Chapter 4 The Technological World

Section 1 • Graphical Language

Student textbook, page 329

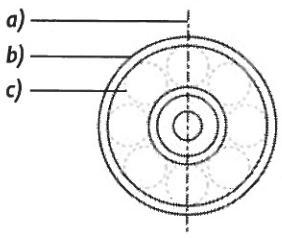
The Conceptual Sketch and the Technical Drawing (*page 324*)

1. What is the difference between a conceptual sketch and a technical drawing? *A conceptual sketch is a drawing made without instruments or measurements. It is a rough draft, an approximate drawing, a sort of prelude to the technical drawing. It is drawn by hand and is not to scale. The technical drawing is prepared with drawing instruments or a computer. It provides, to scale, all information specific to the shape and dimensions of the object.*

Basic Lines (*pages 325 and 326*)

2. Name the type of line associated with the following functions:
   a) Line showing the centre of a circle or indicating the presence of symmetry in a circular part *Axial line*
   b) Line representing the outline and visible details of an object *Object line or visible outline*
   c) Line used to make a draft of a drawing *Construction line*

3. In the following drawing, identify each of the lines indicated and specify its function:



   a) *Axial line: line showing the centre of a circle or indicating the presence of symmetry in a part*
   b) *Object line or visible outline: line representing the outline and visible details of the object*
   c) *Hidden line: line indicating the hidden details of an object*

4. Name two types of lines that are drawn:
   a) Fine *Possible answers: construction line, dimension line, extension line, ghost line, hatched lines, long break, leader line*
   b) Medium *Possible answers: hidden line, short break*
   c) Thick *Possible answers: object line or visible outline, cutting plane line*

Geometric Layout (*page 327*)

5. What is a geometric layout? *A geometric layout is the set of lines that form a technical drawing in two dimensions.*

6. Name five instruments used to create a geometric layout. *Possible answers: drawing board, T-square, set squares, rulers, compass, protractor, 2H pencil, HB pencil, calculator (optional), eraser, erasing shield*

Scales (*page 328*)

7. Why is scale useful in technical drawing? *Scale is necessary to reduce or enlarge the image of an object in order to see it properly or to be able to represent it on paper.*

8. If the units are in millimetres, what exactly does a scale of 1:300 mean? Is this an enlargement or a reduction? *A scale of 1:300 means that 1 mm on the drawing corresponds to 300 mm on the actual object. It is a scale of reduction.*

9. What would be the height of a table in a scale drawing of 250:1 if the table were actually 1000 mm high? *The height of the table would be 250 m!*

Ask students to find a scale that would be suitable for a drawing of this table (for example, at 1:25, the height of the table would be 40 mm).

10. What would be the diameter of an iris (the coloured membrane of the eye) in a scale drawing of 4:1 if the iris were actually 10 mm wide? *The diameter of the iris would be 40 mm.*

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Types of Projection (*pages 330 to 336*)

1. What is perspective? *Perspective is a form of representation that gives an impression of depth.*

2. Name three types of projection used in technical drawing. *Multiview projection, isometric projection, oblique projection*

3. Which of these types of projections are "orthogonal" projections? *Multiview projections and isometric projections*

4. In what type of projection:
   a) Are the visual rays diagonal to the paper? *In oblique projections*
   b) Is a reference cube used? *In multiview projections*
   c) Do the dimensions represent the object's actual dimensions? *In multiview projections and isometric projections*
   d) Do the object's three principal edges form 120° angles? *In isometric projections*

5. What does isometric paper look like? *Isometric paper has vertical and diagonal lines that intersect at 30° angles.*

6. In a multiview projection, is it always necessary to draw the six views? Why or why not? *No. We choose the views that will allow us to understand the object's every characteristic. Usually, three views provide enough information about the dimensions and characteristics of an object. In technical drawing, the top, front and right views are the ones commonly used to represent an object.*

AST 7. What type of drawing shows every part that makes up an object? *The exploded view*

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Cross-sections (*pages 337 and 338*)

1. What is a cross-section? *A cross-section is a drawing of an object as if it were cut by a cutting plane line.*

2. What identifies the place where a cross-section is made on a technical drawing? *The cutting plane line*

3. What are the hatched lines in a cross-section used for? *They show where the cuts were made.*

Sections (*page 339*) AST

4. What is a section? *A section is a partial representation of an object that presents only the object's surface on a cutting plane line.*

5. What are the two ways to represent a section in a technical drawing? *We can use a revolved section or a removed section.*

Dimensioning (*pages 339 to 341*)

6. What are the two types of sections used in technical drawing? *The revolved section and the removed section. (This question overlaps with Question 5.)*

7. What are the two types of lines used for labelling length dimensions? *Dimension lines and extension lines*

8. Indicate whether the following statements are true or false:

a) The dimension lines should be outside the part's outline. *True*

b) The extension lines should be 5 mm from the drawing. *False. They should be 2 mm from the outline of the object.*

c) The longest dimensions should be as close as possible to the part. *False. The smallest dimensions should be closest to the object.*

d) It is necessary to write the measurements of hidden lines. *False. The measurements of hidden lines should not be indicated.*

Tolerances (*pages 341 and 342*) AST

9. Define tolerance. *Tolerance is the total deviation permissible between the actual dimensions of a part and the corresponding dimensions that appear on the technical drawing.*

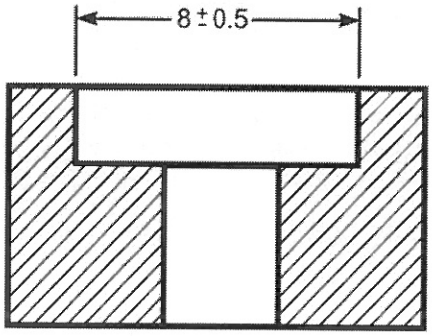
10. Among the following measurements, which respects the indicated tolerance on the part in the illustration?

a) 7.4 mm

b) 8.8 mm

c) 8.2 mm

Answer:
c) 8.2 mm



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Diagrams and Symbols (*pages 343 to 349*)

1. In each of the following cases, indicate whether the statement applies to the design plan, the plan for manufacturing of components or to both:

a) It is produced freehand. *Design plan*

b) It is not necessarily drawn to scale. *Design plan*

c) It indicates the specific materials and dimensions of the components. *Plan for manufacturing of components*

d) It is designed to explain the forces and motions involved in an object's functioning. *Design plan*

e) It shows all of an object's parts. *Both*

f) It represents the links between the parts. *Plan for manufacturing of components*

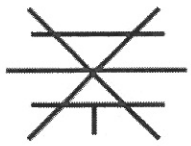
g) It is produced with drawing instruments. *Plan for manufacturing of components; the design plan is also usually produced with drawing instruments.*

h) It is made to scale. *Design plan; the design plan can be drawn to scale, but it is not mandatory.*

i) It shows how to build an object. *Plan for manufacturing of components*

2. Draw the standard symbol associated with the following concepts:

a) Complete link



b) Tension force

c) Bidirectional rectilinear translation

3. Which concepts are the following standard symbols associated with?

a) Tension force

b) Bidirectional rectilinear translation

c) Toggle switch

d) Complete link

Section 2 • Engineering

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Basic Mechanical Functions (*pages 355 to 358*)

1. Name the five typical functions in mechanics. *Link, guiding control, lubrication, seal and support*

2. What is a mechanism? Give an example. *A mechanism is a part or substance having a specific function.*

3. Describe the four characteristics of the links in each of the following examples:

a) A table and its four legs connected with screws *Indirect, removable, rigid, complete*

b) A pair of scissors *Indirect, non-removable, rigid, partial*

c) A pen and its cap *Direct, removable, rigid, complete*

Motion Transmission Systems (*pages 358 to 366*)

4. Explain motion transmission. *Motion transmission is a system's ability to transmit motion from one part of an object to another.*

5. A motion transmission system always involves three types of mechanisms. Name and define each of these mechanisms.

1. *Motor mechanism: Component of a system on which force is applied*
2. *Intermediate mechanism: Component of a system that transfers the action of the motor mechanism (driving force) to the receiving mechanism*
3. *Receiving mechanism: Component of a system that receives the motion through an intermediate mechanism*

6. What type of motion is transmitted in the following systems?

a) Chain and sprocket wheels *Rotation*

b) Gears *Rotation*

7. Give an example of an object that uses the following motion transmission systems:

a) Gears *Various answers: e.g. clock, hand drill*

b) Belt and pulley *Various answers: e.g. clothesline, ski lift*

c) Chain and sprocket wheels *Various answers: e.g. bicycle*

d) Gear and worm wheel *Various answers: e.g. guitar tuning keys*

AST **8.** What causes a motion transmission mechanism to change its speed?
The speed change is caused by the difference between the rotational speed of the receiving mechanism and that of the motor mechanism. This difference is due to the respective size of each mechanism.

AST **9.** Calculate the speed of the driven gear in the following example:

The driving gear has 30 teeth and rotates at a speed of 10 rotations/min. The driven gear has 10 teeth.

Speed of driven gear = 30/10 × 10 rotations/minute

Speed of driven gear = 3 × 10 rotations/minute

Speed of driven gear = 30 rotations/minute

Motion Transformation Systems (pages 366 to 370)

10. Explain motion transformation.
Motion transformation is the ability of a mechanism to modify the nature of the motion produced by another mechanism.

11. Indicate the type of motion transformation produced in the following systems:

a) Rack and pinion *Rotational motion into translation motion*

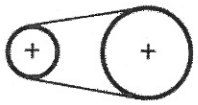
b) Connecting rod and crank *Rotational motion into alternating translation motion*

c) Cam and follower *Rotational motion into alternating translation motion*

d) Screw gear *Rotational motion into translation motion*

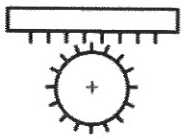
12. Identify the standard symbols below and indicate whether each one represents a motion transmission system or a motion transformation system:

a)



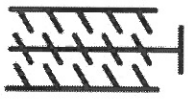
Belt and pulley: motion transmission

b)



Rack and pinion: motion transformation

c)



Screw gear: motion transformation

Electrical Engineering (*pages 372 to 377*) AST

1. What is the definition of electrical engineering? *Electrical engineering is defined as a branch of engineering that deals with the design, manufacturing and operation of electrical systems.*

2. Match each of the following electrical components with its corresponding role:

Power supply *d* Protection *b* Conduction *f* Insulation *e* Typical controls *a* Transformation of electrical energy *c*

a) Connects the conductor wires in order to allow the current to flow in the circuit

b) Prevents short circuits and overloads

c) Transforms electrical energy into usable energy to operate the objects being used

d) Supplies the energy required for the electrons to flow through an electrical conductor based on the electrical voltage and electrical intensity required to operate the objects being used

e) Prevents the escape of electrons from the electrical circuit

f) Allows the flow of electrons

3. *a)* Name two devices that play a protective role in an electrical circuit. *Fuse and circuit breaker*

b) What is the difference between these two devices? *The fuse is a device consisting of a lead wire that melts when the intensity is too high. It must be replaced after a short circuit or overload. The circuit breaker is a switch that opens when the intensity of the current is too high. The reaction time of a circuit breaker is slower than that of a fuse, which allows the circuit to tolerate overload conditions for a certain amount of time. It must be reset after a short circuit or overload.*

4. Give the function that corresponds to each of the following elements:

a) Porcelain receptacle *Insulation*

b) Motor *Transformation*

c) Copper wire *Conduction*

d) Fuse *Protection*

e) Electrical outlet (power system) *Power supply*

f) Circuit breaker *Protection*

g) Plastic wire sheath *Insulation*

h) Toggle switch *Control*

i) Metallic material *Conduction*

5. What are the following switches called?

a)

Lever

b)

Push button

c)

Toggle

d)

Magnetic controller

Student textbook, page 400

Stress (*pages 382 to 384*)

1. Name five types of forces that can be applied to an object. *Tension, compression, flexion, torsion, shearing*

2. What happens when an object is subjected to a force? *It can deform.*

3. What is stress? *Stress is the effect that occurs inside a material due to the external force that deforms it.*

4. Name the three types of stress presented in this section. *Tension stress, compression stress, torsion stress*

5. Name the two types of deformations and define each one.

   Elastic deformation: temporary change in the dimensions of a part when subjected to stress. The object returns to its initial shape once the force is removed.

   Plastic deformation: permanent deformation that occurs when a part is subjected to a stress and that remains until the force causing the deformation is removed.

Mechanical Properties of Materials (*pages 385 and 386*)

6. Identify the mechanical property corresponding to each of the following definitions:

   a) Ability to resist tension *Rigidity*

   b) Property of breaking without deforming under the effect of a force *Brittleness*

   c) Ability of an object to return to its original shape when the force acting on it is removed *Elasticity*

7. Define the following mechanical properties:

   a) Coefficient of thermal expansion *Property characterizing the relative increase in the volume of a body according to the increase in temperature*

   b) Malleability *Ability to be flattened into sheets without tearing under a compressive force*

   c) Hardness *Ability to resist deformation when hit by another hard object*

Types of Materials and Their Properties (*pages 386 to 399*)

8. Name the main groups of materials and give an example of each one.

   1. *Metals (iron, aluminum, bronze, brass)*
   2. *Plastics (rubber, PVC, polystyrene)*
   3. *Organic materials (wood, paper, leather, cotton, wool)*
   4. *Ceramics (glass, porcelain, brick)*
   5. *Composites (carbon fibre bicycle frames, tennis racket)*

9. Why are metals in their pure state rarely used? *Metals are rarely used in their pure state. They are usually mixed with other substances, which improves their properties. Such combinations result in mechanical properties that are more beneficial than the properties of metals in their pure state.*

10. What term is given to a combination of several metals? *Alloy*

11. What term is given to an iron-based alloy? *Ferrous alloy*

12. What substance is obtained by mixing iron and carbon? *Steel or cast iron is obtained, depending on the amount of carbon.*

13. Describe a quick way to determine whether an alloy is ferrous or nonferrous. *A simple test can be carried out with a magnet. Iron is recognized for its magnetic properties. If it is present in an alloy, it will attract the magnet.*

14. Name some nonferrous metals commonly used today, and provide an example of each one. *Aluminum (doors and windows), copper (electrical wires), titanium (boat hulls), zinc (pipes), magnesium (car wheel rims), chrome (protective coating against corrosion), nickel (coins), lead (batteries), tungsten (incandescent lamp filaments). See pages 390 and 391 of the student textbook for a more detailed list of examples.*

15. Name the alloy formed when the following metals are combined:

a) Titanium and aluminum *Titanium*

b) Copper and tin *Bronze*

c) Copper and zinc *Brass*

AST **16.** Name the three categories of plastics and provide an example of each one. *Thermoplastics (PVC, polyethylene, polypropylene) Thermosetting plastics (fibreglass) Elastomers (natural rubber, tires)*

17. Identify the two categories of wood and explain the basis for these categories. *Hardwood and softwood. Hardwood is more resistant to wear and harder than softwood.*

18. What property must be taken into account when wood is used as a material (a property that is not an issue with metals or plastics)? *The lifespan of wood can be shortened by an attack of fungus or insects. This is a disadvantage of using wood and limits the choices depending on the application, in contrast with other materials (metals, plastics).*

19. Which species of wood would you choose for the following applications? Why?

a) The walls and floors of a sauna *Pine, because of its ability to withstand heat and moisture*

b) A wood floor *Hardwood like maple or oak, which resists impacts and is not easily marked*

c) Fibre for pulp and paper *Pine, because the long fibres provide a smooth, strong paper*

20. Identify one advantage and one disadvantage of using modified wood. *Advantage: modified wood is inexpensive.*
Disadvantage: the binders used are often toxic.
For a complete list of the advantages and disadvantages, see Table 30 on page 398.

AST **21.** Why would a living cell be considered a material? *A living cell can be considered a material because it is used to produce, create or reconstruct organs. They can even be used to create consumer products.*