

A Throughput Accounting question worked through.

So, here we have a factory with three machines making three products. We plan to make 600 A which need each 5 minute on Machine 1, 4 minutes on Machine 2 and 3 minutes on Machine 3.

		Minutes on Machine	Minutes on Machine	Minutes on Machine
Units	Product	1	2	3
600	A	5	4	3
500	B	4	5	6
400	C	3	3	3

Step 1. Identify the bottleneck.

In reality you could do it mathematically or by walking around the factory. The bottleneck will be the poor person who is working frantically hard but just can't keep up. There will be a huge pile of work for them to do on one side of their machine and people further down the line with not enough to do.

In our exam question we will have to work out which machine it is.

We need to calculate the time needed on each machine to make all of the units of all of the products that we plan. **The requirement.**

This would be 600×5 to make all the A, 500×4 to make all of the B and 400×3 to make all of the C. This gives a requirement of 6,200 minutes to do all of the production on Machine 1.

	Minutes on Machine	Minutes on Machine	Minutes on Machine
Total time required	1	2	3
A	3000	2400	1800
B	2000	2500	3000
C	1200	1200	1200
	6200	6100	6000

We now compare this to **the capacity** of each machine - i.e. how long we can work on the machine.

This would usually be given in the question and in our example here it is given as:

	1	2	3
Time available	7000	6200	5800

Clearly there is enough time on machines 1 and 2, but not enough on Machine 3. That one is our bottleneck. We could do all the work we needed to on the other two machines but we couldn't finish it all off on Machine 3.

Step 2. Calculate Throughput.

Having identified our bottleneck machine we now want to work out our **Throughput per Minute** on the bottleneck machine.

This is like contribution per unit of limiting factor, but there is a significant difference between throughput and contribution.

We are used to calculating contribution, it is **Sales minus Variable costs = contribution**. You will remember that the components of Variable costs are Direct Materials, Direct Labour and Direct Expenses.

With throughput we actually calculate **Sales minus Direct Materials = Throughput**.

The big difference is we are only taking away Direct Materials. All other variable costs are treated as if they are part of the overhead. Why?

In the short term we cannot lay off staff or avoid paying the electricity bill etc., so if our production slows down the only thing we will spend less on is the direct material. We will be spending less as we are using less as we are making fewer of our products.

We are only considering the short term here because we are going to have to do something pretty quickly to solve the bottleneck issue if we want to meet our production plans.

The question will have data in it about sales price and costs:

		Costs		
Product	Sales £	Material £	Direct Labour £	Overhead £
A	200	100	60	15
B	300	180	70	30
C	280	200	40	35

To illustrate using A: Sales minus Direct Materials is £200 - £100 = Throughput of £100. If we wanted to calculate the profit, we would then take away the Direct Labour of £60 and Overhead of £15 to give £25 per unit.

Throughput

	Sales £	Material £	Throughput	Operating Expenses	Net profit
A	200	100	100	75	25
B	300	180	120	100	20
C	280	200	80	75	5

Note how the Direct Labour and Overheads have been added together to gives us **Operating Expenses**. For A this is £60 DL + £15 O = £75.

Product B looks to be the most important as it has the highest throughput per unit., then A then C last.

Step 3. Calculate the Throughput per Minute.

But, like when we look at contribution when we have got a limiting factor, this isn't enough on its own. We need to look at throughput per unit of limiting factor, i.e. **Throughput per Minute**.

When we say minute, we mean '**minute on the bottleneck**'. That is, the time on the machine that is slowing us down as that is our limiting factor.

We have to go back to our bottleneck machine and see how long it takes to earn the Throughput for each product.

Throughput per minute

	Throughput	Mins on Bottleneck	Throughput/Min
A	100	3	£ 33.33
B	120	6	£ 20.00
C	80	3	£ 26.67

We see now that Product A is the most important as it earns us £33.33 per minute.

We now have our order of priority = A, C, B and we will make all of the A first, then what C we can (hopefully all of them) and then any B if there is time left.

Quite frankly I think we could stop there, but everything I have ever seen has required students to calculate the **Throughput Accounting Ratio** (and we will come to this in a minute). However, it is still going to give me the same order of priority, so being essentially lazy, I wouldn't bother going any further.

Step 4. Calculate the Cost per Minute.

The Throughput Accounting Ratio is the relationship of the Throughput per Minute to the Cost per Minute.

Throughput per min : Cost per min

You can express it as a ratio, but usually ratios are easier to understand as percentages. For example a ratio of 1:2 is the same as $\frac{1}{2} = 0.5$. That ratio is pretty obvious, but look at the ones we get in this question. You will agree that percentages are easier.

Cost per Minute.

This is an interesting idea; it is like we are blaming the bottleneck machine for all the costs of the entire factory!

We can calculate the costs for the whole factory by taking the Operating Expenses for each product and multiplying by the number of units of each that we planned to make. So for A this would be $\text{£}75 \times 600 \text{ units} = \text{£}45,000$.

Why do we calculate from the plan when we are actually not going to make the planned number of units?

Good question. It is because we are treating all costs except Direct Materials as a Fixed Cost, and as we know, fixed Costs are not going to change just because we've made fewer than we planned.

We will calculate the total cost and then divide by the actual number of minutes that the bottleneck machine can work. Note; it is not the budgeted minutes of 6,000, but the actual minutes of 5,800 for Machine 3 (our bottleneck).

Cost per Factory Minute			
	Cost	units	total
A	75	600	£ 45,000
B	100	500	£ 50,000
C	75	400	£ 30,000
			£ 125,000
		Minutes	5,800
		Cost/Min	£ 21.55

This gives us a Cost per Minute.

Step 5. Calculate the Throughput Accounting Ratio

Look at the ratios. Wouldn't you say 1.55 (throughput is 55% higher than cost) was easier to understand than 33.33:21.55?

TA Ratio			
	Return/min	Cost/min	TA Ratio
A	£ 33.33	£ 21.55	1.55
B	£ 20.00	£ 21.55	0.93
C	£ 26.67	£ 21.55	1.24

Look at the order of priorities this reveals. Err? The same as we had before = A, C, B.

Does the ratio tell us anything useful then?

Theoretically what it is telling us is that A and C make a 'profit' but that we get less throughput on a B than it costs us to make. Note any number below 1.0 means the costs are greater.

Does this mean we shouldn't make B at all; after all it is losing us money?

I think it would be wrong not to make B. look at what would happen if we didn't.

Remember, the only thing we save by not making B is the cost of the Direct Materials and we have already dealt with that in our calculation of Throughput.

Every B we don't make means we won't get £20 of Throughput. However many B we make we still have total costs of £125,000 to pay – they are Fixed and won't go down if we don't make B. Not making something because it appears that it is losing money is a good way of actually losing money.

As we are short in this question of 200 minutes (that's why machine 3 is the bottleneck), and we are going to make B last this means we will reduce the production of B by 200 minutes divided by the minutes per unit (that's 3 on machine 3).

$200/3 = 67$ units we can't make. We could make therefore 333 units of B. Each one would give us £20, so that's £6,660. If we don't make B at all we will have £6,600 of overhead that will have to be paid out of the profits from the other products. Make B!

You could say, ah!, it shows us that we should make A and C in preference to B. yes it does, but we knew that anyway from our order of priorities. We would have shifted production to A first then C anyway if we could, but the question tells us the maximum we could sell. Might as well make some B rather than waste the time if you ask me.

What if the exam question asks us to do the TA ratio? -

I am not telling you not to do it; you need to do what the question asks (even if it is pointless in my view!).