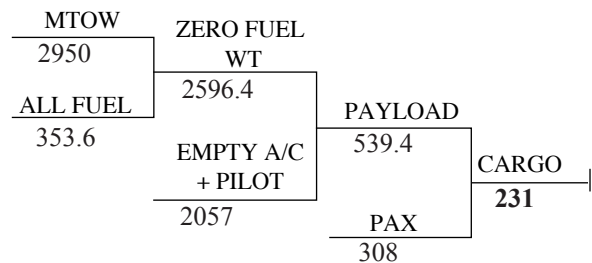


Max take-off weight is the least of:
 Take off limit ----- 2950
 Landing Wt + Burn-off
 2700 + 90 ----- 2790
 Zero Fuel WT + All fuel
 2630 + 140 ----- 2770

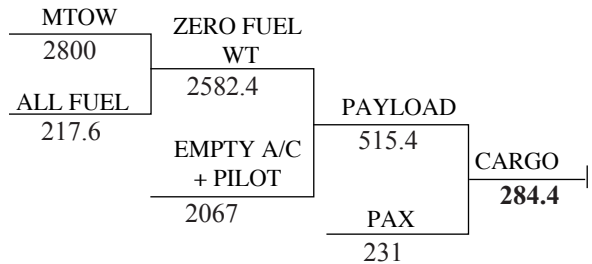
The maximum take-off weight is 2770 kg

EXERCISE 5.2

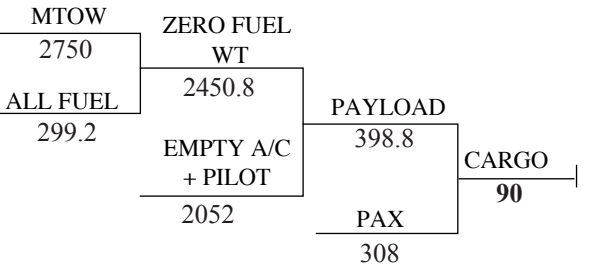
1



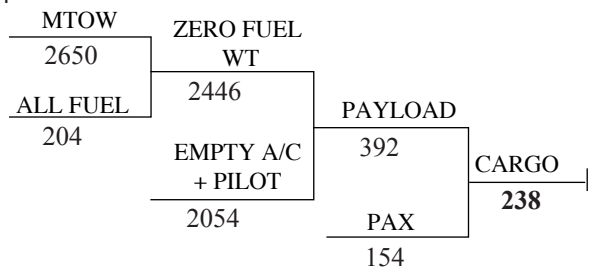
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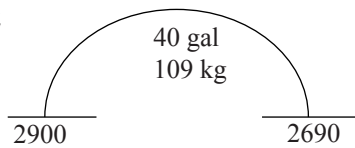
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4



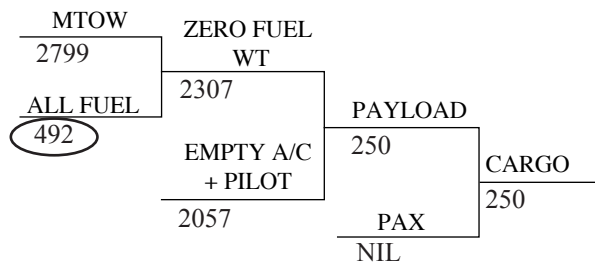
No 2



Max take-off weight is the least of:

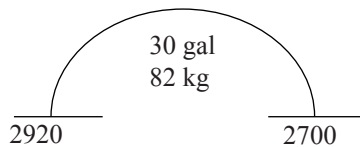
Take off limit ----- 2900
 Landing Wt + Burn-off
 2690 + 109 ----- 2799

The maximum take-off weight is 2799 kg



Maximum fuel at take-off is 491 kg. [This is more than the tanks can hold, so load full tanks - 490 kg]

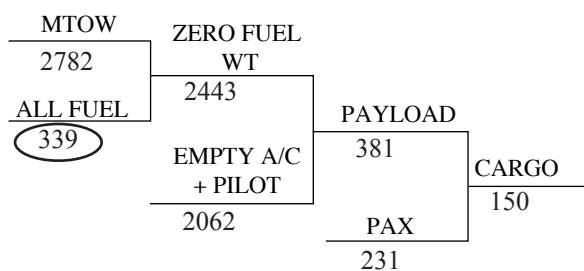
No 3



Max take-off weight is the least of:

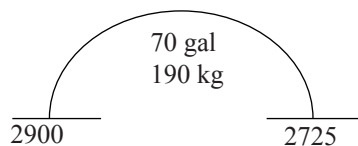
Take off limit ----- 2920
 Landing Wt + Burn-off
 2700 + 82 ----- 2782

The maximum take-off weight is 2782 kg



Maximum fuel at take-off is 339 kg.

No 4



Maximum take-off weight is 2900 kg.

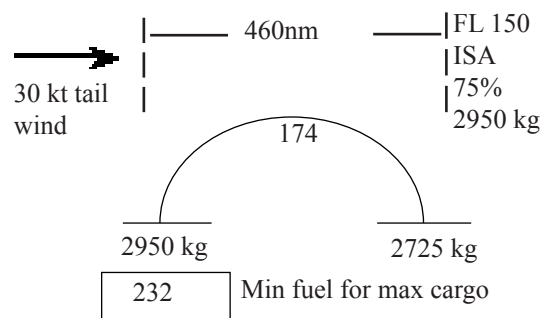
Maximum fuel at take-off is 443 kg

ANSWERS TO EXERCISE 5.6

1.

You will need to know the TAS to get a ground speed so that you can calculate the trip fuel. However, no weight is given since that is what you have to find. You cannot get a TAS until you know the weight and you cannot calculate a weight until you know a TAS.

You must estimate a weight for the sake of getting a TAS. Since you are leaving a good strip and going to a good strip, you will be about 2725 kg when you land. So you will be somewhere between 2950 and 2725 kg throughout the flight. Use the 2950 kg table for the sake of getting a TAS [or you could use 2725 kg it really doesn't matter at all].



From Chart 5: TAS = 205 kt
 Ground Speed = 205 + 30 = 235kt

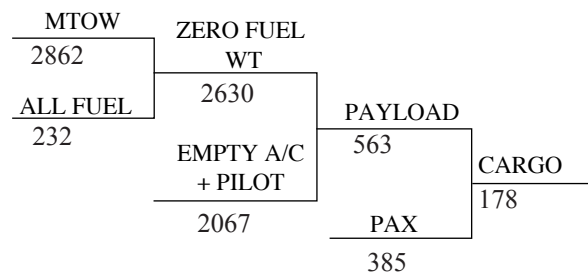
From Chart 6: Fuel flow = 32.6 gph
 Trip fuel = Distance x fuel flow ÷ ground speed
 = 460 x 32.6 ÷ 235
 = 63.8 gal
 = **174 kg**

[Since you are to carry max cargo, use minimum fuel]

Min fuel = 174 x 1.1 + 41 = **232 kg**

MTOW is the least of:

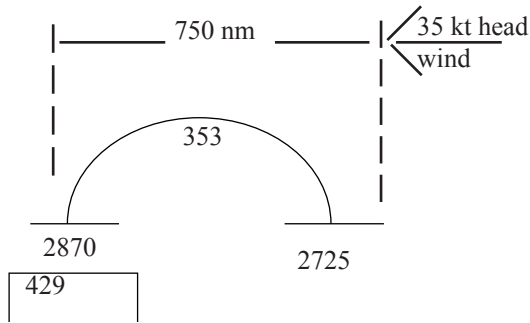
Take off limit 2950
 Landing limit + burn off 2899
 2630 + all fuel at take off 2862



YOU CAN LOAD 178 KG OF CARGO

2.

Once again use 2950 kg for the sake of estimating a TAS from the TAS table in the supplement.



From TAS table at 2950 kg; 17500 ft; ISA + 20; 65%
TAS = 197 kt

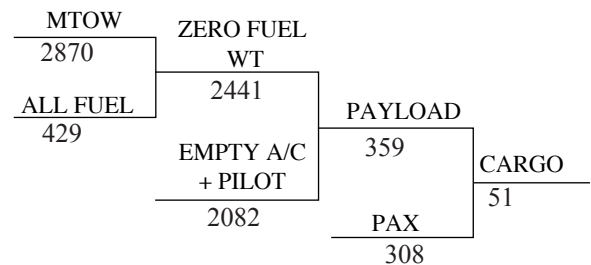
Ground speed = 197 - 35 kt = 162 kt

Trip fuel = Distance x fuel flow ÷ ground speed
= 750 x 28 ÷ 162
= 129.6 gal
= 353 kg

Minimum fuel at take off = 353 x 1.1 + 41
= 429 kg

Maximum take off weight is the least of:

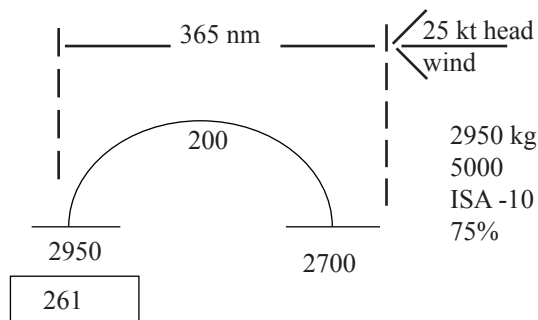
Take off limit 2870 kg
Landing limit + burn off 3078 kg
2630 + 447 3077 kg



YOU CAN LOAD 51 KG OF CARGO

3.

Once again use 2950 kg for the sake of estimating a TAS from the TAS table.



From the TAS table, TAS = 187 kt

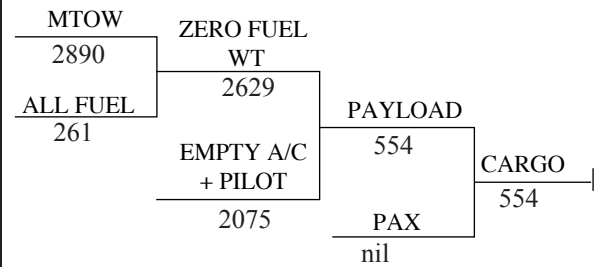
Ground Speed = 187 - 25 = 162 kt

Trip fuel = Distance x fuel flow ÷ ground speed
= 365 x 32.6 ÷ 162
= 73.4 gal
= 200 kg

Minimum fuel at take off
= 200 x 1.1 + 41 = 261 kg

Maximum take off weight is the least of:

Take off limit 2950
Landing limit + burn off 2890
2630 + 261 2891



YOU CAN LOAD 554 KG OF CARGO