A LEVEL
DESIGN AND TECHNOLOGY
(PRODUCT DESIGN)
FOR TEACHING FROM 2017

2019 EXAMINATION

COMPONENT 1 OER MATERIAL (ANNOTATED)

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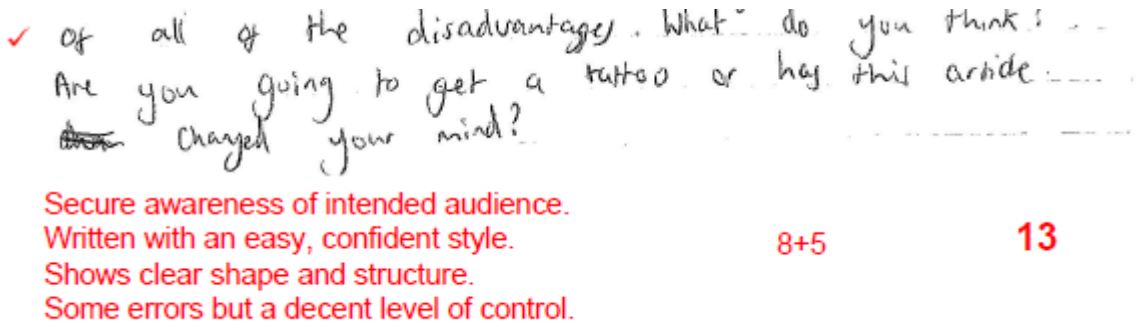

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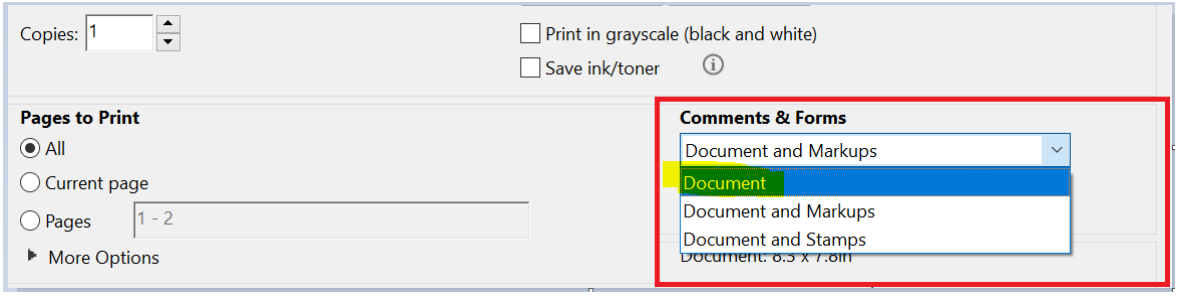

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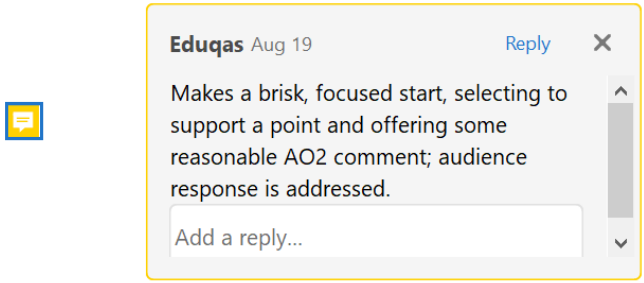

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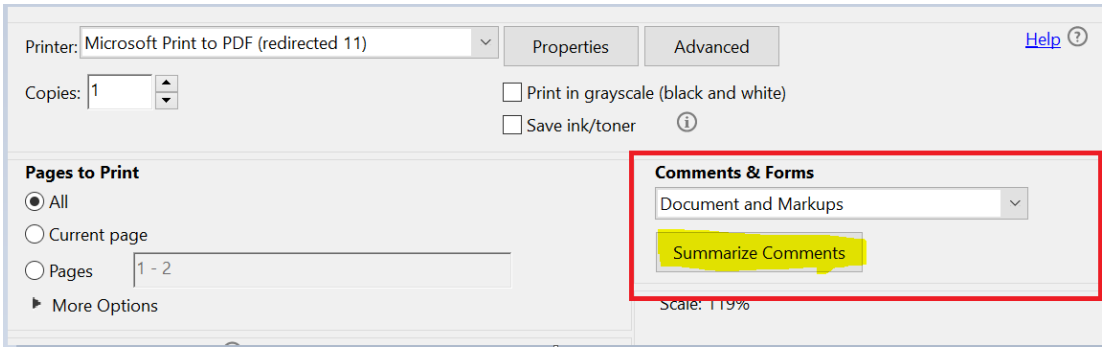

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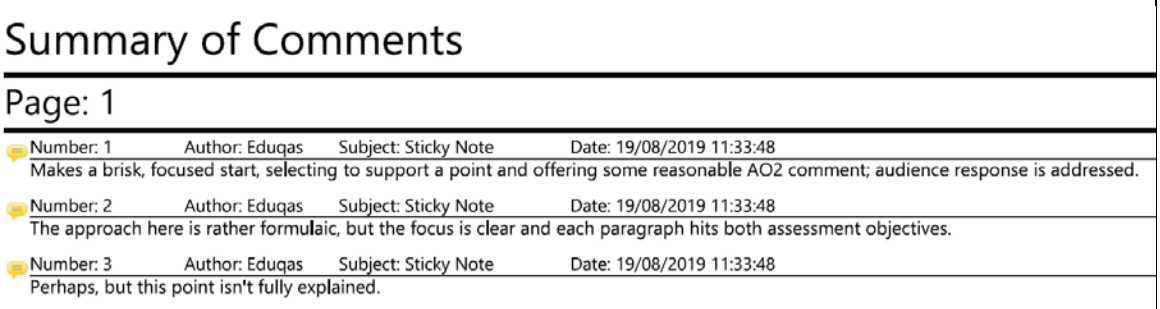

8. Many companies are now reconsidering their environmental and sustainable credentials. When they design products they often 'design for maintenance' by the consumer in order to extend the product's life.

Using named examples, explain how designers are making products 'maintainable' by the consumer in order to extend the product's life and analyse how this impacts on the environment.

[9]

Question 8

Many companies are now reconsidering their environmental and sustainable credentials. When they design products they often 'design for maintenance' by the consumer in order to extend the product's life.

Using named examples, explain how designers are making products 'maintainable' by the consumer in order to extend the product's life and analyse how this impacts on the environment. [9]

Q 8	Science	Maths		AO3		AO4					Total
				2a	2b	2a	2b	2c			
				6				3			**9**

Candidates should provide evidence of *logical reasoning* or *deconstructing information* and *applying* this to be awarded up to 9 marks. Focus should be on the analysis of the factors, though candidates are expected to apply knowledge and understanding of designing and making principles in the deconstruction of information and discussion.

Answers must be related to functional and environmental factors affected by a 'designed for maintenance' methodology.

Maximum of 6 marks if specific named product/s are not identified.

Ways in which manufacturers have designed for maintenance may include:

- Electronic products capable of having software updates to fix bugs
- Designed using common fixtures and fittings so the user can easily source replacements
- Make parts of the product that are likely to wear and tear easy to remove from the main product and replace. Effective design leading to intuitive fixing means consumers feel more confident fixing products rather than buying new. An example of this is the Dyson vacuum where colour coding is used to identify fixings that can be removed by the user without the use of specialist tools.
- Modular design using sealed units that can be 'clicked' together
- Reduced number of fixings and simpler design so it is easier to maintain
- Make it easy for the user to quickly identify faulty parts to ease with diagnosis
- Make it easy to source and order replacement parts
- Products may use industry standard fixings, or brand specific fixings that are the same across the product range, this will ensure replacement parts can be made available even if the product model is no longer in production
- Provision of maintenance guides for reference by the user. These can take any form from paper copy through to YouTube tutorials.
- Some companies offer cash-back for old products which means they are able to disassemble and recycle the materials
- Manufacturers are choosing stronger, more durable materials that are less likely to break

Environmental impact, answers may include:

- Products being replaced less often leads to less going to land fill
- Smaller parts or sub-assemblies being purchased (rather than whole product) leads to smaller parcels for shipping –reduction of carbon foot print
- Products being replaced less often leads to less demand for raw materials
- Products that easily disassemble are easier to recycle

Credit any other appropriate response.

Band	Marks	AO3 2a	Marks	AO4 2c
3	**5-6**	Excellent analysis of the 'designed for maintenance' factors that need be considered when designing a named product. A thorough discussion, which deconstructs information and demonstrates logical connections and reasoning throughout. Well-considered, relevant functional factors and environmental factors used as a context for the discussion	**3**	Applies a thorough knowledge and understanding of designing and making principles to the selection of materials, fixings techniques for a 'maintainable' product, with well-considered relevant functional factors and environmental factors identified.
		There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured.		
2	**3-4**	Good analysis of the 'designed for maintenance' factors that need be considered when designing a named product. A generally sound discussion, which deconstructs information and provides adequate connections and reasoning. Generally well-considered and relevant factors used as a context for the discussion	**2**	Applies a generally sound knowledge and understanding of designing and making principles to the selection of materials, fixings techniques for a 'maintainable' product, with generally well-considered factors identified.
		There is a line of reasoning which is generally coherent, mainly relevant and with some evidence and structure.		
1	**1-2**	Limited analysis of the 'designed for maintenance' factors that need be considered when designing a named product. Little evidence of deconstructing information and limited connections are made. Few factors are identified.	**1**	Applies a basic knowledge and understanding of designing and making principles to the selection of materials, fixings techniques for a 'maintainable' product.
		There is limited evidence of relevant examples or structure.		
	0	No response or work that is worthy of a mark		

Write the two digit question number ***inside*** the boxes next to the first line of your answer

Answer

0 8 Designers are designing products that have parts that can be easily replaced so that consumers can repair products instead of throwing them away and buying new ones. An example of this would be James Dyson designed his vacuums so that if a part of it broke that part could be easily fixed by purchasing the component that broke online rather than disposing of the whole vacuum and buying a new one. Designers are also designing products for disassembly which means products can be easily taken apart after their use without breaking any components this allows and encourages the user to recycle the product and sometimes recieve a monitary gift back as an incentive. A company that does this is ~~eg~~ Apple with their iPhone recycling scheme. Consumers can trade in the older models for money that can be used to purchase a newer one. In order for the user to recieve any money the phone has to be in good condition therefore it encourages the consumer to look after the phone. Once it has been handed in the components can be re-used by the company. ~~Exam~~

Designers are also using stronger and

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Answer

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0 8 more hardwearing materials that would last longer. ~~The~~ Many super-markets have discontinued the supply of single use plastic bags and replaced them with either jute bags or more durable plastic bags that can be easily re-used. This reduces the amount of single use bags that end up in landfill or in the oceans which all have detrimental impacts on the environment.

Providing the consumer with clear after care instructions as well helps them maintain and extend a products life.

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Answer

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Designers are making products more 'maintainable' by using longer-lasting materials. For example, Dyson uses ABS, a plastic. They have specially designed the products so that, if a part breaks, it can be easily replaced so that the whole product does not have to be replaced. The impact on the environment, because of this, is minimal. It means that the products lifespan is longer so much less waste is produced. Generally, designers make products with a certain lifetime so that customers come back to buy more. However, as more customers seek longer living products, designers are changing the design. Dysons contra-rotating washing machine uses water jets and cyclonic technology to reduce the amount of water used and time to reduce the time for each cycle. This has made the product less energy intensive and given them a much longer lifetime because they are more efficient both in their water and energy use. Another innovative design aiming to make the product more maintained is the Ford electric car. This is powered by electricity instead of fuel. This has extended the lifetime of these products because there is a growing decline of fuel. Electricity, however, can be powered by a range of things. This means that as cars are losing the amount of fuel available to them, electric cars are gaining. There have, however, been changes to car design to make them more 'maintainable'. Many designers, like Ford and BMW, have tried to increase the fuel efficiency of cars. This means that they can travel more miles per litre of petrol/diesel. This reduces the amount of carbon dioxide and other polluting gases released from cars, which are a leader in emissions. Similarly for electric

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Answer

they often can only travel very short distances before needing recharging. Tesla have been a leader in trying to increase the distance travelled and have succeeded in reaching 400 miles before needing recharging. Therefore, as you can see, many everyday UK products are trying very hard to extend the products life and decrease the products impact on the environment.

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Answer

0 8

Companies are required to reconsider their environmental and sustainable credentials. This is extremely significant in the current contexts as the environmental damage manufacturers and consumers are producing is threatening. Designers are now making products more durable in that they are extending product's life cycles. A large amount of this 'maintainability' that designers are reverting to is the idea of reuseability.

An example of this is plastic bottles that are used once and thrown away. The throwaway culture of consumers is coming to an end through companies such as 'Chilly's bottles.' Instead of using blow injected PET bottles and others, Chilly Bottles have created a trend of using bottles made of stainless steel. This use of material is encouraging reuseability in the market and the design has been copied by multiple others.

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Answer

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As well as decreasing use of throwaway plastic bottles, this use of stainless steel keeps drinks hot for 12 hours and cold for 24 hours. Not only has the change of bottle material decreased water purchases, but also benefits the customer's wants.

Another example of this environmental change in the market has evolved use of plastic bags. Not only are supermarkets such as Tesco, Asda and Lidl, charging for polythene ~~bags~~ bags, they are batch producing cotton tote bags, and acrylic fibre bags. These promote reusability and last for a long time, which makes the consumer want to reduce spending 5p each time they require a plastic bag. This is helping the environment in that less plastic pointless plastic use is slowing its manufacture and supply - so there is less plastic pollution.

Cars are also evolving and becoming more economical and maintainable through use of hybrid / rechargeable cars. Brands such as BMW and Tesla have taken the technology pushing innovation and better fuel consumption and greenhouse gas emissions. As well as these cars becoming better for the environment, they are more efficient and so will have an extended product life cycle.

9. Explain how CAD/CAM technologies have facilitated a truly global workforce in terms of the design and manufacture of products. [9]

Question 9

Explain how CAD/CAM technologies have facilitated a truly global workforce in terms of the design and manufacture of products. [9]

Q 9	Science	Maths		AO3		AO4					Total
				2a	2b	1a	1b	1c	2b	2c	
							5		4		**9**

Candidates should demonstrate knowledge and understanding of technical principles and design and making principles and apply this to be awarded up to 9 marks based on:

CAD

- Allows for design teams to work simultaneously on the same drawing from different locations
- CAD drawings using standard conventions such as BSI mean that language barriers can be avoided – translation to CAM manufacture leaves little room for misinterpretation
- Designs can be developed 24 hours a day, as a design team in one location may be ending their work day, another team may only be starting
- Digital documents can be accessed anywhere, anytime so designers do not need to be tied to a specific geographical location.
- Brands such as Alessi make use of global design talent – designers can live anywhere while manufacture happens mainly in Italy
- CAD allows for expertise to be identified and employed from any part of the globe rather than having to rely on talent relocating to a specific office
- Small changes and iterations can be made easily, making small changes required for different geographical locations more efficient. E.g. electronics such as DVD players

CAM

- Manufacturing can happen in any geographical location and companies can make use of cheaper manufacturing costs in some locations (with awareness of moral and ethical considerations)
- CAD files can be read by CAM machines such as water jet cutters or CNC routers therefore increasing accuracy and making QC easier to control
- The speed of digital transfer allows manufacture to start almost instantly (save for set up time)

Candidates need to demonstrate knowledge and understanding of how CAD/CAM have impacted on a global company and a global workforce. Comparison with traditional methods of design/manufacture such as hand-drawn working drawings/hand manufacture can be used as an alternative. Do not accept unqualified assertions such as quicker, easier or faster.

Credit any other appropriate response.

Band	Marks	AO4 1b and 1c	Marks	AO4 2b and 2c
3	**4-5**	Demonstrates and applies a thorough knowledge and understanding of technical principles in the context of the CAD/CAM theme. Well-considered, relevant wider issues identified.	**3-4**	Demonstrates and applies a thorough knowledge and understanding of designing and making principles in the context of CAD/CAM, drawing upon well-considered, relevant examples. .
		There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured.		
2	**2-3**	Demonstrates and applies a generally sound knowledge and understanding of technical principles to the context of the CAD/CAM theme. Generally well-considered, relevant issues identified.	**2**	Demonstrates and applies a generally sound knowledge and understanding of designing and making principles in the context of the CAD/CAM. Generally well-considered examples are provided.
		There is a line of reasoning which is generally coherent, mainly relevant and with some evidence and structure.		
1	**1**	Demonstrates and applies a basic knowledge and understanding of technical principles to the context of the CAD/CAM theme. Few issues are identified.	**1**	Demonstrates and applies a basic knowledge and understanding of designing and making principles in the context of CAD/CAM. Few examples are provided.
		There is limited evidence of relevant examples or structure.		
	0	No response or work that is worthy of a mark		

Write the two digit question number ***inside*** the boxes next to the first line of your answer

Answer

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0 9 Computer aided design ~~has~~ (CAD) has ~~a~~ created more efficient ways of designers producing and drawing designs. CAD software is more accurate than hand drawing and allows quick and easy changes to be made to designs without having to redraw the whole design. Softwares such as sketch-up and Prodesktop can be used to produce models of designs which can be easily sent globally from designer to client over e-mail the client can then easily email back any adjustments and edits they have for the designer and the designer can implement them with

Write the two digit question number ***inside*** the boxes next to the first line of your answer

Answer

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a few clicks. CAD Designs and drawings especially 3D surface models can have mathematical tests ran on them and also stimulations. These models are made mathematically and can be tested for aerodynamics, centre of gravity, strength and resistance to various conditions. If the company has an efficient production data management system all of these designs can be accessed from one central place which allows for efficient data exchange.

~~CAM~~ computer Aided manufacturing (CAM) produces highly accurate and of high quality products using computer numerical control. Data from CAD software can be easily sent or inputed into a CAM machine such as a laser cutter or a CNC lathe and then the machine will produce the designed product very quickly. In the use of rapid prototyping CAM machines such as a 3D printer can use a filament like ~~ABS~~ or PLA and quickly produce a small model of a part using multi layer additive manufacturing. The same data can be sent globally to a similar machine and the exact same product will be produced without the need to fly a specialist out there. Since these machines are quick it reduces production times and other parts of the product

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Answer

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0 9 can be started.

Write the two digit question number ***inside*** the boxes next to the first line of your answer

Answer

global market → design → manufacture

9 Computer-aided design (CAD) is a truly revolutionary way of designing products. Because they are online, designs can be easily sent between computers, no matter where they are. With this back and forth emailing, designers can quickly make alterations to the product without needing to wait send designs via the post, taking a very long time and having higher costs. Once the design has been approved, it can be sent to the manufacturer ready for production. This helps with the division of labour. This means that headquarters are and research and development tend to be in developed countries whilst manufacturing is often in developing countries, with cheaper costs. This is the way for the global workforce. With CAM aiding this by reducing lag time and production time because designs, queries and messages can be sent instantaneously from around the world. This is an example of remote manufacturing, where clients, designers and manufacturers are in different parts of the world. Computer-aided manufacture (CAM) has also played an excellent role in facilitating the global workforce. This is because it has meant that manufacturing processes mean more simple for the workers so lower-skilled employees are required. This means that manufacturing can occur.

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Answer

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in developing countries. This has made the workforce much more global because within one company, people are employed all around the world. Computer-aided manufacture is much more accurate than hand manufacture, this means it facilitates the global workforce by creating higher quality products. The speed of CAM is also immense as some could run for 24 hours, meaning more products are made and manufacturing is more efficient. This mean products can be shipped around the world quicker. Standardised components (created by computers) are often used in manufacturing. This facilitates the workforce because it means more people are employed in different companies.

Write the two digit question number ***inside*** the boxes next to the first line of your answer

Answer

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0 9

CAD and CAM technologies have enabled mass innovation within the market and have ~~provided~~ facilitated a global workplace. The ease of designing and manufacturing is growing evermore efficient with the use of computer aided design, and computer aided manufacture.

Write the two digit question number ***inside*** the boxes next to the first line of your answer

Answer

Computer Aided Design technologies have evolved designing immensely. The ability to design 3D models on programmes and control/ adapt them makes it so efficient for market research. CAD designs can be viewed from all angles, 3D and 2D as well as provide walk throughs and zoom-ins. This makes it easy for designers and target audiences to have an accurate look at what their product will look like. CAD designs can also be rendered finishes and variations of colours by the click of a button. This allows for easy developments and gives the audience a chance to see the product in variations of its possible design. The portability of CAD designs also makes for an efficient viewing. CAD designs can be shared all across the globe and provide the possibility for consumers to view and approve designs without needing to physically hold the products. Another feature CAD designs also have is the ability of aesthetic and performance tests - programmes can put a series of tests on a product to see if it works well, such as a weight test. Programmes such as 2D Design and Google SketchUp.

Computer Aided Manufacture technologies have allowed for excellent prototyping and manufacturing of products. For example the laser cutter can cut/ engrave varying materials of many thicknesses and sizes very quickly. There is also little to no human error involved. The 3D printer is also a successful innovation in manufacturing as it can produce any shape one could want and provide accurate, identical products quickly. The use of CAM technologies relies lots of computers, instead of

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Answer

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people, ~~so~~ which means in ~~a factory~~ manufacturing, there is lower staffing costs as less staff are required.

Computer Aided design and manufacture has brought about big advancements in products, making them easier to produce.

10. Evaluate the advantages and disadvantages to the designer and manufacturer of using concurrent engineering for either high volume consumer products such as mobile phones or large complex one-off projects such as a modern ocean liner. [12]

Question 10

Evaluate the advantages and disadvantages to the designer and manufacturer of using concurrent engineering for either high volume consumer products such as mobile phones or large complex one-off projects such as a modern ocean liner. [12]

Q 10	Science	Maths		AO3		AO4					Total
				2a	2b	1a	1b	1c			
	✓				6			6			**12**

Candidates should provide evidence of either *appraisal* and/or *making judgements* and *applying* this to be awarded up to 12 marks based on:

With concurrent engineering multiple tasks are carried out at the same time rather than in sequence.
Possible responses may include:

Advantages

- Several people or teams of people work on the same project. These can be in the same or in different geographical locations depending on where the expertise is located.
- It encourages multi-disciplined teams to work together. In some cases working across teams in this way can lead to unique and novel approaches to product design solutions as 'standard' conventions can be challenged
- Concurrent engineering allows products to get to market quicker. For consumer products such as personal electronics, this will lead to a greater market share for the company as other companies rush to catch up
- Designers, Engineers researchers and manufacturers all work together from the start of the project. This means that no-one in the team is waiting for 'early' stages of the project to be completed (unlike a 'serial' design process). The whole process is more efficient
- Can reduce the cost of the project and increases the quality of the product as all expertise are involved from the outset and support the life cycle of the project. Production issues can be identified earlier in the design process
- Increases productivity as all parties are engaged in the project from the outset.

Disadvantages

- Communication between multidisciplinary teams can be difficult to manage, miscommunication or no communication can lead to additional costs and increased project timeline.
- Iterations in the product design may not be communicated to all interested parties efficiently.
- Compromises based on 'easy' fit of solution, rather than 'best fit' may filter through.

The following may be credited as either an advantage or a disadvantage depending on how the candidate uses them in their evaluation

- Good communication is essential to avoid misunderstanding that could lead to lengthening the design/manufacturing process
- Design and technical specifications are essential to make sure all teams and individuals are working to the same set of guidelines
- All are aware that one small change to their specific area of the project can have a knock-on effect to the other teams

Credit any other appropriate response.

Band	Marks	AO3 2b	Marks	AO4 1c
3	**5-6**	Excellent evaluation of concurrent engineering used in the development of products. A thorough discussion, which appraises and/or makes judgements about the use of concurrent engineering in the development of domestic/one-off products. Well-considered, relevant wider issues used as a context for the discussion.	**5-6**	Applies a thorough knowledge and understanding of technical principles to the use of concurrent engineering in the development of domestic/ one-off products. Well-considered, relevant wider issues identified.
		There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured.		
2	**3-4**	Good evaluation of concurrent engineering used in the development of products. A generally sound discussion, which appraises and/or makes judgements about the use of concurrent engineering in the development of domestic/one-off products. Generally well-considered, relevant issues used as a context for the discussion.	**3-4**	Applies a generally sound knowledge and understanding of technical principles to the use of concurrent engineering in the development of domestic/ one-off products. Generally well-considered, relevant issues identified.
		There is a line of reasoning which is generally coherent, mainly relevant and with some evidence and structure.		
1	**1-2**	Limited evaluation of concurrent engineering used in the development of products. Little evidence of appraising or making judgements about the use of concurrent engineering in the development of domestic/ one-off products. Few issues are identified.	**1-2**	Applies a basic knowledge and understanding of technical principles to the use of concurrent engineering in the development of domestic/one-off products.
		There is limited evidence of relevant examples or structure.		
	0	No response or work that is worthy of a mark		

Write the two digit question number ***inside*** the boxes next to the first line of your answer

Answer

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1 0 The advantages of concurrent engineering are that processes such as designing and developing can be ran simultaneously instead of consecutively which leads to a reduction in production time of the mobile phone. This means the phone can hit the market as quick as possible and generate revenue very quickly. Another advantage would be that any flaws in the design would be witnessed immediately as production is occuring at the same time this means that it minimises costly mistakes that could occur ~~be created~~. Another advantage is that it allows companies to recognise and meet consumer demand quickly and make updates to the mobile phone as soon as they receive feedback this allows them to stay on top of market trends and gives them flexibility to adapt.

Disadvantages is that concurrent engineering is very difficult to set up and requires a lot of planning and patience. Also one mistakes in planning could halt the production of the mobile phone and then disappoint all the customers waiting. Especially with a high volume product like the phone a halt in production could cause a large dip in sale for the company and end

Write the two digit question number ***inside*** the boxes next to the first line of your answer

Answer

up costing a lot of money. Another disadvantage would be mistakes made during manufacturing of the phone would also cost the company a lot of money as they would have recall all the products back. Concurrent engineering requires everyone to be on the same page so an efficient communication system is required in order for people to know what they are doing and when. This includes the design team communicating with the product manager and production workers. As well as material and components suppliers supplying the components need for the phone & production like the circuit board or battery or fan on time. Also a delay in one side of the process will eventually cause a delay in the other. If the designers and software engineers delay the new update to the model of the phone what it needs to be produced can't be ordered the production of the phone slows and and release to the market is delayed. this could also cause a loss in money

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Answer

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Concurrent engineering is a way of manufacturing with lots of different groups of people who are simultaneously ~~the making~~ individually making one part of the product so that once all of the components are made, they can be assembled.

High volume consumer products like mobile phones are often made in ~~on~~ in masses due to the demand for them. Usually, the product (for mass production) is quite simple so that it can be replicated easily between each product. For more complex items, like mobile phones, concurrent engineering is excellent because it can reduce the ~~same~~ production time and time massively. Because all the ~~products~~ components are being made simultaneously, the manufacturer can meet the high demand. It also means that the products are made to a higher quality because quality control measures will ~~mean~~ be easier to carry out. Quality assurance will also improve because the workers will feel more satisfied. For the designer, they are able to make more complex designs without the worry of how long they are going to take to make because concurrent engineering will

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Answer

improve time. During manufacturing, the workers are more likely to see identify errors because they are working more specifically on a single area of the product. On a single production line, an error may only be identified much further down the line than when it occured because people are not working as closely to it.

The disadvantages are mainly about cost. It will cost more to employ more people to work on the different areas and the machinery may be more advanced so will therefore be more expensive. Some groups of people part of the product may take longer to make than others. This mean that production time may be increased as they will wait on that part of the product to be made so that it can be assembled. Concurrent engineering can be an issue when the product may suddenly be changed. For example, with mobile phones, incremental improvements occur all the time. This means that the workers and machinery need to be flexible to manufacture different versions of products. This will come at an expense.

To conclude, concurrent engineering advantages outweigh the disadvantages because it allows the product to be made of a higher quality in a quicker time.

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Answer

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Advantages :

→ Produces products quickly and ~~then~~ efficiently

→ Enables accuracy in products as they will all be identical.

→ Mass production is cheaper as same production line repeatedly used

→ & One-off production can be specialised as easy to do quality assurance and quality control tests

→ For one-off, designer can focus predominantly on best solution for the one product

→ Cheap to maintain.

Disadvantages :

→ Expensive to set-up.

→ Mass production ~~required~~ requires a large amount of staff who will lose morale as have little responsibility

→ One-Off production may become very time-consuming and disheartening for manufacturers

→ Specialisation of one-off product requires skilled staffing.

→ One-Off production ~~could~~ ~~may~~ ~~not~~ does not provide as much profit as batch or mass

→ Mass production can only have QC tests