

Payload Calculations

Refer to B727 Operating Manual + Load and Trim Addenda.
(This is provided by ASL in the CASA exam).

Introduction

As an airline pilot you are an approved load controller (ALC) under the regulations. This means that you must know how to load the aircraft, and in doing so not exceed any limits.

Normally in airline flying the airlines ALC will prepare the load sheet for you, detailing the payload and centre of gravity (C of G) position. In the ATPL examination you will be required to assess the maximum payload that the aircraft can carry from the departure airport.

Note: The calculation of the C of G position is covered in the ATPL "Performance and Load exam" and the "Performance and Load course texts", not the flight planning exam !

Abbreviations Used

BR: Brake release.
P/BRW: The limit weight based on aircraft takeoff/climb performance on the active runway.
BRW: The actual brake release weight having considered all limits, including performance and structural.
P/LW: The limit landing weight based on aircraft landing performance (max braking) on the active runway, assuming NO reverse thrust available.
MZFW: The absolute maximum limit weight without fuel load. This is effectively a spar stress limitation.
FOB: Fuel on board.
Flight fuel: The fuel required from brake release at departure to touchdown at destination.
FBO: Fuel burn-off (same as flight fuel).

There are only three things that make up the total gross weight (GW) of any aircraft. They are ...

- The aircraft airframe and it's crew. This is called the "Basic Operating Weight".
- The weight of fuel on board.
- The payload. This is made up of passengers and freight.

The maximum payload can be limited by:

a. The take off performance limits (P/BRW) imposed by the runway length, and climb limit capabilities assuming recognition of the failure of the critical engine at or after V1 (decision speed).
b. Any landing weight (PLW) limits imposed by the destination runway length, or at the alternate (if required).
c. The fuel requirements for the flight, including the necessary reserves.
d. The aircraft structural limitations, which are:

- The maximum zero fuel weight (MZFW), which for the B727 is 63502 kg.
- The maximum structural brake release weight, which is 89357 kg.
- The maximum structural landing weight at destination, which is 72574 kg/30 flap, 64636 kg/40 flap.

A typical ATPL exam type question will give you the P/BRW at the departure airport, P/LW (s) at the destination airport, and alternate (if required). It will also quote the flight fuel from departure to destination, and where required, destination to alternate. Armed with this information you must assess the maximum payload that can be carried.

A flow chart system is used in these training texts to guide you through the steps. No flow chart will be made available by CASA in the exam, so you must eventually understand the calculation routine.
For now simply follow the arrows and fill in the boxes. First some examples - refer next page !

Payload example .1.

Data:
Departure airport “SUITABLE”. P/BRW 86, 000 kg (i.e. performance limited, not structurally limited).

Destination airport “SUITABLE”. P/LW 72, 574 kg (i.e. structurally limited using 30 flap).

Flight fuel from departure to destination is 12, 000 kg including approach/manoeuvre fuel.

Abnormal ops are NOT limiting.

Aircraft basic operating GW is 47, 000 kg (i.e. the fleet average).

Carry minimum fuel required for this operation, as per company fuel policy (page 1-17).

Find: The maximum payload that can be loaded at departure airport ? _____ kg

Working:

Points to note.

- Departure airport is limited to 86, 000 kg by aircraft runway or climb performance. (Not structurally limited)
- Destination airport is limited by the 30 flap structural limit only (ie: 72, 574 kg - refer page manual page 1-1). It is not performance limited due to runway length.
- Destination airport is forecast to remain “SUITABLE”, meaning that airport is forecast to be above alternate minima for the period of possible use. Therefore fuel to fly to an alternate is NOT required.
- Flight fuel is given as 12, 000 kg. This is all the fuel burnt from brake release at departure to touchdown at the destination, but NOT taxi or reserve fuel.
- Abnormal operations are NOT limiting. This means that the fuel required for normal operations from departure to destination exceeds that required for CPDP, and CP 1 Engine Inop fuel requirements.

We will always assess the flight assuming we get airborne at the maximum BRW from the departure airport, and check that in doing so we will not land at the destination overweight, or exceed the maximum ZFW.

Step 1. Working forward from the maximum BRW at departure airport.

Max BRW at Dep	86, 000
Minus flight fuel	12, 000
LW at Dest	74, 000
Max LW at Dest	72, 574
Over/Under by	**1, 426 kg**

So if we depart at the maximum BRW of 86, 000 kg from the departure airport, we will land over-weight at the destination airport.

Refer to next page for step 2 onwards

Step 2. We must now add up the minimum amount of fuel which must be on board at BRAKE RELEASE. After that we can check whether, in leaving the departure airport at 86000 kg, we will exceed the maximum ZFW, which is 63500 kg for all B727 aircraft (refer limitation section manual page 1-1).

Normal operations fuel summary at BR.

Item	Kg
Flight Fuel	12, 000
V/R 10%	1, 200
Fixed Reserve (N/ops)	3, 300
Wx Hold (at dest)	NIL
Traffic Hold (at dest)	NIL
WIP Hold (at dest)	NIL
Final Taxi (at dest)	100
Min FOB @ BR	**16600 kg**

Step 3. Check ZFW at BR at departure.

Item	Kg
Max BRW	86000
Minus FOB at BR	16600
ZFW at BR	69400
MZFW	63502
Over/Under by	**5898**

So if we depart at the maximum BRW of 86000 kg from the departure airport, we will exceed the maximum ZFW by 5898 kg.

Step 4. Comparing the overweight landing exceedance of 1426 kg, with the ZFW exceedance of 5900 kg, it is obvious that the ZFW exceedance is greater than the LW exceedance. If we now reduce the BRW by the larger of these two exceedance (i.e. 5898 kg) we will take care of the lesser landing weight exceedance in doing so.

P/BRW	86000 kg
Minus largest exceedance	- 5898 kg
Revised BRW	**80102 kg**

Note: ZFW is the limiting factor here. This means that the maximum payload can be carried. The payload is always the difference between the ZFW and the basic operating GW.

Payload is always the difference between the ZFW and the Basic Op GW !

Step 5. Find payload using revised BRW.

Item	Kg
Revised BRW	80102
Minus min FOB at BR	16600
ZFW	63502
Minus basic Op	47000
Payload	**16502**

Answer !

Points to note:

It is really important that you learn the structure and logic of the above steps. In the payload summary just imagine a B727 has taxied out from the terminal building and is lined up for takeoff, sitting on a set of scales. A fuel truck arrives and drains all the fuel out of the aircraft tanks. The scales now register the weight of the aircraft without any fuel in it (i.e. the zero fuel weight).

Next the aircraft structure disappears, leaving the passengers, their baggage and freight sitting on the scales. This is the payload. You must use the company fuel policy from page 1-17 of the B727 manual, and know how to apply it.

On short flight sectors with minimal fuel requirements, you will almost certainly be ZFW limited, and so be able to carry the maximum payload. On longer flight sectors the high fuel requirements may mean trading off payload for fuel. Remember, uplifting the correct fuel is the most important aspect, whatever additional weight capacity is left will be payload. The sign of a great aircraft is that it can carry it's maximum payload over a great distance (i.e. be ZFW limited everywhere it goes, not by runway limits).

We always check the ZFW at BR, when the wing spar is under lift stress !

Extra fuel = less bums on seats = less revenue !

Payload example 2.

Data:
Departure airport "SUITABLE". P/BRW 88000 kg (i.e. performance limited, not structurally limited).

Destination airport "ACCEPTABLE" for the period of possible use becoming "SUITABLE" with holding fuel to cover INTER weather deteriorations below alternate minima. Additionally 15 minutes traffic holding is required. P/LW 70, 000 kg (i.e. performance limited by runway length, NOT structurally limited).

Flight fuel from departure to destination is 15, 000 kg including approach/manoeuvre fuel.

Abnormal ops are NOT limiting.

Aircraft basic operating GW is 47100 kg.

Carry minimum fuel required for this operation, as per company fuel policy (page 1-17).

Find: The maximum payload that can be loaded at departure airport ? _____ kg.

Working:

Step 1. Working forward from the maximum BRW at departure airport.

Max BRW at Dep	88000
Minus flight fuel	15000
LW at Dest	73000
Max LW at Dest	70000
Over/Under by	**3000 kg**

Refer to next page for step 2.

Step 2. Assess min FOB for normal ops at BR.

Normal operations fuel summary at BR.

Item	Kg
Flight Fuel	15000
V/R 10%	1500
Fixed Reserve (N/ops)	3300
Wx Hold (at dest)	2000
Traffic Hold (at dest)	1000
WIP Hold (at dest)	NIL
Final Taxi (at dest)	100
Min FOB @ BR	**22900 kg**

Step 3. Check ZFW at BR at departure.

Item	Kg
Max BRW	88000
Minus FOB at BR	22900
ZFW at BR	65100
MZFW	63502
Over/Under by	**1598**

Step 4. Comparing the overweight landing exceedance of 3000 kg, with the ZFW exceedance of 1598 kg, it is obvious that the LW exceedance is greater than the ZFW exceedance. If we now reduce the BRW by the larger of these two exceedance (i.e. 3000 kg), we will take care of the lesser ZFW exceedance.

P/BRW	88000 kg
Minus largest exceedance	- 3000 kg
Revised BRW	**85000 kg**

Step 5. Find payload using revised BRW.

Item	Kg
Revised BRW	85000
Minus min FOB at BR	22900
ZFW	62100
Minus basic Op	47100
Payload	**15000**

Answer !

In this case the flight was NOT ZFW limited, but LW limited at destination due to a short runway. We could NOT carry the maximum payload for that reason.

Payload example 3.

Data:
Departure airport "ACCEPTABLE" for the period of possible use, becoming "SUITABLE" , with holding fuel to cover TEMPO weather conditions. Additionally, a 30 traffic holding requirement applies.
P/BRW 77, 000 kg (ie: performance limited, not structurally limited).

Destination airport "ACCEPTABLE" for the period of possible use becoming "SUITABLE" with holding fuel to cover INTER weather deteriorations below alternate minima.
P/LW 69, 000 kg (ie: performance limited by runway length, NOT structurally limited).

Flight fuel from departure to destination is 14, 000 kg including approach/manoeuvre fuel.

Abnormal ops are NOT limiting.

Aircraft basic operating GW is 47, 250 kg.

Carry minimum fuel required for this operation, as per company fuel policy (page 1-17).

Find: The maximum payload that can be loaded at departure airport ? _____ kg

Working:

Points to note.

- For normal ops, it is the holding fuel requirements at the destination that is of interest to us, NOT that at the departure airport. Normal ops means you will proceed to the destination. You would only return to the departure airport if the aircraft suffered a failure of the cabin pressure (depressurisation), or the loss of thrust from an engine. These two would require you to consider the conditions at the departure airport, and you would carry the holding on whichever airport had the highest applicable holding when considering these. As the flight is said to be limited by the normal operations fuel requirement, the depressurised and 1 engine inop cases are covered by this amount of fuel.

For normal ops, consider only the holding fuel at the destination airport !

Step 1. Working forward from the maximum BRW at departure airport.

Max BRW at Dep	77000
Minus flight fuel	14000
LW at Dest	63000
Max LW at Dest	69000
Over/Under by	**6000 kg**

Refer to next page for step 2.

No LW problem here !

Step 2. Assess min FOB for normal ops at BR.

Normal operations fuel summary at BR.

Item	Kg
Flight Fuel	14000
V/R 10%	1400
Fixed Reserve (N/ops)	3300
Wx Hold (at dest)	2000
Traffic Hold (at dest)	NIL
WIP Hold (at dest)	NIL
Final Taxi (at dest)	100
Min FOB @ BR	**20800 kg**

Step 3. Check ZFW at BR at departure.

Item	Kg
Max BRW	77000
Minus FOB at BR	20800
ZFW at BR	56200
MZFW	63502
Over/Under by	**7302**

Not ZFW limited !

So we can leave the departure airport at 77000 kg, and in doing so not exceed either the maximum LW at destination, or the ZFW. We are limited by the takeoff performance at the departure airport to 77000 kg.
It is this weight which is will limit the amount of payload that can be carried !

Step 5. Find payload using revised BRW.

Item	Kg
Revised BRW	77000
Minus min FOB at BR	20800
ZFW	56200
Minus basic Op	47250
Payload	**8950**

Answer !

If the flight is limited by other than ZFW, max payload can NOT be carried !

Next we will look at the scenario whereby an alternate is required. Refer to next page.

Payload Calculation - Alternate required on Destination

Payload example 4.

General

The work-flow is very similar to that previously, except that we must ensure that we do not exceed our LW at both destination, and alternate airports. Refer to example below.

Data:

- Departure airport “ACCEPTABLE” for the period of possible use, becoming “SUITABLE” , with holding fuel to cover TEMPO weather conditions. Additionally, a 15 traffic holding requirement applies.
- P/BRW 89357 kg (i.e. structurally limited, not performance limited).

- Destination airport “ACCEPTABLE” for the period of possible use. (needs an alternate).
- P/LW 72574 kg (i.e. performance limited by 30 flap structural landing limit, NOT runway length,).

Alternate airport “ACCEPTABLE” for the period of possible use, becoming “SUITABLE”, with weather holding to cover INTER deteriorations below alternate minima. Additionally, a 15 minutes traffic holding requirement applies. P/LW 65000 kg

- Flight fuel from departure to destination is 10000 kg.
- Flight fuel from destination to alternate is 6000 kg, including approach/manoeuvre fuel.
- Abnormal ops are NOT limiting.
- Aircraft basic operating GW is 46850 kg.
- Carry minimum fuel required for this operation, as per company fuel policy (page 1-17).

Find: The maximum payload that can be loaded at departure airport ? _____ kg

Refer to flight profile below for guidance !

REMEMBER

Fixed reserve when an alternate is required is 2, 250 kg, NOT 3, 300 kg.

P/BRW 89357 kg

P/LW 72574 kg

P/LW 65000 kg

Flight Profile

Refer to next page for working.

Payload example 4 continued ...

Step 1. Working forward from the maximum BRW at departure airport to destination.

Max BRW at Dep	89357
Minus flight fuel Dep to Dest	10000
LW at Dest	79357
Max LW at Dest	72574
Over/Under by	**6783 kg**

Step 2. Working forward from the maximum BRW at departure airport to Destination, and destination to alternate.

Max BRW at Dep	89357
Minus flight fuel Dep to Dest, to Alt	16000
LW at Alternate	73357
Max LW at Alt	65000
Over/Under by	**8357 kg**

Step 3. Normal operations fuel summary at BR.

Item	Kg
Flight Fuel	16000
V/R 10%	1600
Fixed Reserve (N/ops)	2250
Wx Hold (at alt)	2000
Traffic Hold (at alt)	1000
WIP Hold	NIL
Final Taxi (at dest)	100
Min FOB @ BR	**22950 kg**

Step 4. Check ZFW at BR at departure.

Item	Kg
Max BRW	89357
Minus FOB at BR	22950
ZFW at BR	66407
MZFW	63502
Over/Under by	**2905**

Step 5. Reduce the BRW of 89, 357 kg at departure by the largest exceedance. In this case the 8, 357 kg exceedance of LW at the alternate airport.

P/BRW	**89357 kg**
Minus largest exceedance	- 8357 kg
Revised BRW	**81000 kg**

Step 6. Find payload using revised BRW.

Item	Kg
Revised BRW	81000
Minus min FOB at BR	22950
ZFW	58050
Minus basic Op	46850
Payload	**11200**

Answer !

Payload example 5.

Data:

- Departure airport “ACCEPTABLE” for the period of possible use, becoming “SUITABLE” , with holding fuel to cover INTER weather conditions.
- P/BRW 86500 kg (i.e. performance limited, NOT structurally limited).

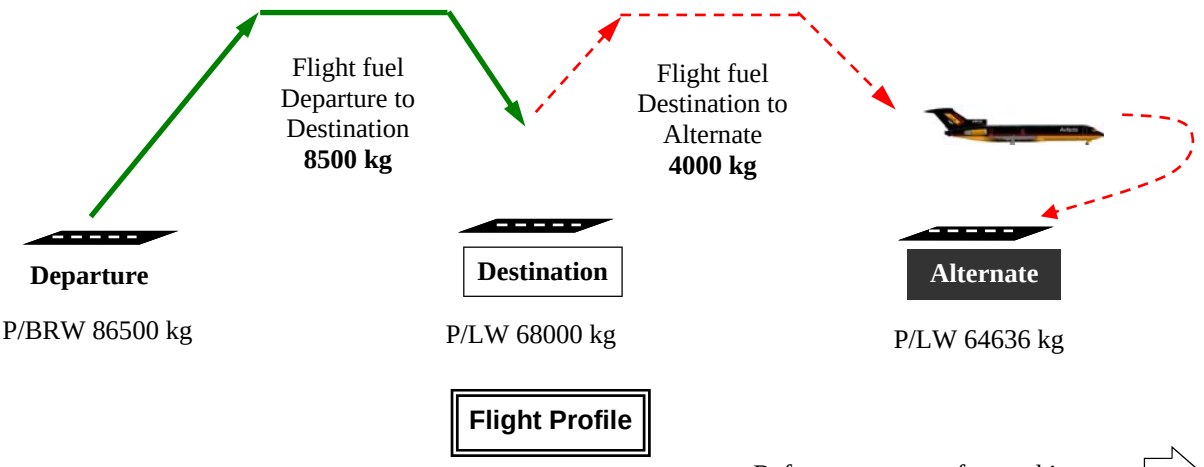
- Destination airport “ACCEPTABLE” for the period of possible use. (needs an alternate). Additionally, a 15 minute traffic holding requirement applies.
- P/LW 68000 kg (i.e. limited by landing performance, NOT by 30 flap structural landing limit.

- Alternate airport “SUITABLE” for the period of possible use. P/LW 64636 kg (limited by 40 flap structural landing limit refer manual page 1-1).

- Flight fuel from departure to destination is 8500 kg.
- Flight fuel from destination to alternate is 4000 kg, including approach/manoeuvre fuel.
- Abnormal ops are NOT limiting.
- Aircraft basic operating GW is 47450 kg.
- Carry minimum fuel required for this operation, as per company fuel policy (page 1-17).

Find: The maximum payload that can be loaded at departure airport ? _____ kg

Refer to flight profile below for guidance !



Flight Profile

Refer to next page for working.

Step 1. Working forward from the maximum BRW at departure airport to destination.

Max BRW at Dep	86500
Minus flight fuel Dep to Dest	8500
LW at Dest	78000
Max LW at Dest	68000
Over/Under by	**10000 kg**

Step 2. Working forward from the maximum BRW at departure airport to Destination, and destination to alternate.

Max BRW at Dep	86500
Minus flight fuel Dep to Dest, to Alt	12500
LW at Alternate	74000
Max LW at Alt	64636
Over/Under by	**9364 kg**

Step 3. Normal operations fuel summary at BR.

Item	Kg
Flight Fuel	12500
V/R 10%	1250
Fixed Reserve (N/ops)	2250
Wx Hold (at alt)	NIL
Traffic Hold (at dest)	1000
WIP Hold	NIL
Final Taxi (at alt or dest)	100
Min FOB @ BR	**17100 kg**

Step 4. Check ZFW at BR at departure.

Item	Kg
Max BRW	86500
Minus FOB at BR	17100
ZFW at BR	69400
MZFW	63502
Over/Under by	**5898**

Step 5. Reduce the BRW of 86500 kg at departure by the largest exceedance. In this case the 10000 kg exceedance of LW at the destination airport.

P/BRW	86500 kg
Minus largest exceedance	- 10000 kg
Revised BRW	**76500 kg**

Step 6. Find payload using revised BRW.

Item	Kg
Revised BRW	76500
Minus min FOB at BR	17100
ZFW	59400
Minus basic Op	47450
Payload	**11950**

Answer !

Loading Max Fuel at Departure

From page 5 of the B727 Flight Planning Operating Manual - addenda, note that the total amount of fuel which can be loaded on an ISA day using under-wing (pressure refuelling) 29094 kg. This addenda will be supplied as part of the work booklet in the CASA examination.
There may be occasions in the CASA exam, and in real life, where you wish to uplift as much fuel at the departure airport as possible, perhaps because the price of fuel at the destination is much higher. These types of questions will be worth 3 or 4 marks in the CASA exam, so you can ill afford to get them wrong.
You will be given:

- A performance limited BRW (PBRW). An exam question may provide a PBRW that is over maximum structural takeoff weight. You must reduce this to 89357 kg (Refer B727 addenda) in this event.
- The payload (total weight of passengers and freight).
- Basic operating GW (fleet average is 47000 kg - B727 manual page 1-1).
- The flight fuel.
- The minimum ramp fuel for the flight (i.e. flight fuel plus reserves required).

Always assume that the reserves will remain unused upon landing at destination, unless specifically advised otherwise in the question !

Example 6.

Given: Route Adelaide to Jakarta. Flight Fuel 18650 kg. Total minimum ramp fuel required 24065 kg.
P/BRW Adelaide is 91000 kg. Payload is 12000 kg. Basic operating GW is the fleet average. Uplift maximum fuel ex Adelaide due to high fuel cost in Jakarta !
Underwing (pressure) refuelling is available in Adelaide, where the temperature is ISA.

Which answer is closest to the planned landing weight at Jakarta, assuming reserves are unused ?

a. 66200 kg b. 69300 kg c. 69450 kg d. 70550 kg

Working:

Step 1.
Reduce BRW to 89357 kg to conform to published Max structural BRW.
Ramp max GW is 89357 kg + 150 kg = 89507 kg.

Step 2.
Find max fuel that can be loaded.

Item	Kg
Revised Ramp	89507
Minus Basic Op	47000
Minus Payload	12000
Max Ramp fuel	**30507**

Reduce this to max underwing capacity of 29094 kg

Step 3. Summary

Item	Kg
Basic Op GW	47000
Plus Max fuel uplift	29094
Plus Payload	12000
Ramp Wt Adelaide	88094
Less Taxi Adelaide	150
Less flight fuel	18650
LW Jakarta	**69, 294**

Answer "B" closest !!

Example 7.

Given:

- Route Melbourne to Singapore.
- Flight Fuel 20000 kg.
- Total minimum ramp fuel required 25550 kg.
- Payload 11000 kg.
- P/BRW Melbourne is 92000 kg.
- Basic operating GW is 47200 kg.
- Uplift maximum fuel ex Melbourne due to high fuel cost in Singapore !
- Underwing (pressure) refuelling is available in Melbourne. Assume ISA conditions in Melbourne.

Which answer is closest to the planned landing weight at Singapore, assuming reserves are unused?

a. 67300 kg
b. 67050 kg
c. 60250 kg
d. 67150 kg

Working

Step 1.
Reduce BRW to 89357 kg to conform to published Max structural BRW. Max ramp GW is 89357 kg + 150 taxi out fuel = 89507 kg.

Step 2.
Find max fuel that can be loaded.

Item	Kg
Revised Ramp GW	89507
Minus Basic Op	47200
Minus Payload	11000
Max Ramp fuel	**31307**

Reduce this to max underwing capacity of 29094 kg !!

Step 3. Summary

Item	Kg
Basic Op GW	47200
Plus Max fuel uplift	29094
Plus Payload	11000
Ramp Wt Melbourne	87294
Less Taxi Melbourne	150
Less flight fuel	20000
LW Singapore	**67144**

Answer "D" closest !

Example 8.
Given:

- Route Perth to Bali. Flight Fuel 15000 kg.
- P/BRW Perth is 88000 kg.
- Basic operating GW is 47350 kg. Payload as per summary.
- Uplift maximum fuel ex Perth due to high fuel cost in Bali !
- Underwing (pressure) refuelling is available in Perth.
- Assume Perth conditions are ISA.
-

Which answer best describes the planned landing weight in Bali assuming reserves are unused?

a. 71800 kg
b. 71200 kg
c. 72850 kg
d. 71000 kg

Payload Summary

Item	Kg
Zone 1	20 adults
Zone 2	15 adults/2 adolescents
Zone 3	18 adults/2 adolescents/2 children
Zone 4	22 adults/2 infants/2 children
Zone 5	16 adults/2 adolescents/2 infants
Fwd Cargo 1	500 kg
Fwd Cargo 2	1, 000 kg
Aft Cargo 4	400 kg
Aft Cargo 5	500 kg
Extra Crew	1

Working

Step 1.
Add up payload using B727 operating addenda for standard Pax weight info. You should get 10484 kg.

Step 2.
Find max fuel that can be loaded.

Item	Kg
Max ramp GW Perth	88150
Minus Basic Op	47350
Minus Payload	10484
Max Ramp Fuel	**30316**

Reduce this to max underwing capacity of 29094 kg

Step 3. Summary

Item	Kg
Basic Op GW	47350
Plus Max fuel uplift	29094
Plus Payload	10484
Ramp Wt Perth	86928
Less Taxi Perth	150
Less flight fuel	15000
LW Bali	**71778**

Answer "A" closest !!

Example 9.

Given:

- Route Sydney to Melbourne. Flight Fuel 5500 kg. P/BRW Sydney is 92500 kg.
- Basic operating GW is 47150 kg. Maximum payload.
- Uplift maximum fuel ex Sydney due to a fuel strike in Melbourne. Underwing (pressure) refuelling is available in Sydney. Assume Sydney conditions are ISA.
- Sydney Airport - Suitable, +30 traffic holding.
- Melbourne Suitable with INTER , + 20 traffic holding.

Which answer best describes the maximum fuel which can be on board at Sydney Ramp ?

a. 14700 kg b. 29000 kg c. 13500 kg

Working:

Step 1. The flight will be a zero fuel weight limited one due to short distance. Therefore we can carry maximum payload - this is the difference between MZFW 63502 kg (for all B727 aircraft), and the basic operating GW of 47150 kg. Max payload is therefore 16352 kg. You can carry maximum payload up to about 1000 nm. Melbourne is less than 400 nm from Sydney.

Step 2. An important consideration here is that you could load 29094 kg of fuel above the MZFW of 63502 kg, to get a Ramp GW of 92596 kg. This would yield a BRW well above the maximum BRW of 89357 kg.
So we are limited to a max structural BRW of 89357 kg or less out of Sydney.

Step 3. If you released the brakes at 89357 kg, and burnt only 5500 kg as flight fuel to Melbourne, you would land at 83857 kg, which is over the 30 flap maximum structural landing weight of 72574 kg by a staggering 11283 kg. Clearly we can NOT carry the maximum possible fuel load of 29094 kg at Sydney, without smashing the aircraft on landing at Melbourne. Melbourne LW is the most limiting case.

Step 4. Working backwards from the maximum LW at Melbourne of 72574 kg, and adding the flight fuel of 5500 kg, we get a maximum BRW at Sydney of 78074 kg, and a max ramp weight 150 kg heavier at 78224 kg. The difference between this maximum ramp weight and the MZFW of 63502 kg, is the maximum weight of fuel we can have in the tanks to avoid landing overweight in Melbourne.
In this case it 14722 kg. Check this by working logically forward as shown in the summary below.

Step 5. Summary check - forward thinking.

Item	Kg
Max ramp weight Sydney	**78224**
Less initial taxi fuel	**150**
Max BRW Sydney	**78074**
Less flight fuel	5500
LW Melbourne	72574
Less unburnt fuel at landing (14722 - 150 - 5500)	9072
ZFW	**63502**

Answer "A" closest !!

Note: The minimum fuel required for the flight is 12933 kg. We will be carrying 14722 kg, so margin fuel is the difference between them of 1789 kg. We will probably have to return to Sydney via say Canberra to pick up more fuel, then proceed on the Sydney from there. The information on holding at Sydney and Melbourne would be needed only if they asked you how much margin fuel you could carry out of Sydney.

Example 10.
Here it asking for the minimum fuel you can carry above flight fuel. See below. Worth about 2 marks.

Given:
- PBRW 86800 kg
- LW at the destination is limited by structural considerations only.
- Flight fuel (FBO) 12200 kg
- Payload: 10500 kg
- Basic operating GW is the "fleet average".

At the brake release point the maximum FOB over and above the Flight Fuel is closest to ?

A. 17100 kg.
B. 15000 kg.
C. 16850 kg.
D. 19850 kg.

Step 1. Check LW at destination.

ITEM	Kg
PBRW	86800
Less flight fuel	-12200
LW at destination	74600
MLW 30 flap	- 72574
"Over" MLW by	**2026**

Step 2. Check ZFW.

ITEM	Kg
Basic Op GW	47000
Add Payload	+10500
ZFW	57500
MZFW	63502
"Under" MZFW by	**6002**

Step 3. Reduce BRW for LW exceedance.

ITEM	Kg
PBRW	86800
OVER weight landing	-2026
Revised BRW	84774

Step 4. Summary

ITEM	Kg
PBRW	84774
Less payload	-10500
All fuel + Op GW =	74274
Less flight fuel	-12200
Basic Op GW + extra fuel =	62074
Less Basic Op GW	-47000
Extra fuel above flight fuel	**15074**

ANSWER !

NOTE:
1. The trap here is that if you released the brakes at 86800 kg you would land over weight at destination. Need to check ZFW also - okay in this case.
2. Included in this 15074 kg figure are the reserves. Whatever is left after the reserves are removed that would be "margin fuel".
3. Had the question asked for the minimum extra fuel above flight fuel that could be carried measured at the ramp it would not quite be the same but 150 kg more (15224 kg). This is because the 150 kg taxi out fuel is part of the reserves.
4. Always round down your answer in this type of question.

Example 11. (about 3 marks)
Asking this time for the "margin fuel" you can carry above the minimum required including reserves.
See below….

Given:

- PBRW 88000 kg
- PLW at the destination is 70000 kg.
- Flight fuel (FBO) 15000 kg
- Payload: 15000 kg.
- FOB at Ramp 24050 kg
- Basic operating GW is 47100 kg.
- Uplift maximum fuel at departure due to the high cost of fuel at destination.
- Departure airport SUITABLE.
- Destination Airport acceptable becoming suitable with INTER + 15 traffic holding.
- Abnormal operations are NOT limiting !

At the brake release point the maximum margin fuel is closest to ?

A. Nil.
B. 4000 kg.
C. 1000 kg.
D. 8900 kg.

Working:

Step 1. Working forward from the maximum BRW at departure airport.

Max BRW at Dep	88000
Minus flight fuel	-15000
LW at Dest	73000
Max LW at Dest	-70000
Over/Under by	**3000 kg**

Step 2. Assess min FOB for normal ops at BR.

Item	**Kg**
Flight Fuel	15000
V/R 10%	1500
Fixed Reserve (N/ops)	3300
Wx Hold (at dest)	2000
Traffic Hold (at dest)	1000
Final Taxi (at dest)	100
Min FOB @ BR	**22900 kg**

Step 3. Check ZFW at BR at departure.

ITEM	Kg
Basic Op GW	47100
Add Payload	+15000
ZFW	62100
MZFW	63502
"Under" MZFW by	**1402**

OKAY !

Step 4. Revise at BR at departure.

P/BRW	**88000 kg**
Minus largest xceedance	- 3000 kg
Revised BRW	**85000 kg**

Refer to next page for step 5.

Step 5. Summary.

ITEM	Kg
PBRW	85000
Less payload	-15000
All fuel + Op GW =	70000
Less flight fuel	-15000
Basic Op GW + extra fuel =	55000
Less Basic Op GW	-47100
Extra fuel above flight fuel	**7900**

Step 6. Find margin fuel.

ITEM	Kg
FOB @ Ramp (given)	24050
Less initial taxi out fuel	-150
FOB @ BR	23900
Less flight fuel	-15000
Less required reserve fuel @ BR point (22900-15000)	-7900
Margin fuel	**1000**

ANSWER !

Now attempt the payload assignments !