Mark scheme

Q1a)

- The material will not return / not spring back to its original shape (1) after being deformed / force is removed. (1)

Q1b)

- UF is a thermal insulator (1) which means it does not absorb heat easily (1), which will stop the plug overheating and potentially catching fire. (1)
- UF is an electrical insulator (1) which means it does not conduct electricity (1), which prevents electric shock when handling the plug. (1)
- UF is a thermosetting plastic (1) which means it does not soften or melt when heated (1), which helps the plug maintain its shape and remain safe under high temperatures. (1)
- UF is hard and rigid (1) which means it resists deformation and wear (1), which protects the internal components from damage. (1)

Q2a)

- PTFE has a low coefficient of friction (1) which means it is non-stick (1), which prevents food from sticking and makes the pan easier to clean. (1)
- • PTFE is heat resistant (1) which means it can withstand high cooking temperatures (1), which allows the pan to be used safely without degrading. (1)
- PTFE is chemically inert (1) which means it does not react with food substances (1), which makes it safe for cooking and prevents contamination. (1)
- PTFE is a good thermal insulator (1) which means it does not transfer heat quickly (1), which helps prevent burning and improves cooking control. (1)

Q2b)

$A = \pi r^2 = \pi \times 14^2 = 615.8\ \text{cm}^2$

(1 mark)

$V = 615.8 \times 0.02 = 12.32\ \text{cm}^3$

(1 mark)

$m = 12.32 \times 1.8$

(1 mark)

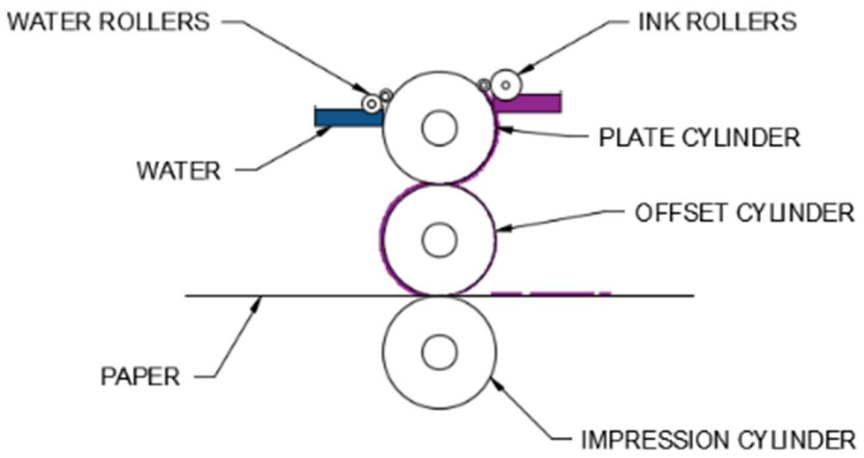
$m = 22.2\ \text{g}$ (final answer)

(1 mark)

Q3a)

- Coated paper has a smooth / glossy surface (1) which allows high-quality, sharp images and text to be printed. (1)
- Coated paper improves ink absorption control (1) which prevents ink spreading (bleeding). (1)
- Coated paper produces a high-quality finish (1) which makes images appear more vibrant and professional. (1)

Q3b)



- Digital files are broken down by colour separation. (1)
- The image is etched onto an aluminium plate for each colour, through a laser. (1)
- Each image plate is then loaded onto a plate cylinder. (1)
- The plate cylinder will dampen the non-image area of each file with water. (1)
- A vegetable oil-based paint solution will then be added successively to the plate to imprint the colour. (1)
- The plate cylinder will transfer the colour to another cylinder which is equipped with a rubber blanket that will print it directly onto the paper. (1)

If no sketch, a sketch without annotations or incorrect order, award a maximum of 3 marks.

Q3c)

- Offset lithography is a high-speed printing process (1) which allows large volumes of newspapers to be produced quickly (1), which is important for daily publication deadlines. (1)
- It is cost-effective for mass production (1) because the unit cost decreases when printing large quantities (1), making newspapers cheap to produce and sell. (1)
- It produces consistent, high-quality text and images (1) which ensures newspapers are clear and readable (1), improving communication of information to the reader. (1)
- It uses smooth printing plates and indirect transfer of ink (1) which reduces wear on the printing surface (1), allowing long production runs without loss of quality. (1)
- It can print on lightweight, low-cost materials such as newsprint (1) which reduces production costs (1), making newspapers affordable for consumers. (1)

Q4a)

- Strength (1) in order to withstand high forces without breaking / deforming (1)
- Heat resistant (1) so they do not soften / weaken when in situ (1)
- Stable (1) so that they do not excessively expand with heat causing malfunction (1)
- Hard (1) so that they do not wear away /scratch when in use (1)
- Lightweight (1) increasing efficiency (e.g. fuel saving) (1)

(3 x 2)

Q4b)

- TQM is how manufacturers implement quality assurance/quality control systems (1)
- For the continuing development/improvement of the product/process (1)
- For the complete life cycle of the product (1)
- Employee involvement/teamwork/work ethos/satisfaction(1)
- Customer focused involvement/feedback (1)
- Departments are treated like individual clients which leads to good relationships/good quality products (1)
- Quality assurance/Quality control test procedures happen at every stage of production (1)

- ISO 9000 is awarded for companies who demonstrate high standards of consistency/quality which leads to a good reputation/repeat business (1)
- System to achieve customer satisfaction / confidence by using Quality assurance (1)

Q4c)

Convert to pass probabilities:

$$P(A') = 0.99,\ P(B') = 0.9985,\ P(C') = 1 - c$$

(1 mark)

Multiply (independent events):

$$0.99 \times 0.9985 \times (1 - c) = 0.96$$

(1 mark)

Solve:

$$0.988515(1 - c) = 0.96$$

$$1 - c = \frac{0.96}{0.988515} \approx 0.9711$$

$$c \approx 0.0289$$

(1 mark)

Q4d)

Volume of cylinder:

$$V = \pi r^2 h = \pi \times 0.6^2 \times 4$$

(1 mark)

$$V = \pi \times 0.36 \times 4 = 4.523\, m^3$$

(1 mark)

Convert to litres:

$$4.523 \times 1000 = 4523\, L$$

(1 mark)

Cost:

$$4523 \times 1.25 = £5654 \text{ (≈ £5654)}$$

(1 mark)

Q4e)

- Identify the hazards / risks (1)
- Identify the people at risk / who might be harmed. (1)
- Evaluate the risks / assess the seriousness of it / likelihood of it happening. (1)

- Decide / implement / check appropriate control measures / an example of a control measure Eg. guards, PPE, signage, training, maintenance, etc. (1)
- Record /store the risk assessment (1)
- Set a review date / regularly review the risk assessment. (1)

Note that the order of the points should not be considered.

Q4f)

- Registered design rights must be formally applied for and approved (1) whereas unregistered design rights are automatically given when a design is created (1)
- Registered design rights provide stronger legal protection (1) whereas unregistered design rights offer more limited protection (1)
- Registered design rights protect appearance such as shape, configuration and decoration (1) whereas unregistered design rights mainly protect the shape and configuration only (1)
- Registered design rights last longer (up to 25 years if renewed) (1) whereas unregistered design rights last for a shorter time (1)

Q5a)

- A consumer society is one where people are encouraged to buy and use large amounts of goods and services (1) which leads to high levels of consumption (1) driven by advertising, trends and consumer demand (1)

Q5b)

New selling price after 10% discount:

$15.50 \times 0.9 = 13.95$

(1 mark)

Revenue:

$5600 \times 13.95 = 78,120$

(1 mark)

Variable cost:

$5600 \times 7.20 = 40,320$

(1 mark)

Total cost (including fixed advertising):

$40,320 + 18,000 = 58,320$

(1 mark)

Profit:

$78,120 - 58,320 = 19,800$ (profit)

(1 mark)

Q6a)

- The CNC machines are generally fully enclosed (1) unmanned (1) therefore there is generally less direct manual contact with the machine (1)
- CNC machines run simulations before machining commences (1) therefore the operator can tell whether the process is viable and safe to run (1)
- Safety cut-out switches are fitted to the CNC machine doors (1) which means the operator cannot open the doors during production (1)
- CNC machines often have built-in extraction (1) reducing the hazards associates with dust (1)
- Human tiredness/error (1) can lead to injuries/accidents (1)

Q6b)

- Powder coating provides a hard, durable finish which will resist the wear from children's shoes. (1)
- Thicker coats can be achieved than feasible with liquid paint finishes. (1)
- A wide range of colours are available, as pigments can be added. (1)
- Powder coating will protect the frame from oxidising. (1)
- Powder coating gives an even coat of material around cylindrical shapes. (1)
- Overspray from the climbing frame can be recycled and reused. (1)

- Powder coated finishes are less prone to fading from UV degradation due to the use of stabilisers. (1)
- Powder coated finishes are less likely to chip than traditional paint finishes. (1)
- Powder coated finishes are not affected by extremes of temperature found outdoors during summers and winters. (1)

Q6c)

- Users should be aware of the COSHH guidance that governs their use, storage and disposal. (1)
- Users must store the adhesive in a COSHH cupboard when not in use. (1)
- The adhesive may be irritant to skin so correct PPE should be worn eg gloves. (1)
- The adhesive may be a liquid so correct PPE such as goggles should be worn. (1)
- Vapours that can be released can be highly flammable so no naked flames should be present when using the adhesive. (1)
- Users must ensure that instructions have been read and guidance is followed. (1)
- Vapours can be released therefore the adhesive should be used in a well ventilated area. (1)
- Users must identify and understand the COSHH symbol present which will both govern its use and disposal. (1)

Q6d)

Convert thickness to metres:

$2\ \text{mm} = 0.002\ \text{m}$

(1 mark)

Volume per joint:

$V = 0.8 \times 0.5 \times 0.002 = 0.0008\, m^3$

(1 mark)

Volume for 6 joints:

$0.0008 \times 6 = 0.0048\, m^3$

(1 mark)

Convert to litres:

$0.0048 \times 1000 = 4.8\, L$

(1 mark)

Cost:

$4.8 \times 4.80 = 23.04$

(1 mark)

Final answer stated with correct units:

$£23.04$

(1 mark)

Q7)

- Introduced in 1975 as a reaction against functionality of modernism. (1)
- Designs are quirky/individual/have character. (1)
- Postmodern design movement accommodates elements from all previous movements/styles, such as seen in the Louis Ghost chair. (1)
- Starck challenges perceptions with his work. This is done through challenging forms that question what we expect specific products to look like and how we expect them to perform, such as seen in the Juicy Salif lemon juicer. (1)
- Starck uses materials in challenging ways to reimagine classic designs, such as the Hot Bertaa kettle design. (1)
- Starck uses product design to produce products more at home in an art gallery than a home such as both the Juici Salif and Hot Bertaa. (1)
- Range of materials used and used in creative ways. (1)
- Starck uses product design to make political and social statements, as seen in the Flos Gun Table Lamp. (1)
- Philippe Starck's work exemplifies Form over Function. (1)

Q8)

- PDM manages product design data like CAD files, BOMs, and version control (1) so design teams can maintain accurate and up-to-date product records (1)
- ERP systems manage business-wide functions such as inventory, finance, procurement, and scheduling (1) ensuring coordinated business operations (1)
- Integration allows seamless transfer of design data (e.g. BOMs) from PDM to ERP (1) which reduces manual data entry and human error (1)
- Real-time updates across systems ensure all departments work with the latest product information (1) leading to fewer delays and rework (1)
- Supports better inventory and procurement decisions (1) because ERP systems can automatically respond to product design changes (1)
- Improves time-to-market (1) by speeding up the transition from design to production (1)
- Reduces miscommunication between departments (1) supporting leaner, more coordinated manufacturing (1)
- Helps meet compliance and traceability requirements (1) by maintaining a consistent data trail from design to delivery. (1)

Q9)

- Hazardous substances used in battery development increase production costs and safety requirements for manufacturers. (1)
- Environmental concerns around extraction of rare earth materials increase sourcing and ethical supply-chain costs. (1)
- Use of fossil fuels in electricity generation and manufacturing increases embedded production cost of EVs. (1)
- Electric cars are currently more expensive than petrol/diesel vehicles, making them less affordable for consumers. (1)
- Rising petrol and diesel prices encourage consumers to switch to EVs despite higher upfront cost. (1)
- Lower running costs (electricity vs fuel) reduce long-term cost for consumers. (1)
- Range anxiety and limited charging infrastructure may increase indirect costs (planning, charging time, home charger installation) . (1)
- High temperatures can degrade batteries, leading to replacement costs for consumers. (1)
- Ongoing maintenance costs such as battery replacement and disposal are significant consumer concerns. (1)

- Manufacturers face huge upfront investment costs in R&D, retooling factories, and developing battery technology. (1)
- Government targets (e.g. banning new petrol/diesel sales) drive manufacturer investment but also increase short-term financial burden. (1)
- Economies of scale may reduce production costs over time as EV adoption increases. (1)
- Environmental benefits and reduced emissions may reduce long-term societal costs and increase government incentives for EV adoption. (1)

Q10)

Indicative content:

Anthropometrics

- Adjustable height shower head accommodates different user heights (5th–95th percentile)
- Shower rail allows positioning for children and taller adults
- Controls positioned at standing reach height
- May not be accessible for wheelchair users / seated users
- Fixed wall unit height may not suit all users
- Hose length allows flexibility of movement

Ergonomics

- Large rotary dials allow easy grip, especially with wet hands
- Simple control interface reduces user confusion
- Clear labelling improves usability
- Smooth surfaces easy to clean and maintain hygiene
- Rounded edges improve safety
- Potential issue: controls may be difficult for users with limited dexterity or grip strength
- Risk of slipping if controls are not textured

Functionality

- Heats water instantly (no need for hot water tank)
- Independent of central heating system
- Adjustable temperature and flow rate
- Provides consistent water supply
- May have limited water pressure depending on mains supply
- High electrical energy consumption
- Built-in safety features (e.g. thermal cut-off)

- Easy to install compared to mixer showers

Level	Mark	Descriptor
0	0	No rewardable material
Level 1	1–3	• Applies a basic understanding of the electric shower with limited reference to anthropometrics, ergonomics or functionality. • Makes simple or generic points with limited connections between concepts. • Evaluation is incomplete with an unsupported or unclear conclusion. • Judgements are weak and lack supporting evidence.
Level 2	4–6	• Applies a generally sound understanding with some reference to anthropometrics, ergonomics and/or functionality. • Makes some relevant connections between concepts but may be inconsistent. • Evaluation is present but may be imbalanced or lacking depth, leading to a general conclusion. • Judgements are occasionally supported by relevant evidence.
Level 3	7–9	• Applies an effective understanding of anthropometrics, ergonomics and functionality in relation to the electric shower. • Provides logical and clear connections between concepts. • Evaluation is balanced, considering advantages and disadvantages, leading to a reasoned conclusion. • Judgements are mostly supported by relevant evidence.
Level 4	10–12	• Applies a comprehensive understanding of anthropometrics, ergonomics and functionality throughout. • Provides detailed and insightful connections between concepts in context. • Evaluation is thorough and balanced, synthesising ideas into a well-developed and justified conclusion. • Judgements are consistently supported by pertinent evidence.

END OF MARK SCHEME