Worked Examples (Aligned to the June 2025 Paper)

1. Materials & Design

Sample Question:
A handheld mixer uses a **thermosoftening polymer** casing. Give **two properties** of this material and explain why they are suitable.

Worked Example Answer (4 marks)

Property 1: Impact resistance

> **Explanation:** The mixer might be dropped during use; a thermosoftening polymer absorbs impact without cracking, making the product durable.

Property 2: Mouldability when heated

> **Explanation:** The casing can be injection-moulded into complex ergonomic shapes cheaply and quickly.

2. Electrical Power & Efficiency

(Similar to Q1b)

Sample Question:
A small device uses a **5.0 V** rechargeable battery and charges at **0.2 A**.
(a) Calculate the **power delivered to the battery**.
(b) The charger is **80% efficient**. Calculate the **input power** drawn from the mains.

Worked Example

(a) Power delivered

$P = V \times I = 5.0 \times 0.2 = 1.0 \text{ W}$P=V×I=5.0×0.2=1.0 W

Answer: 1.0 W

(b) Input power with efficiency

$\text{Efficiency} = \frac{\text{Output power}}{\text{Input power}}$Efficiency=Input powerOutput power

Rearrange:

$\text{Input power} = \frac{1.0}{0.80} = 1.25 \text{ W}$Input power=0.801.0 =1.25 W

Answer: 1.25 W

3. Mechanisms – Converting Motion

(Similar to Q1c)

Sample Question:
A device requires **rotary motion** to be converted into **oscillating motion**. Sketch and describe a mechanism that achieves this.

Worked Example Answer (verbal description)

A **crank + connecting rod + lever** mechanism:

> A rotating crank pushes a connecting rod.
> The rod moves a lever back and forth around a pivot.
> This produces **angular oscillation**.

This is the same principle used in oscillating fans.

4. Volume & Geometry (Sphere Calculation)

(Similar to Q2a)

Sample Question:
A hollow plastic ball needs an **internal volume of 30 cm³** and has a **wall thickness of 2 mm**.
Calculate the **external diameter**.

Worked Example

Step 1: Internal radius from volume

$V=43πr3$
$V = \frac{4}{3}\pi r^3$V=34 πr3

Rearranged:

$r3=3043πr^3 = \frac{30}{\frac{4}{3}\pi}$r3=34 π30
$r3=304.18879=7.16r^3 = \frac{30}{4.18879} = 7.16$r3=4.1887930 =7.16
$r=7.163=1.92 cmr = \sqrt[3]{7.16} = 1.92\text{ cm}$r=37.16 =1.92 cm

Step 2: Add wall thickness

2 mm = 0.2 cm
External radius:

$1.92+0.2=2.12 cm1.92 + 0.2 = 2.12\text{ cm}$1.92+0.2=2.12 cm

External diameter:

$2×2.12=4.24 cm2 \times 2.12 = 4.24\text{ cm}$2×2.12=4.24 cm

Answer: 4.24 cm

5. Probability (Independent Events)

(Similar to Q2b)

Sample Question:
In a batch of **20,000** parts:

Probability of **fault X** = 0.03
Probability of **fault Y** = 0.02

(a) How many parts are expected to have fault X?
(b) How many are expected to have **both** faults?

Worked Example

(a) Fault X

*20,000×0.03=60020,000 \times 0.03 = 600*20,000×0.03=600

Answer: 600 parts

(b) Both faults

Independent events:

*0.03×0.02=0.00060.03 \times 0.02 = 0.0006*0.03×0.02=0.0006
*20,000×0.0006=1220,000 \times 0.0006 = 12*20,000×0.0006=12

Answer: 12 parts

6. Arc Length & Chord Length

(Similar to Q2c)

A wooden arc has:

Radius **800 mm**
Angle **30°**

(a) Find the **arc length**.
(b) Find the **chord length**.

Worked Example

(a) Arc length

$L = 2\pi r\left(\frac{\theta}{360}\right)$L=2πr(360θ)
$L = 2\pi(800)\left(\frac{30}{360}\right)$L=2π(800)(36030)
$L = 5026.55 \times 0.0833 = 419\ \text{mm}$L=5026.55×0.0833=419 mm

Answer: 419 mm

(b) Chord length

$A = 2r\sin\left(\frac{\theta}{2}\right)$A=2rsin(2θ)
$A = 2(800)\sin(15^\circ)$A=2(800)sin(15∘)
$A = 1600 \times 0.259 = 414\ \text{mm}$A=1600×0.259=414 mm

Answer: 414 mm

7. Ethics & Responsible Sourcing

(Similar to Q3b)*

Sample Question:
Explain **one social**, **one environmental**, and **one ethical** reason why manufacturers should ensure responsible sourcing of lithium.

Worked Example Answer (6–8 marks)

Social: Prevents unsafe working conditions in mines, protecting workers and nearby communities.
Environmental: Reduces damage to ecosystems caused by open-pit mining and water pollution.
Ethical: Ensures materials are extracted without exploitation, supporting fair-trade and transparency.

8. Surface Mount Technology (SMT)

(Similar to Q4c)

Sample Question:
Explain why SMT is suitable for mass production of small electronic products.

Worked Example Answer (4 marks)

SMT components are **small**, allowing more compact circuits.
They can be placed automatically by **pick-and-place machines** for high-speed production.
Reflow soldering allows many joints to be soldered at once.
Results in **lower cost, higher reliability** PCBs.