

## Design & Technology

# Modern manufacturing systems

### Materials required for questions

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- Pencil
- Rubber
- Calculator

### Instructions

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- Use black ink or ball-point pen
- Try answer all questions
- Use the space provided to answer questions
- Calculators can be used if necessary
- For the multiple choice questions, circle your answer

### Advice

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- Marks for each question are in brackets
- Read each question fully
- Try to answer every question
- Don't spend too much time on one question

## Good luck!

**Q1.** What is a **NOT** a benefit of a robust IT system in production logistics?

- A Monitor progress easily
- B Easily access information
- C Easy to use

**Q2.** What is **NOT** a way AGV's are guided?

- A Through remote control
- B Through laser guidance
- C Through radio wire guidance

**Q3.** Why might a company buy in standardised parts?

- A Readily available
- B More reliable
- C More quality control

**Q4.** What is a **disadvantage** of using robots in production?

- A Not as safe as human workers
- B Not as flexible as humans
- C Inexpensive set up costs

**Q5.** Why might a manufacturer choose a robot over a human worker?

- A**      Able to repeat repetitive tasks
- B**      Can perform multiple roles
- C**      Cheap to maintain

**Q6.** What does CNC stand for?

- A**      Computer Numerical Coordinates
- B**      Computer Numerical Control
- C**      Computer Numerical Coaxial

**Q7.** What is not an area where AGVs can be used?

- A**      Pallet trucks
- B**      Assembly line
- C**      Trailer unloading

**Q8.** Why might a manufacture choose a human over ASRS?

- A**      Humans can spot faulty parts
- B**      Humans are cheaper
- C**      Humans are safer

**Q9.** Automated storage and retrieval systems (ASRS) are used in industry. Explain two advantages of using an automated storage and retrieval system (ASRS) **(4 marks)**

1.

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2.

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**Q10.** Draw a flow chart to represent a closed loop system. **(2 marks)**

















## Answers

Q1. C

Q2. A

Q3. A

Q4. B

Q5. A

Q6. B

Q7. C

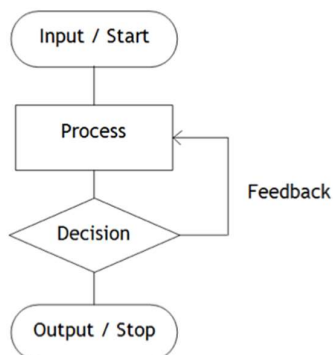
Q8. A

Q9.

- Items are located/ retrieved / delivered faster /more accurately/ right place right time (1)
- More efficient/faster business/company/production line/lean manufacturing time to market/ lead time (1)
- Items are easily catalogued / recorded/ on central database (1)
- Automatically reordered/never run out of stock/reduced human error (1)
- They can lift heavy loads (1)
- Safer/ reduced H&S issues (1)
- They can stack products in a more organised way/ higher (1)
- Reduced required floor space/land costs/better use of space
- They require very little manual input/run24/7/fully automated
- Reduced costs/ wages/ employment (1)

Q10.

- input (start), process, output (stop) (1) – all 3 required for 1 mark
- decision / feedback (1) – both required for 1 mark



**Q11.**

- Feedback/QC checks are made/used/carried out constantly (1)
- Improved/maintained control/accuracy of stock/material/product levels/quality/right first time/less faults (1)
- Improved tracking of performance (1)
- Able to predict maintenance / failure points (1)
- Early detection of faults (1)
- Reduced waste (1)
- Requires no human intervention (1)
- Reduced labour costs (1)
- Reduced human error/increased reliability (1)
- Increased/faster/quicker productivity/checking /cost saving/less time to market (1)
- Ability to adapt/make changes/decisions (1)
- More flexibility/customisation possible within the system (1)

**Q12.**

- Pallet trucks (1)
- Forklift / fork trucks (1)
- Towing vehicles / pull truck (1)
- Unit load vehicles (1)
- Light load (vehicles) (1)
- Assembly line vehicles (1)
- Heavy burden carrier vehicles (1)
- Automatic guided carts (1)

**Q13.**

- Control via a central / on-board computer (1)
- Programmed route or fixed route/path (1)
- Radio frequency wires / magnetic strip embedded in the factory floor (1)
- Painted line / floor mounted strip (1)
- Input sensors (1)
- Laser guidance (1)
- GPS guidance (1)
- Inertial (gyroscopic) navigation (1)
- Automated failsafe systems embedded in guidance systems /collision control (1) Barcode scanning (1)

**Q14.**

- Movement of materials/components to required position is controlled by computer (1)
- AGVs follow lines/buried wires/tape on/in the floor (1)
- AGVs can enter / work in dangerous areas where humans would be excluded (1)
- Materials / components are stored in a racking system (1)
- Automated use of bar code reader to identify components (1)
- Transportation via conveyor or automatic guided vehicle (AGV) (1)
- Automated transfer of component to/from transportation system via robotics/AGV forklift/crane (1)
- Faster/improves efficiency/runs 24/7 by reducing the labour required for distributing materials and components (1)

**Q15.**

- Flow (1) design of processes that result in uninterrupted flow from raw materials to delivery of the finished product (1) including the use of JIT (1)
- Pull (Kanban) (1) design of manufacturing systems for 'pull' of the product through the process (1) as a response to demand (1)
- Perfection (Kaizen) (1) adopting an approach that continually improves working processes (1) resulting in getting it right first time (1)

**Q16.**

Answers may refer to the following points:

- Efficiency
- Move from batch to flow production
- Use of total quality management (TQM)
- Just In Time (JIT)
- Flexibility of teams/manufacturing cells
- Use of flexible manufacturing systems (FMS)
- Production triggered by demand
- Less storage needed
- Less capital tied up in stock
- Use of a pull process/kanban system
- High automation including robots and AGVs
- Increased reliance on the supply chain

Expansion that can be used to justify judgements relating to positive or negative points:

- Incorporation of customer options
- More able to capitalise on change in demand
- Immediate shipping of goods
- Minimisation of waste
- Production teams take responsibility for quality
- Improved job satisfaction
- Attracts customers
- Industrial action in supply chain causes disruption
- Transport problems causes delays
- Capacity to meet large changes in demand
- Changes the roles and responsibilities of employees

**Q17.**

- They allow the company to make use of specialist manufactures of particular component, making financial savings by not having to produce the range of components themselves.
- A product manufacturer may not have the expertise or ability to produce all necessary components in house, so it would be necessary for them to use bought-in components from other suppliers and manufacturers.
- It allows companies to bulk buy from a variety of suppliers allowing them to secure the best price and unit cost.
- It can speed up the manufacturing process by ensuring that enough of the component are available.
- It provides manufacturers with the assurance of consistency meaning the components can be designed around a stock size or form, e.g. nuts and bolts
- Provides the manufacturer with peace of mind that the components will be of the correct standard as companies will have produced the components in line with ISO 9001.

**Q18.**

- A series of CNC machines are located in close proximity to each other in a cell, within a manufacturing facility to reduce the distance and time taken to move a component around a large manufacturing facility.
- Should any larger distance need to be covered automatic guided vehicles (AGV's) would be used that take the most efficient path and communicate with the other AGV's.

- The machines are organised in a logical sequence corresponding to the order in which they will be used to limit movement time and maximise efficiency.
- The loading and unloading of each machine is automated and performed by a robotic arm. This ensures accuracy and efficiency as the movement of the workpiece is programmed to take the most direct path. There is no human error in either the transfer or in the removal/installation of the workpiece.
- Some cell production may include manual machines and in these situations the operators are highly skilled and familiar with all of the machinery in their cell, allowing them to job share.
- These cells are often rewarded for their productivity and as a result there is a shared desire to hit targets which in turn has a positive effect on the efficiency of a cell.

### **Q19.**

- Components are not stockpiled so scheduled deliveries must be on time to minimise disruption to manufacture
- Delay in deliveries will affect the productivity of the manufacture, in severe cases
- Limited storage is available so stock piles must be regularly topped up and maintained
- JIT manufacture allows for flexibility on the production line so customers' orders must arrive on time and consistently in order to prevent down time
- Suppliers can be selected by proximity to the assembly plant to reduce travel time and disruption
- Machinery and layout in the factory should be optimised to allow for efficient delivery of components
- Stock is managed by computer systems
- RFID identification is used to track products through the factory and automatically select the correct parts to install and order stock when necessary



