MET2
MANUFACTURING ENGINEERING TRIPOS PART IIA
Paper 5 Answer Sheet
Section A

a) Retained earnings

	£000	£000	£000
Balance b/f			818
Sales		4,006	
Opening stock	410		
Purchases	2,120		
Closing stock	(450)		
		(2,080)	
Gross Profit		1,926	
Expenses	1,640		
Depreciation	100		
Bad debts written off	20		
Loan interest [W1]	20		
		1,780	
Net profit for year			146
Balance c/f			964

W1 £000 Loan interest

Bal b/f	10
Profit and loss	20
Bank	20
Bal c/f	10

b) Balance sheet

	£000	£000
Non-current assets		
Fixed assets cost	1,000	
Depreciation	(330)	670
Current assets		
Stock	450	
Debtors (690-20)	670	
Cash	114	1,234
Current liabilities		
Creditors	180	
Accruals [W1]	10	190
Non-current liabilities		
10% Debenture		200
		1,514
Capital and reserves		
Share capital (400+150)	550	
Retained profits	964	
		1,514

c) Note on the accounting treatment of research and development

Research is original and planned investigation, undertaken with the prospect of gaining new scientific or technical knowledge and understanding. The company is researching the unknown, and therefore, at this early stage, no future economic benefit can be expected to flow to the entity.

Development is the application of research findings or other knowledge to a plan or design for the production of new or substantially improved materials, devices, products, processes, systems, or services, before the start of commercial production or use.

Research does not directly lead to future economic benefits, and capitalising such costs does not comply with the accruals concept. Therefore, the accounting treatment for all research expenditure is to write it off to the profit and loss account as incurred.

Development expenditure may be written off to the profit and loss account as incurred, as with the expenditure on research. However, under the accounting principle there is an option to defer the development expenditure and carry it forward as an intangible asset if the following criteria are met:

(a) The project is technically feasible.

(b) The project once completed can be used or sold.

(c) The project will generate probable future economic benefits which exceed costs (commercially viable).

(d) Technical, financial and other resources are available to complete the development.

(e) Its ability to measure reliably the expenditure attributable to the intangible asset during its development (costs are separately identifiable).

Development expenditure so deferred as an intangible asset should be amortised over the economic life of the development.

Question 1 was generally well answered. Students answered a) and b) with largely accurate calculations of retained earnings and balance sheet entries. However, there was a lack of attention to detail in formatting the balance sheet and some struggled with the calculation of depreciation on a straight line basis and interest payable. Part c) was generally much less well answered with some students omitting to separate research from development in their responses and assuming a single accounting treatment for both aspects. Few students knew the conditions under which development can be considered an intangible assets.

2. Calculation of ratios

Inventory days 2016: (3,000/9,300) × 365 = 118 days
2015: (1,300/6,600) × 365 = 72 days
Sector average: 90 days

Receivables days 2016: (3,800/15,600) × 365 = 89 days
2015: (1,850/11,100) × 365 = 61 days
Sector average: 60 days

Payables days 2016: (2,870/9,300 × 0.95) × 365 = 119 days
2015: (1,600/6,600 × 0.95) × 365 = 93 days
Sector average: 80 days

In each case, the ratio in 2016 is higher than the ratio in 2015, indicating that deterioration has occurred in the management of inventories, receivables and payables in 2016. Inventory days have increased by 46 days or 64%, moving from below the sector average to 28 days – one month – more than it. Given the rapid increase in sales revenue (40%) in 2016, Pip may be expecting a continuing increase in the future and may have built up inventories in preparation for this, i.e. inventory levels reflect future sales rather than past sales. Accounting

statements from several previous years and sales forecasts for the next period would help to clarify this point.

Receivables days have increased by 28 days or 46% in 2016 and are now 29 days above the sector average. It is possible that more generous credit terms have been offered in order to stimulate sales. The increased sales revenue does not appear to be due to offering lower prices, since both gross profit margin (40%) and net profit margin (34%) are unchanged.

In 2015, only management of payables was a cause for concern, with Pip taking 13 more days on average to settle liabilities with trade payables than the sector. This has increased to 39 days more than the sector in 2016. This could lead to difficulties between the company and its suppliers if it is exceeding the credit periods they have specified.
There is a reduction in equity between the two years. Pip has no long-term debt and the statement of financial position indicates an increased reliance on short-term finance, since cash has reduced by $780,000 or 87% and the overdraft has increased by $850,000 to $1 million. Perhaps the company should investigate whether it is undercapitalised (overtrading) and consider whether it needs some long term debt finance if the business is still basically profitable.

b)

Ratio	Definition	Used to assess
(i) Return on capital employed	$\frac{\text{Operating profit}}{\text{Average capital employed}}$	Profitability
(ii) Revenue per employee	$\frac{\text{Sales}}{\text{Average number of employees}}$	Efficiency
(iii) Current ratio	$\frac{\text{Current assets}}{\text{Current liabilities}}$	Short-term liquidity
(iv) Debt to equity ratio	$\frac{\text{Liabilities}}{\text{Equity}}$	Leverage
(v) Debt service or interest coverage ratio	$\frac{\text{Operating profit}}{\text{Interest payable}}$	Leverage – credit risk
(vi) Earnings per share	$\frac{\text{Net profit after franchise cost}}{\text{Average number of issued common shares}}$	Investment return

(c) Limitations of ratio analysis

- Need for a benchmark against which to compare the ratios.
- Use of historical data (may be out of date/no longer relevant).
    - Does not account for Inflation.
    - May not reflect market value.
- Comparisons between different industries may be difficult.
- May be distorted by accounting policies.

Question 2 Part a) was well answered with accurate calculations. Some students did not adjust the payables calculation to reflect the fact that it was related to credit purchases. A few answers gave exceptionally clear definitions of the ratios in section b together with the key use for each ratio. Errors in this section mainly came from difficulties with remembering which ratios are calculated using average values for the year. Some lack of learning of key accounting vocabulary was evident. Part c was less well answered with students reflecting on a range of issues, but omitting to include basic issues such as the fact that ratios are calculated using historic data.

Section B

3 a) Advantages and disadvantages of using Internal Rate of Return to assess planned investments:

(1) Time value of money
IRR is a discounted cash-flow model, which considers the time value of money (as does NPV). The time value of money is important for investment appraisal as otherwise the different times cannot be distinguished from each other.

(2) Scale
IRR offers a relative measure of return, and therefore fails to reflect the amount of initial investment or the absolute increase in corporate value (or the scale of the investment).

(3) Comparison across projects
IRR which will not reliably determine which project to invest in to maximise shareholder value. IRR will only reflect whether projects are acceptable in offering returns higher than the discount rate.

(4) Variable discount rates
NPV enables changes in discount rates to be incorporated while IRR relies on calculating a consistent rate across the life of the project.

(5) Re-investment assumption
NPV assumes that intermediate cash flows are re-invested at the company's cost of capital, which is reasonable assumption as the company's cost of capital represents the average opportunity cost of the company's providers of finance, i.e., it represents a rate of returns which exists in the real world. By contrast, IRR assumes that intermediate cash flows are reinvested at the IRR rate, which may not be available outside the project.

(6) Non-conventional cash flows
Non-conventional cash flows could exist when negative cash flows arise during the life of the projects. With such non-traditional cash flows, IRR can suffer from the technical problem of giving multiple internal rates of return or no internal rate of return.

b) i)

Net Present Value

Year	*opening*	*2011*	*2012*	*2013*	*2014*
	£000	£000	£000	£000	£000
Sales income [W1]		12,525	15,030	22,545	22,545
Conversion cost [W2]		(7,913)	(9,495)	(14,243)	(14,243)
Contribution [W3]		4,612	5,535	8,302	8,302
Fixed costs (net cash flow)		(4,000)	(5,000)	(5,500)	(5,500)
Before- franchise cost cash flow		612	535	2,802	2,802
franchise cost liability at 28%		(171)	(150)	(785)	(785)
After- franchise cost cash flow		441	385	2,017	2,017
Initial investment	(4,000)				
Cash Flow	(4,000)	441	385	2,017	2,017
Discount factor @10%	0	0.9091	0.8264	0.7513	0.6830
Present values	(4,000)	401	318	1,516	1,378
NPV	(387)				

Workings

Average selling price = (30,000 × 0.20) + (42,000 × 0.45) + (72,000 × 0.35) = £50,100 per unit

Average conversion cost = (23,000 × 0.20) + (29,000 × 0.45) + (40,000 × 0.35) = £31,650 per unit

W1 *Year*	*2011*	*2012*	*2013*	*2014*
Sales volume (units/year)	250	300	450	450
Average selling price (£/unit)	50,100	50,100	50,100	50,100
Sales income (£000/year)	12,525	15,030	22,545	22,545

W2 *Year*	*2011*	*2012*	*2013*	*2014*
Sales volume (units/year)	250	300	450	450
Average conversion cost (£/unit)	31,650	31,650	31,650	31,650
Conversion cost (£000/year)	7,913	9,495	14,243	14,243

W3 Alternatively Contribution may be calculated directly

Average contribution = 50,100 – 31,650 = £18,450 per unit.

Year	*2011*	*2012*	*2013*	*2014*
Sales volume (units/year)	250	300	450	450
Average contribution (£/unit)	18,450	18,450	18,450	18,450
Contribution (£000/year)	4,613	5,535	8,303	8,303

Internal rate of return: -

	Opening	*2011*	*2012*	*2013*	*2014*
Cash Flow	(4,000)	441	385	2,017	2,017
Discount factor @10%		0.9091	0.8264	0.7513	0.6830
Present values	(4,000)	401	318	1,516	1,378
NPV £000	(387)				
Cash Flow £'000	(4,250)	553	497	2,129	2,129
Discount factor @5%		0.9524	0.9070	0.8368	0.8227
Present values	(4,000)	527	451	1,782	1,752
NPV £000	261				

Interpolating on a straight line basis between the two points
387+261/5 = change in NPV per % change in discount rate = 129.6
261/129.6 = 2.01 Thus IRR = 7.01% which is below the discount rate

b) ii)
After- franchise cost cash flow from year five onwards into perpetuity will be:
2,802 – 785= 2,017 £000 per year.

PV in perpetuity= annual cash flow/discount rate
Cash flow in perpetuity from year 5 £000 = (2,017/0.10) = 20,170

Discount back to present in £000 20,170 × 0.683 = 13,776

Net of NPV for first 4 years of -387
Making the NPV of the project in perpetuity £000 13,776 – 387 = 13,389

Additional years to positive NPV is 1 as PV of 5^{th} year is 2,017 * 0.6209 = 1,252
therefore NPV at year 5 is (£000) 1252-387= 865

If only the first four years of operation are considered, the NPV of the planned investment is negative and so it would not be financially acceptable. If production and sales beyond the first four years are considered, the NPV is strongly positive and so the planned investment is financially acceptable. It only takes until year 5 for the project to achieve a positive NPV.

Question 3 This question principally required a reasonably straight forward net present value calculation which was generally well presented. Part a) caused some difficulty with few students fully aware of the range of advantages and disadvantages of using internal rate of return. The inclusion of probabilities of various outcomes was addressed well and caused minimal difficulty. Hardly any responses to part c) demonstrated knowledge of the formula for calculating NPV in perpetuity. Most students responded by calculating the NPV for one, two or more years, which was not sufficient to answer the question.

4.
a) Verify that labour is the limiting factor.
Each product uses 9 hours of machine time (3+2+4). Thus to produce 4,000 units needs 36,000 hours of machine time. Only 24,000 hours of machine time are available so there is a shortfall of 12,000 hours of production that needs to be filled by purchases from the subcontractor.

£	M	Y	S
Variable cost of making	20	36	24
Variable cost of buying	29	40	34
Additional cost of buying	9	4	10
Machine hours saved by buying	3	2	4
Variable cost of buying per hour saved	3	2	2.5

The analysis shows that it is cheapest to buy Y and most expensive to buy M. The priority for making the components in house will be M then S then Y. There are enough machine hours to make all 4,000 units of M (12,000 hours) and to produce 3,000 units of S (12,000) hours. 1,000 units of S and all 4,000 units of Y must be subcontracted.

	Machine hours used	Number of units	Units variable cost	Total variable cost
			£	£
Make M	12,000	4,000	20	80,000
Make S	12,000	3,000	24	72,000
Buy S		1,000	34	34,000
Buy Y		4,000	40	160,000
Total variable costs				346,000
Total costs including assembly costs of 4000x100				746,000

Cost is £746,000
Selling price is £200 x 4,000 units is £800,000
Profit is £54,000

b)
At 2,500 units the machine hours required is only 22,500 (2,500 x9) and thus machine hours is no longer the limiting factor. Demand is now the limiting factor.

	Machine hours used	Number of units	Units variable cost	Total variable cost
			£	£
Make M	7,500	2,500	20	50,000
Make Y	5,000	2,500	36	90,000
Make S	10,000	2,500	24	60,000
Total variable costs				200,000
Total costs including assembly (2,500x100)				450,000

Cost is £450,000
Selling price is £210 x 2,500 units is £525,000
Profit is £75,000

Thus would advise increasing the price to £210 as it leads to a higher profit

Factors that would need to be taken into account would include

- the impact on the workforce (would there be need for redundancies)
- the impact on customers (would Mysty ltd lose market share to competitors- who may become monopolistic)
- the impact on competitors (would they also change their pricing)
- impact of contracting production on the future growth prospects of the company.

(c) Alternatively if there is scope within the market Mysty could consider becoming a subcontractor and selling M, Y and S as components for other manufacturers. If Mysty was able to obtain the same market prices as Maddison & Co then:

£	M	Y	S	Total
Variable cost of making	20	36	24	
Subcontracting sales price	29	40	34	
Profit per unit	9	4	10	
Machine hours needed	3	2	4	
Production if all 24,000 hours used on one product	8,000	12,000	6,000	

Profit if all 24,000 hours used on one product	£72,000	£48,000	£60,000	
Maximum profit available				£72,000
Production if 24,000 hours distributed evenly across products	2,667	2,667	2,667	
Profit if 24,000 hours distributed evenly across products	£24,000	£10,667	26,667	
Total				£61,334

Whether the units have to be produced in a 1:1:1 ratio or whether they can be produced to maximise the individual profit by producing only M, the overall profit would be greater than adopting the 4,000 item production, but less than adopting the 2,500 item production run. From the prices charged by Maddison, it would appear that their cost structure is different and there may be opportunities for Maddison and Mysty to work together and specialise in particular components.

Factors to consider in adopting such as plan would include the impact of no longer doing assembly on the overall work force and the impact on the subcontract market of increasing supply (which may lower the price chargeable). It would be important to explore alternative markets for M, Y and S.

Students may answer this without the full calculation above.

Question 4 Only a few students answered this question, but those who did generally produced good answers. The calculations required for parts a) and b) were well approached. Some students omitted to verify that the machine hours was the limiting factor. The impacts of changing the production schedule were accurately calculated but the implications for the company were less well described. Few students considered in part c) the use of the subcontractor's rates as representative of the likely sales price of the individual components.

Section C

5 (a)

		HOTEL B	
		Collude	Compete
HOTEL B	Collude	(40, 40)	(10, 50)
	Compete	(50, 10)	(30, 30)

Begin with a simplified situation of just two luxury hotels. Assume the payoff matrix shown above (the 1st figure in each box shows profit in millions of Euros to Hotel B, the 2nd figure shows profits to the Hotel A).

In the absence of coordination, each hotel will reject the "collude" option in the knowledge that its rival can increase profits by choosing to "compete". Hence both end up earning €30m. However, with communication they can agree to collude and increase their profits to €40m each. A long history of coexistence and similar values and norms between the hotels probably facilitated collusion.

The situation is different when a significant customer (e.g. a tour operator or a corporation) asks for a discount. Each hotel knows that, unless a discount is offered, that customer is likely to go elsewhere. If a hotel has rooms available, there is a strong incentive to offer a substantial discount—the incremental cost of letting a room rather than leaving it empty is small. While communication over list prices ("rack rates") is simple (it needs to happen just once a year), communicating and reaching agreement over discounts to individual customers would be very difficult. The attractions of offering individually negotiated discounts are increased by the likelihood that they will remain secret.

(b) A real option is an alternative or choice that becomes available with a business investment opportunity. Real options have the principle that a firm has the right but not the obligation to exercise the option on the investment opportunity/asset. Real options can include opportunities to expand and cease projects if certain conditions arise, amongst other options. They are referred to as "real" because they usually pertain to tangible assets such as capital equipment, rather than financial instruments. Real options allow a firm to modify the commitment as conditions evolve. Delay commitment until better information is available on profitability. A real option exists if future information can be used to tailor decisions. Key balancing 'learn rate' (receive new information to adjust strategy) versus 'burn rate' (irreversible commitments). Real options points to two major types of option: flexibility options and growth options.

The company could create options be increasing flexibility throughout its whole range of activities. For example, to take account of opportunities to exploit lower costs resulting from exchange rate movements it could move to shorter contracts with its suppliers, or have contracts which are more flexible with regard to quantity. It could require that suppliers reorganize their production processes to allow greater flexibility with regard to colour and size to permit faster responses to market preferences. In terms of growth options, the company could make initial investments in new product areas, new markets, and new product and process technologies.

Alliances including minority investments in companies which offer the potential to diversify into new product areas would also create option value.

5a)
The question was generally answered satisfactory. A very good answer would have included explaining the theory (prisoner's dilemma) with the support of a collusion table. The student would have then gone on to apply the problem to the hotel example in detail and show limitations to the theory as well as the example. A good answer would have been very well structured and showing a connection between theory and example. No student directly related the theory to both (the prisoner's example and the hotel example) in the form of a collusion graph. Average answers stated the theory and loosely linked it to the example or vice versa.
5b I) This question was generally answered well. Most students understood the value of real options to firms. Differences in answers included the understanding of real options as a financial tool, to allow flexibility in forms of delay or not enacting on the option.
5b II) This question was generally answered below expectations. Most students showed a lack of detail understanding of real options and gave relatively random examples. A good answer would have pointed to enacting flexible choice of future investments. Examples in good answers included new product areas, flexible or new production processes and technologies. etc..

6 (a) Unless a new process is revolutionary (e.g. Pilkington's float glass process), new processes are typically incremental improvements or reconfigurations of existing processes. In such cases, process patents can be circumvented. Moreover, alternative mechanisms for protecting innovations—e.g. secrecy, lead time, and manufacturing capabilities—tend to be more effective for process innovations than product innovations. In particular, since processes cannot be easily viewed by competitors, secrecy is highly effective in protecting process innovations. On the other hand, product innovations are more visible and hence can be copied more easily by competitors. Therefore, product innovations require patents more than process innovations in order to protect intellectual property and make superior returns for firms.

(b) A large, multibusiness firm—whether a vertically integrated firm comprising multiple vertical stages, a multiproduct company, or a multinational company—comprises a number of business units presided over by a corporate head office. In a stable environment, most decisions are of a routine nature and can be made lower down in the organization. In a turbulent environment, changing circumstances require that increasing numbers of decisions go up to the corporate level. The likelihood is that corporate managers become overburdened and the speed of decision making slows.

However, in terms of overall adaptability to change, much depends upon the nature of the business turbulence and the type of coordination required. In the case of vertical integration, uncertainty over the level of demand from day to day encourages purchasing from independent suppliers (most umbrella retailers buy rather than make their umbrella).

Conversely, a business where design changes are very rapid—fashion clothing—a firm may find it can adapt more swiftly to changing design preferences by being vertically integrated rather than continually negotiating new market contracts i.e., contracts are invariably incomplete and hence, firms will try to internalise such external costs of renegotiating contracts when there is a turbulent external environment.

6a) 19 students answered this question. The question was generally answered well and complete by most of the students. Variations were: weaker answers included a description of the course material and no detailed logic behind process vs product innovation. Better answers cross compared and

detailed the pro and cons between product and process innovation concluding that even though both is possible, the rule is patents are used more used for product innovations. Excellent answers stated good examples and combined them to argue and state their point.

6b) The answers to the question were in average good. Most students have shown that they understand the basics of outsourcing and what core business / core capabilities means. The below average answers were accounts of the occurance of outsourcing in general. Better answers have pointed at strategic analysis tools (e.g. PESTEL or Porter) and have argued along these principles that firms in crises are likely to externalize none core businesses. Other good answers have defined vertical and horizontal integration as business focus and how this may help in contradiction to outsourcing.

Section D

7. (a) A business model is the approach to doing business that describes the revenue model and the accompanying cost structure that enables the firm to deliver the customer value proposition using the marketing mix. A business model summarises the architecture and logic of a business and defines the organisation's value proposition and its approach to value creation and value capture. Some definitions might also include the value network i.e., which firms the firm forms collaboration to design and deliver the proposition.

Other similar definitions are also acceptable as there are no standard agreed definition.

(b) Possible business models include among others (1) Collecting the data and creating the content but using other organisations to distribute (2) Act only as a distributor by buying content from other sources (3) Neither acting as a content provider nor distributor but merely renting the brand and acting as an orchestrator (ala Nike)

(c) Challenges includes (1) overcoming internal resistance from employees (2) mental models of the existing business models might act as a constraint (e.g., Xerox and PARC) (3) resource constraints (4) metrics of the existing business model might act as a constraint to innovate. This is because the new business model might not look as attractive when evaluated using the metrics of the existing business.

7a) most students could show a business model in a structured form. The weaker answers were not as well structured. Average answers stated and repeated the model as given in class. A good answer would show the model and give insights on the different parts, including a critical or problematizing comment on the part.

7b) the quality of the answers varied, but was overall good. The weaker answers stated possible extensions without logical connection to question 7a) the average answers would show a connection to 7a) and argue a logical connection to the case mentioned. A good answer argued multiple business model extension options with a logical connection to 7a) advising and grouping on horizontal and vertical extensions. (eg. extending markets (UK to Europe), extending topics (e.g. giving other information or applying the information already gathered to new means like hedge funds).

7c) overall the question was well answered by students. A weaker answer would have stated that there are problems and listed risks. A better quality answer would state a clear link to the question before and explained logical problems in implementing business models (overcoming internal resistance, mental models in employees do not change processes; or more technical, cash flow or capability limitations).

8. (a) Two-sided markets are markets where two different types of users may realise gains by interacting with each other through a common platform. For example, Adobe Acrobat, Ebay etc

(b) In two-sided markets because of the interconnected nature of the market the number of customers on one side affects the number of customers on the other side. Demand side network externality is where the addition of a customer adds value to other customers. Many industries such as telecommunications and financial services among others tend to display demand side

externalities. Cross-price elasticity is a measure of the sensitivity of the price on one side of the market affecting the number of customers/users on the other side of the market.

(c) CityInfo needs to study and estimate the effects of this cross-price elasticity in order to develop a pricing strategy. In extreme cases, it might be appropriate to give away for free the proposition to one side of the market in order to generate users on the other side that could be charged. This is when the lost revenue from not charging is lower than the gains from charging the other side. Examples include Adobe Acrobat. Other factors to consider are, consumer preference changes in the future, competitive effects and the effect on the brand and potential future propositions.

8a) overall the question was answered very well. A good answer would have repeated a definition given in the lecture including an example. A better answer would explain two sided answers with a clear link to one or multiple examples. (some students got the concept right, however the examples were not with a two sided markets link)
8b) the question was answered of very high quality overall. A good answer explained the concept in relationship to two sided markets and gave a good example. A very good answer explained the concept in a clear and concise manner using as well graphs for support and a very logical link to the examples given.
8c) the question was answered with a varying quality. A weaker answer would generally point at cross price elasticity and the question. Good answers would show a clear understanding of Cross price elasticity, multisided markets and apply the question to the cityinfo case study. There would be a good analysis of options and a potential extension of strategic options.

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MANUFACTURING ENGINEERING TRIPOS PART IIA
Wednesday 01 May 2019, Module 3P8/3P9, Question 3

Discount Rate Data Sheet

Discount rate p.a., r	Number of years, T	Present value of £1 receivable at the end of T years, $PV = \frac{1}{(1+r)^T}$
0.05	1	0.9524
	2	0.9070
	3	0.8638
	4	0.8227
	5	0.7853
	6	0.7462
	7	0.7107
	8	0.6768
	9	0.6446
	10	0.6139
0.10	1	0.9091
	2	0.8264
	3	0.7513
	4	0.6830
	5	0.6209
	6	0.5645
	7	0.5132
	8	0.4665
	9	0.4241
	10	0.3855
0.15	1	0.8696
	2	0.7561
	3	0.6575
	4	0.5718
	5	0.4972
	6	0.4323
	7	0.3759
	8	0.3269
	9	0.2843
	10	0.2472
0.20	1	0.8333
	2	0.6944
	3	0.5787
	4	0.4823
	5	0.4019
	6	0.3349
	7	0.2791
	8	0.2326
	9	0.1938
	10	0.1615