Mark scheme

Section A – Core technical principles

Q1) A

Q2) C

Q3) A

Q4) A

Q5) C

Q6) A

Q7) A

Q8) B

Q9) C

Q10) A

Q11ai)
For the eccentric and pear cams – do NOT accept 'can rotate in either direction'

- Eccentric cam – rise and fall which are of equal length (1) Smooth motion (1) Simple Harmonic Motion S.H.M. (1)

Q11aii)

- Pear shaped cam – rise and fall are rapid (1) with a dwell (1)

Q11aiii)

- Snail cam – a smooth continuous rise (for almost 360 degrees) (1) rapid fall (1) can only rotate in one direction (1) (3 x 2)

Q12)

Pro

- It is a clean energy source with no greenhouse gas emissions. (1)
- Large amounts of energy are readily available. (1)
- The power stations are relatively small compared to other forms. (1)
- They generate only small amounts of waste. (1)
- Generation costs are relatively low. (1)
- Reliable / consistent supply (1)

Con

- Leeks from nuclear energy / waste are extremely harmful / dangerous. (1)
- It cannot easily be destroyed, but has to be securely stored for many years. (1)
- Accidents / attacks could have devastating effects. (1)
- Not in my backyard. (1)
- Developmental costs / complexity are prohibitive. (1)
- Can enable to the spread of nuclear weapons. (1)

Section B – Specialist technical principles

Q13)

- The level of moisture in the wood can be controlled accurately (1) resulting in a more reliable/consistent/even moisture content (1)
- The moisture level can be reduced to a lower/guaranteed level (1) which means the timber can be used in drier environments (1)
- The speed of the drying is much quicker (1) meaning capital is tied up for a shorter period/timber gets to the customer more quickly (1)
- Kiln seasoning is done at a higher temperature (1) therefore increasing the effective eradication of infestation in the timber (1)
- Kiln seasoning takes up less space (1) therefore reducing the need for large premises (1)
- Kiln seasoning is equally effective all year round/not seasonal (1) therefore supplier is consistently able to meet customer demand (1)

Q14)

- A jig improves accuracy by removing the need for measuring and marking out to take place each time a cut is made or a hole drilled. This removes the potential for human error throughout the marking out process.

- A jig can improve the accuracy of manufacturing a particular joint, by securely holding the workpiece while also guiding the cutting tool, eg when cutting a mitre joint in timber or when drilling a hole.
- A jig can be used to ensure consistency when manufacturing a product, eg guiding a router around a particular profile ensuring consistency and accuracy where two kitchen worksurfaces may join.

Q15)

Offset lithography	• Aluminium printing plate prepared with image and non-image areas • Plate is dampened with water (non-image areas attract water) • Ink applied (only sticks to image areas) • Image transferred to a rubber blanket cylinder • Rubber blanket prints image onto paper (indirect printing)
Casting	• Mould created in shape of final product (sand, die, or investment) • Material (usually metal or plastic) melted to liquid form • Molten material poured into mould cavity • Left to cool and solidify into shape • Removed from mould, excess material trimmed to tolerance
Extrusion	• Material heated until soft (thermoplastic or metal) • Forced through a shaped die using pressure (ram or screw) • Produces long, continuous sections with consistent profile • Cooled (air or water bath) to set shape • Cut to length; dimensional tolerance controlled by die and cooling
Flow soldering	• PCB prepped with components inserted • Flux applied to clean contact surfaces • Board passed over wave or bath of molten solder • Solder adheres to exposed metal pads and component leads

	• Ensures electrical joints are formed cleanly and consistently

Q16.1)
Shape area = 14240.87cm^2
Volume = 8544.52cm^3
Mass = 23.92kg

Q16.2)
4 doors = £95.75
Total cost = £430.92

Q17)

- CAD modelling to simulate material tessellation prior to cutting on CNC machinery.
- Greater use of CNC machinery for greater accuracy and therefore less waste.
- Low energy lighting factories.
- Electrical equipment going into standby when not in use.
- Use of renewable sources of power.
- Use of recycled materials wherever possible.
- Use of rapid prototyping to produce testable prototypes before full scale production.
- Reduction of parts (combination) to reduce assembly requirements.
- Use of redistribution production techniques wherever possible.
- The use of reusable metal moulds when forming products removes the need for reproduction.
- Manufacturing plants make use of renewable energy sources, such as solar/wind to power factories.
- CAD simulation can be used to calculate the most efficient tool paths to reduce machining times.
- Manufacturers may aim to reduce the thickness or volume of some components to make savings in the amount of materials used.

Q18)

- Check material quality (with destructive / non destructive tests), eg . strength /toughness/ hardness /durability /corrosion resistant / weight (1)

- Check function / does it work (freely rotate/smooth running chain) (1)
- Check that parts fit together (1)
- Check surface finish (scratches /dents/dirt/blemishes) (1)
- Check sharp corners/edges (1)
- Check casting quality (flaws / cracks / flashing / holes / bubbles /miss-forms / broken parts) (1)
- Check for correct assembly (location/missing components tightness of screws) (1)
- Check threads are fully cut /formed (1)
- Check quality of decals/printing / position (1)

Section C – Designing and making principles

Q19)

- Ease of language options (1)
- Low cost (1)
- Has a global reach/large audience (1)
- Provides a quick/direct/targeted link to customers (1)
- Multimedia/interactive/3d presentations clearly communicate products (1)
- Increased company profile (1)
- Faster processing of transactions/data (1)
- Reduced sales force/retail outlets (1)
- Links can be added to access other sites easily (1)
- Updating/adapting info is quick/easy (1)
- Available 24/7/anytime/anywhere (1)
- Can monitor popularity/demand/trends for products (1)
- On-line banking facilities (1)

Q20)

- So that the components are made to the correct size / standard (1) ensuring the product fits / functions appropriately (1)
- To set up parameters for quality control checks (1) ensuring that only correct components will pass (1)
- So components are not made more accurate than they need to be (1) saving time / money (1)

Q21)

- Danish oil dries to a clear, transparent finish that maintains the natural appearance of the timber.

- Danish oil is a suitable finish for interior and exterior use.
- Danish oil penetrates the surface of the timber creating a hard wearing and durable finish.
- Danish oil is a suitable finish for use on food preparation surfaces.
- Danish oil is water and moisture resistant.

Q22.1)

Points of analysis

- Controls angled toward the driver for improved reach and visibility.
- Multi-function steering wheel allows easy access to controls without removing hands.
- Infotainment screen positioned high on dashboard for reduced eye movement.
- Sports seats offer lumbar support and side bolstering for comfort and stability.
- Gear selector and control dial positioned within easy reach of the driver.
- Use of premium, soft-touch materials for enhanced comfort.
- Logical layout of dashboard reduces driver distraction.

Q22.2)

Points of analysis

- Use of carbon fibre and gloss black finishes gives a modern, sporty appearance.
- Contrasting colours (e.g. black and light grey) create visual interest and a premium feel.
- Ambient lighting and screen layout contribute to a high-tech, futuristic look.
- Clean lines and minimalistic dashboard design offer a sleek and uncluttered aesthetic.
- Metal accents and precision detailing convey quality and sophistication.
- Integrated screen and controls blend seamlessly into the design for a cohesive appearance.
- Bucket seat shape adds an aggressive, performance-oriented visual style.

Q22.3)

Points of analysis

- Controls and infotainment system are positioned for easy access, meeting the need for convenience and safety.
- Comfortable, supportive seating addresses the user's need for long-distance comfort and posture support.

- High-quality materials meet user expectations for a premium experience.
- Digital displays provide clear, up-to-date information, aiding user awareness and control.
- Intuitive layout helps reduce driver distraction, fulfilling the need for ease of use.
- Ample legroom and spaciousness contribute to user comfort.
- Aesthetics and sporty design appeal to users wanting a performance or luxury feel.

Q23.1)

- Use the formula for volume of a cylinder:
  $V = \pi r^2 h$
  $300 = \pi \times 3^2 \times h$
- Simplify:
  $300 = \pi \times 9 \times h$
- Solve for h:
  $h = \frac{300}{9\pi} \approx \frac{300}{28.27} \approx 10.61 \text{ cm}$

Q23.2)

- Curved surface area of a cylinder:
  $\text{CSA} = 2\pi r h$
- Use previous values:
  $r = 3 \text{ cm}, \ h \approx 10.61 \text{ cm}$
- Area of one label:
  $\text{CSA} = 2\pi \times 3 \times 10.61 \approx 199.9 \text{ cm}^2$
- Total for 500 cans:
  $199.9 \times 500 = 99,950 \text{ cm}^2$

Q24)

*This mark scheme uses **Philippe Starck** as an example, but there are 28 possible designers to choose from in total. Any of the listed designers could be used, as long as the answer includes relevant design features, techniques, and specific product examples.*

- Known for innovative and unconventional designs that combine form and function.

- Often uses humour and surprise in everyday objects (e.g. *Juicy Salif* lemon squeezer).
- Incorporates organic and sculptural shapes that are visually striking.
- Embraces mass production techniques, making his designs widely accessible.
- Uses a wide range of materials including plastic, aluminium, and glass, often pushing boundaries of conventional use.
- Works across a variety of products — furniture, homeware, hotels — showing versatility.
- Designs often have aesthetic impact as well as practical use, appealing to both consumers and critics.
- *Ghost Chair* made from a single piece of moulded polycarbonate, showcasing modern materials and industrial techniques.

Mark Scheme (6 marks total):

- 1–2 marks: Basic statements with limited reference to a designer or their work.
- 3–4 marks: Some relevant features or techniques identified, with at least one specific product mentioned.
- 5–6 marks: Clear, well-developed answer including multiple design features/techniques and specific product examples, showing understanding of what made the designer successful.

Q25)

Products:

- Mobile phones – many different parts requiring people with different skills to design them
- Product packaging – package itself, secondary packaging all need designing and will be done outsourced to different companies with different skills, equipment and expertise.
- Motor vehicles, complex products needing the input of team with various skills to meet technical, legal and user requirements.
- Public transport, requiring technical engineering expertise, ergonomic knowledge and interior design
- Medical equipment, requiring medical knowledge, technical and manufacturing expertise and human factors application.

Designing:

- The need to obtain specialist expertise; e.g. electronic engineers working with product designers, architects working with structural engineers

- Companies purchasing outside design ideas e.g. Products marketed as being “Porsche design”
- Where designers work together to solve problems
- Working with other people and not in isolation designers can feed off each other in terms of ideas or experience.
- Chance of designs based on the work of one individual becoming stale and not effective for purpose
- Commercially, companies may become slow to react to changing market demands – collaborative design could ‘future proof’ against this.
- eg IKEA now looking to involve designers from outside the organisation (Tom Dixon)
- Fashion stores will commission designs from designers outside of their own organisation.
- Belief that solutions to problems generated in isolation can be of a lower quality and not address all the needs of the client or user (especially if complex or extensive), due to limitations of expertise or experience.
- Used to increase the range and quality of solutions/ possibilities generated to solve a need eg by using teams of designers in competition
- Use different people with different skills, experience and expertise during the design process. Thus, ensuring a better end result.
- Designers can inspire each other leading to innovative and creative solutions to problems
- Shorter design timescale, as designers can work concurrently

Q26)

- Check that the drill bit is tight in the chuck (1)
- Check that the speed is correct (1)
- Check the work table is secure (1)
- Check that the work is held securely (1)
- Check the emergency stop mechanism works (1)
- Check guards are in position (1)
- Check correct safety clothing is worn (1)
- Check for loose items/hair tied back (1)
- Check chuck key is removed (1)
- Check operator has had correct training (1)
- Check regular maintenance has been carried out (1)
- The area is clear of obstructions (1)
- The use of dust extraction (1)

Q27)

Adjustable seat height

- Allows users of different leg lengths to cycle comfortably
- Prevents overextension or cramping by accommodating a wide range of user heights (e.g. 5th–95th percentile)

Adjustable handlebars

- Lets users of different arm lengths and torso sizes reach comfortably
- Reduces strain on shoulders/back by promoting ergonomic posture

Pedal and crank design

- Crank length suits average leg movement range for effective pedalling
- Pedal spacing matches hip width range, improving comfort and joint alignment