



EXAMINATION SOLUTIONS

(to accompany the examination paper sent to the external examiner
but NOT to be seen by students)

Programme:	BEng Mechanical and Manufacturing Engineering; BEng Extreme Sports Engineering; BEng Energy and Environmental Engineering BEng M/Sport. M/Cycle, Auto Engineering	Level:	5
Module:	Management Innovation & Sustainability M5X01176		
Authors:	Andrew Thorn & Mark Sandford May 2018	Page:	

Q 1	Question	Marks
a)	Mr Whitewall a sole trader is deciding whether or not to start a new business offering a mobile tyre fitting service. Mr Whitewall is preparing a business plan that he will eventually present to a national bank in order to apply for a business loan. Mr Whitewall has identified some capital expenditure that he will need to make to establish the business. Mr Whitewall is envisaging that the equipment will be used for three years after which he will be able to sell it for 25% of the original purchase price.	4Marks
	High top long wheelbase transit van £22,000	
	Portable petrol compressor £ 2,000	
	Portable electrical generator £ 1,000	
	Tyre fitting machine £ 3,500	
	Trolley jacks, rackng etc £ 500	
	Vehicle fitment £ 1,000	
	Total £30,000	
	Calculate the depreciation using:	
	Straight line method	
Using $D = (C - R) / L$		
D= annual deprecistion		
C= original cost		
R= residual value		
L= asset life in years		
$D = (30,000 - 7,500) / 3$		
D= 7,500 per annum		

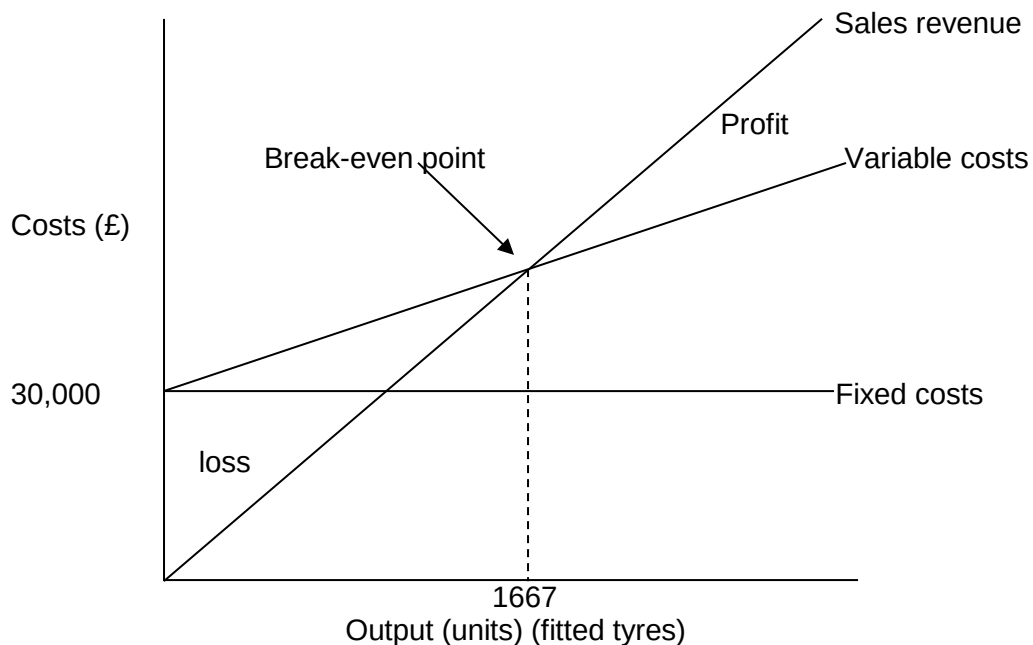


b)	Reducing balance method Reducing balance method D= 1- cuberoot(R/C) x 100 D= 1- cuberoot (7,500/30,000) = 0.6934 D= 1 – 0.6299 x 100 D= 37.01% <table><tr><td>Cost year 1</td><td>30,000</td></tr><tr><td>Less 37%</td><td>11,100</td></tr><tr><td>Value year 1</td><td>18,900</td></tr><tr><td>Less 37%</td><td>06,993</td></tr><tr><td>Value year 2</td><td>11,607</td></tr><tr><td>Less 37%</td><td>04,295</td></tr><tr><td>Value year 3</td><td>07,312</td></tr></table>	Cost year 1	30,000	Less 37%	11,100	Value year 1	18,900	Less 37%	06,993	Value year 2	11,607	Less 37%	04,295	Value year 3	07,312	6marks
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c)	Discuss the advantages and disadvantages of using the straight line and reducing balance methods. Which method of calculating the depreciation is likely to be most appropriate for use in Mr Whitewall’s business case preparation, and why. Candidates should identify that the straight line method is easier to calculate and simple to use, however the method assumes that assets depreciate at a constant rate. The reducing balance method is more complicated but does recognise that a new fixed asset tends to lose more value in the early years than in the latter years. For a motor vehicle the reducing balance method would be the most appropriate for a business plan as it reflects the depreciation profile regularly seen.	5marks														
d)	Mr Whitewall has incurred fixed costs of £30,000. Whilst running his business he incurs: direct costs, variable cost and variable overheads (eg carcass disposal) taken together produce an average cost of £57 per tyre. Mr Whitewall is expecting to change 238 tyres per month.. A finished tyre sells on average for £75. Candidates are required to calculate the break-even point. Break-even point = $\frac{\text{Fixed costs}}{\text{Selling price per unit} - \text{Variable costs per unit}}$ Break-even point = $\frac{30,000}{75 - 57}$ Break-even point = 1667 units (tyres)	4marks														



e)

Candidates are required to draw a break-even chart that shows the firms current position.



6marks

Q 2	Question	Marks
a)	Candidates are required to explain how the six requirements of change can be utilised to make the process of change management easier. The first requirement is to have a group of people at leadership level who believe that change is required. More than that, they must believe that “change management” is required. If these factors is assured. The second requirement is that the people undergoing change must have a reason to believe the change is necessary. They need the bigger picture painted for them to understand what benefits the organisation will gain from what many people will consider as the shared pain of change. Organisational change for organisational change's sake is likely to fail to deliver change. The third requirement is that individuals must know how the change will affect them as individuals. The greatest motivational tool is to be able to respond to the question “What’s in it for me?”	



	The fourth requirement is to “Tell them early, tell them often.” Do not be surprised how many times the message needs to be repeated to the same people. Tell them the compelling reason for the change, the plan for change, the progress of the plan for change including any early wins and their role in change, again and again as the project is implemented. The fifth requirement is to be honest about the change. If there is any bad news say so. If jobs are going to be lost, say so. If there are going to be challenges with the change say so. If people are going to have to re-skill, say so and if targets are going to become much tougher, say so. The sixth requirement is to utilise project management processes and skills. Project management processes and outputs play a big part in both planning and communicating the changes anticipated. They assist in risk management, contingency planning, change control, resource management, prioritisation and post implementation review of the change.	15 marks
b)	Candidates are required to discuss why change management programmes often fail. Suitable answers include: - • Allowing too much complacency and making assumptions that people will willingly follow what is proposed • Failure to generate sufficient resources to see the proposed changes through • Failure to communicate effectively and continuously with everyone involved • Lack of honesty and integrity especially when further changes are required • Top management is frequently unreasonable in its expectations and timescale, forgetting the process it went through when it decided to make the change • Resistance to change may be active or passive, individual or organised, aggressive or timid and on occasions totally justified. • Failure to reward people for their efforts • Failure to deliver to people those rewards which were promised or strongly indicated • Becoming side tracked into operational problems and issues • Failure to create or publicise short term advantages, wins and successes Credit will be given for relevant answers.	10 marks
Q 3	Question	Marks
a)	Candidates are required to calculate the full cost of making the gauges. Firstly, candidates need to calculate the overhead costs (indirect costs) per hour. Overhead costs are as follows:	



	Indirect Labour costs £2,500 Depreciation of machinery £4,000 Rent and rates £6,000 Heating and lighting £4,000 Indirect materials £10,000 Total £36,000 Now calculate the overhead cost per hour Overhead costs p/h = Total overhead costs / Direct labour hours = £36,000 / 6000 = £6 per hour Total overhead costs per gauge are 8 hours x £6.00 = £48.00 Now calculate direct labour costs Each gauge requires 8 hours direct labour Direct labour cost per gauge = 8 x (£70,000 / 6000) = £93.33 Material costs £105 Now calculate the total cost of each element (materials, labour and overheads). Seventy five gauges are required Material costs = 75 x £105.00 = £7,875 Labour costs = 75 x £93.33 = £6999.75 Overhead costs = 75 x £48.00 = £3,600 Total cost of the job is £18,474.75 or £18,500	2 marks
b)	Candidates are expected to calculate the price the company should quote for the job based on a 25% profit. 25% profit = Full cost of job x 0.25 25% profit = £18,475 x 0.25 25% profit = £4,618.75 or £4,619 Price quoted = Full cost of job + 25% profit Price quoted = £18,475 + £4,619 Price quoted = £23,094	2 marks 2 marks
c)	Candidates are required to evaluate three steps the company could take to reduce costs. These include: - • Trying to reduce the costs of raw materials by finding alternative suppliers who can supply goods cheaper and negotiating better deals with existing suppliers to reduce unit costs	



	- Trying to reduce overhead costs by implementing energy saving measures or looking to see if energy can be purchased cheaper - Adopting lean principles to eliminate waste in manufacturing areas - Reducing labour costs if possible - Outsourcing manufacturing to a low cost country This is not an exhaustive list and credit will be given for relevant answers.	9 marks																																																												
Q 4	Question	Marks																																																												
a)	Candidates are required to determine a suitable location for a distribution centre using the centre of gravity technique. First of all candidates need to calculate values for the X weight and Y weight respectively. This is done by multiplying the value for x or y by the respective demand. For example Supplier 1 X weight = X coordinate x X Demand = 87 x 86 = 7482 Y weight = Y coordinate x Y Demand = 18 x 86 = 1548 <table><tr><th>Location</th><th>X</th><th>Y</th><th>Demand</th><th>X Weight</th><th>Y Weight</th></tr><tr><td>Supplier 1</td><td>87</td><td>18</td><td>86</td><td>7482</td><td>1548</td></tr><tr><td>Supplier 2</td><td>74</td><td>33</td><td>74</td><td>5476</td><td>2442</td></tr><tr><td>Supplier 3</td><td>12</td><td>75</td><td>92</td><td>1104</td><td>6900</td></tr><tr><td>Supplier 4</td><td>94</td><td>18</td><td>22</td><td>2068</td><td>396</td></tr><tr><td>Customer 1</td><td>52</td><td>31</td><td>87</td><td>4524</td><td>2697</td></tr><tr><td>Customer 2</td><td>36</td><td>87</td><td>96</td><td>3456</td><td>8352</td></tr><tr><td>Customer 3</td><td>24</td><td>63</td><td>64</td><td>1536</td><td>4032</td></tr><tr><td>Customer 4</td><td>16</td><td>71</td><td>53</td><td>848</td><td>3763</td></tr><tr><td>Customer 5</td><td>38</td><td>52</td><td>79</td><td>3002</td><td>4108</td></tr></table> Once the values have been calculated the total values need to be calculated for the demand, X weight and Y weight. Demand = 653 units X Weight = 29,456 Y Weight = 34,238 Now calculate the X and Y coordinates for a potential distribution centre. $X_o \text{ or } Y_o = \frac{X \text{ or } Y \text{ Weight}}{\text{Total Demand}}$ $X_o = \frac{29,496}{653}$ $X_o = 45.2$ $Y_o = \frac{34,238}{653}$	Location	X	Y	Demand	X Weight	Y Weight	Supplier 1	87	18	86	7482	1548	Supplier 2	74	33	74	5476	2442	Supplier 3	12	75	92	1104	6900	Supplier 4	94	18	22	2068	396	Customer 1	52	31	87	4524	2697	Customer 2	36	87	96	3456	8352	Customer 3	24	63	64	1536	4032	Customer 4	16	71	53	848	3763	Customer 5	38	52	79	3002	4108	8 marks <
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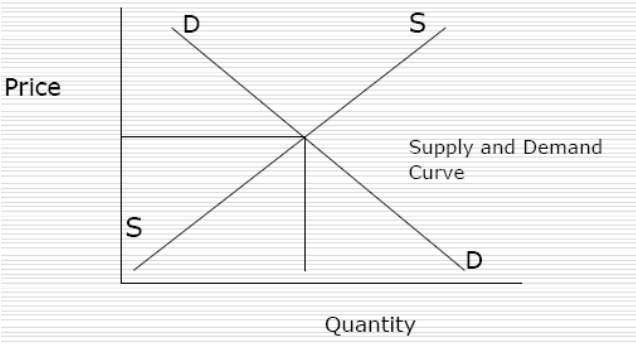
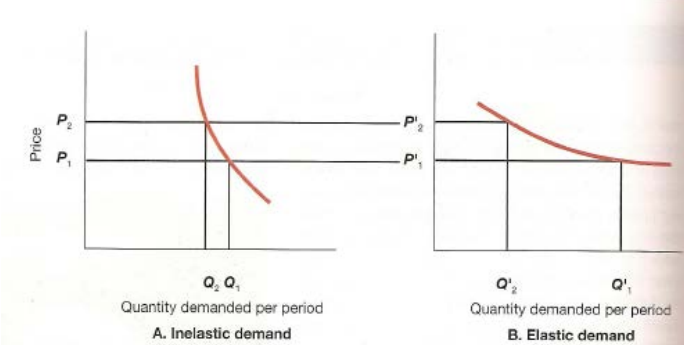
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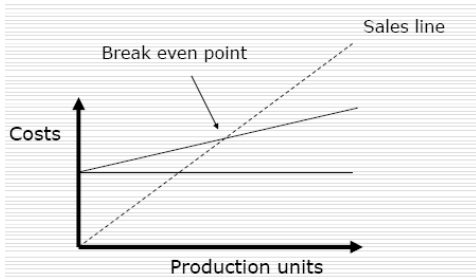
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b)	$Y_O = 52.4$		
	A good place to start looking for locations is around coordinates (45.2, 52.4)		
	Candidates are required to discuss some of the pressures that logistics organisations are currently facing. These include: -		
	• Customers are more knowledgeable and demand higher quality, lower costs and better service		
	• Competition is getting fiercer, and organisations must look at every opportunity to remain competitive		
	• There is changing power in the supply chain and customers demand customised logistics from their suppliers		
	• Some organisations are turning from a product focus to a process focus. This encourages improvement to operations		
	• Organisations are introducing new types of operation, such as lean logistics, agile supply, fully flexible supply chains, time compression, etc.		
	• There have been considerable improvements in communication. These allow satellite navigation, RFID, vehicle tracking systems, item coding, shared knowledge systems		
	• Attitudes towards transport are changing because of increased congestion on roads, concerns about air quality and pollution, broader environmental issues and government policies for real cost of road transport		
	• Organisations are outsourcing logistics more with specialised companies offering a range of services.		
	This is not an exhaustive list and credit will be given for relevant answers.		



Q5	Question	Marks
5 a	The price set for a product or service is often related to supply of, and demand for, that product. A) The student should explain the relationship between supply and demand and pricing. (2 marks) 	4 marks
5 b	i) The student should analyse the relationship between price and demand for the tyres and fuel by comparing the different elasticity. Consumption of fuel is generally independent of price (at least in the short to medium term) So the price is very inelastic, fuel is not very price sensitive. This contrasts with van tyres where the market is competitive and any brand is price sensitive, reduce your price and the consumer will switch. 	6 marks
5 c (i)	A company have developed an innovative crash helmet for road and track use. The helmet is about to be released to the market and the company need to set a price for the product. Naturally the company wish to set a high price. What factors should the company consider in deciding on the price to the potential consumer for the helmet? The student should suggest two approaches. Understanding the consumer Understanding the costs of production and sale. Costs cannot be ignored, but pricing must be consumer or customer orientated, hence	



	1. Identify the potential consumer or market, market survey, potential alternative products. 2. Demand estimation, potential volumes, competitive environment 3. Anticipating competition prices and reactions, discounting. 4. Market share analysis, what is acceptable Cost analysis The student should explain that to ensure profitability, prices must ultimately exceed costs All costs must be considered, production, marketing etc The student could sketch a cost volume diagram 	9 marks
5 c (ii)	☐ Pricing strategy should begin with the consumer and work 'backwards' to the company What pricing strategies could the company consider when entering this mature and competitive market? (6Marks) For pricing strategies the student could suggest and explain the relevance of Cost plus pricing Market skimming if/as the product is sufficiently innovative or novel, this would be the preferred option. Penetration pricing to establish some market share	6 marks

Q6	Question	Marks
6 a	The governing body of the World Rally Cross Championship are considering some significant rule changes to the technical regulations in order to attract more entrants, TV/media coverage and increase the relevance to potential sponsors amidst the current economic and environmental climate.. Possible changes being considered is to allow/encourage the adoption of technologies to reduce the environmental impact of race vehicles. Technologies such as Hybridisation, Full Electric Vehicles etc should be considered. Briefly discuss possible reasons for the governing body to consider these changes. The candidate should discuss the potential adoption these technologies: The governing body – automotive relevance, interest from VM's, greenification of motorsport. The business - advantages to teams, publicity, costs, potential sponsorship The technology – size, relevance, safety complexity.	4marks



6 b	a) Analyze the driving forces affecting the governing body to incorporate environmental changes to the technical regulations by using the PEST/STEP analysis framework. The candidate should perform a PEST analysis on the marco environment. The list bellows is not exhaustive but provides examples. Political Supporting the political agenda Seen to be green Supporting government agendas Green pressure groups Emissions legislation CO2, noxious gasses (4 marks) Economic Expensive to design and develop Extra spares required Potential new sponsorship avenues. Additional staff & facilities required. (4marks) Social Consumer buying patterns Satisfying consumers green agenda Fashion for performance upgrades Fashion for vehicle downsizing Increased use of KERS / hybridisation again for marketing and sales (4 marks) Technological Effect brake stability Effect on vehicle mass Effect on servicing requirements and safety Ease of installation OEM's offering more base vehicles with hybrid capability – technology transfer OEM's providing more 'niche' vehicles Competing technologies such as flywheels batteries, supercaps. Improving vehicle stage performance (especially for restricted engines) Possibilities to 'down size' IC engine. Ever more complex donor vehicle powertrain management systems making KERS/hybrid integration more complex (4 marks)	16marks
6 c	Following the results of your analysis; what advice would you offer the governing body and the teams on the potential adoption of environmental changes to the technical regulations? An open question for the candidate, suggestions could include: Improve the green credentials Target for smaller engines, promote concept of downsizing More potential sponsorship	5 marks



	Probably need market survey, sound out VM's etc Technical and cost impact on teams – study required Safety considerations – study required. Diversify within technology and equipment What other markets could be addressed with similar technology? What spin offs into road vehicle technology? Consider maintaining entertainment spectral.	

Q7	Question	Marks
7 a	Engineers have a duty of care to provide goods and services that are 'fit for purpose'. There are often pressures to bring products or services to market rapidly, or introduce innovative technologies to motorsport vehicles. a) A junior design engineer working for a race team. During the current season the vehicle has not been performing well, the drivers and lead engineers are despondent. The sponsor is disappointed. The junior designer with a colleague have an innovative idea and they rapidly produced a prototype suspension component out of carbon fibre. This prototype was demonstrated to improve performance and the driver wanted to use it at the next event. However the engineer has concerns about the as yet untested component durability. Explain the concept of 'harm'. Outline the pressures and ethical issues affecting the engineer. Suggest possible courses of action. The student should ; Suggest that 'harm' is physical or emotional harm to any stakeholders. Discuss that the pressure to run the prototype components is high due to the potential competitive advantage the team would benefit from. But there is a possibility of harm to driver, other competitors, marshals and the viewing public. Possible damage to circuit/safety fencing causing costs and delay to the event. Possible adverse publicity. -Possible courses of action could include: Do nothing, let the components be used Stop running bits and continue on std 3 month development programme Ask a higher authority – discuss the situation with stakeholders. Outline any alternative strategies that could establish component robustness in the shortest possible timeframe. Sometimes people do not feel comfortable taking an ethical stand against a decision that they do not feel is ethically correct. Later they may come to regret that decision.	8 marks
7 b	b) Suggest a number of reasons (or excuses) that people use in order to not make an ethical stand. Use examples as appropriate.	



	☐ Denial of responsibility ■ What can I do? ■ My arm is being twisted ☐ Denial of injury ■ No one was really harmed ■ It could have been worse ☐ Denial of victim ■ They deserved it ■ They chose to participate ☐ Social weighting ■ You have no right to criticise us ■ Others are worse than us. ☐ Appeal to higher loyalties ■ We did it for a more important cause ■ I would not report it 'cause I'm loyal to Co. boss, colleagues ☐ Metaphor of the ledger ■ We've earned the right ■ It's ok to surf the web, 'cause I do overtime	8 marks
7 c	Generate a series of questions that someone could ask them self when faced with an ethical dilemma. The list should help them evaluate possible courses of action. 1. Have you defined the problem accurately? 2. How would you define the problem from the other side of the fence ? 3. How did the situation occur in the first place ? 4. To whom and to what do you give your loyalty as a person and as a member of a company? 5. What is your intention in making this decision ? 6. How does this intention compare with probable results? 7. Whom could your decision or action harm? 8. Can you discuss the decision with affected parties before making it? 9. Are you confident your position will be as valid over a long time as it appears now ? 10. Could you disclose your decision without a qualm to CEO, the board, family & friends? 11. What is the symbolic potential of your action if it is understood or misunderstood? 12. Under what conditions would you allow exceptions to your stand?	9 marks



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