

Technological World Review – Applied Science and Technology (AST)

This summary provides a quick overview of all the Technological World concepts that will be assessed during the AST ministry exam. To explore a concept in more detail, scan its QR code. To see the summary of Earth and space and the material world, scan the large QR code at the bottom left.

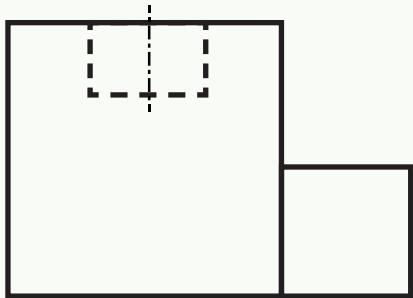
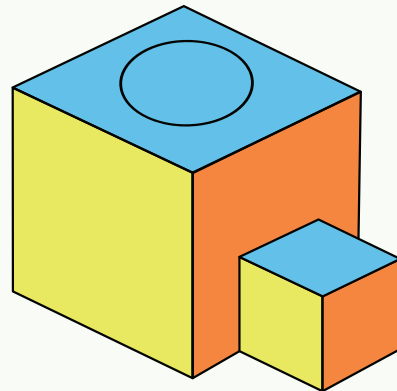
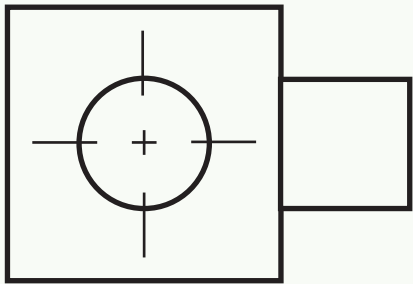
Caution!

When performing a technological analysis of a technical object, it's important to use the terms specific to technology.

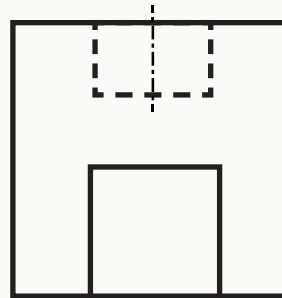


Multiview Orthogonal Projection

Top view



Front view

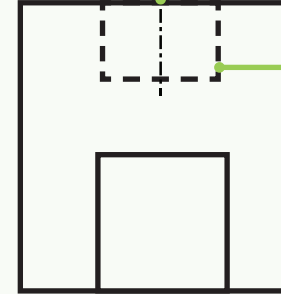


Right-side view



Basic Lines

Centre line



Hidden contour line

Visible contour line

Extension line

Dimension line



Dimensioning Rules

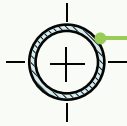
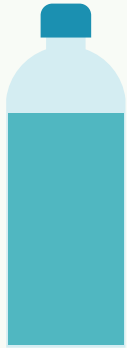
Dimensioning indicates the real measurements and positions of the different elements of an object in a technical drawing.





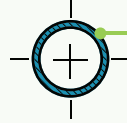
Dimensional Tolerance

The dimensional tolerance indicates the **acceptable deviation** between a part's specified dimensions and the real dimensions of the part after it's manufactured.



$$\varnothing 25.0 \pm 0.5$$

Bottle neck diameter:
from 25.0 mm to 25.5 mm



$$\varnothing 26.0 \pm 0.3$$

Cap diameter:
from 25.7 mm to 26.3 mm



Functional Dimensioning

Provides the dimensions relating to the **operation** of a technical object.

Example: A **clearance** of between 0.2 mm and 1.8 mm is given so that the bottle neck fits into a 26.3 mm diameter cap.

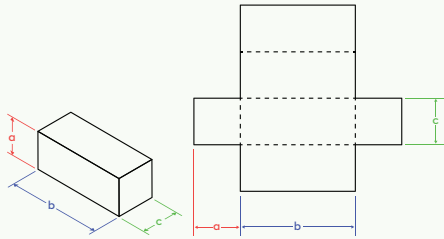
- $\varnothing 25.5$: will always work
- $\varnothing 24.3$: may not always work
The bottle neck may be able to fit into the cap, but the clearance is too high.
- $\varnothing 26.3$: may not always work
There is no clearance.
- $\varnothing 26.4$: will not work
It cannot be inserted into the cap.



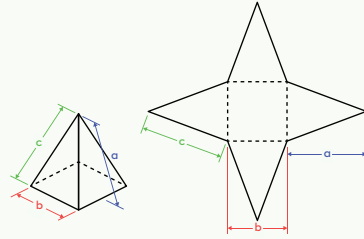
Developments

Developments (or nets) are flat representations of the surfaces of a solid that will be manufactured by cambering (bending).

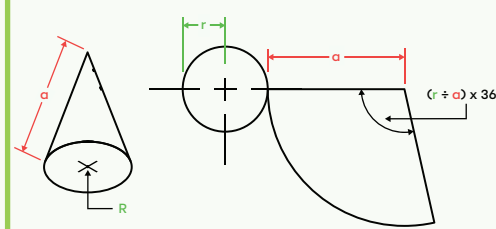
Prism



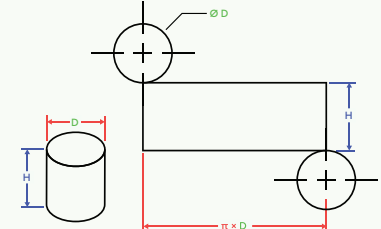
Square-based pyramid



Cylinder



Cone



Legend

Contour line: ———

Bend line: - - - - -



Material Protection

Certain **treatments** slow down or prevent the degradation of materials.

- Galvanization (zinc plating)
- Application of paint, varnish or oil-based rust inhibitor
- Addition of pigments capable of reflecting UV rays
- Antioxidant additives
- Waterproof treatment



Types of Deformation

Deformation can be either **invisible** or **visible**, depending on the nature of the material and the magnitude of the applied stress.

- **Elastic deformation** (temporary): The material returns to its original shape once constraint is no longer applied.
Example: Compressing a spring
- **Plastic (or permanent) deformation**: The material does not return to its original shape once the constraint is no longer applied.
Example: Compressing an empty soft drink can
- **Fracture**: The constraint exceeds the strength threshold of the material.
Example: Snapping a dry piece of spaghetti in half



Mechanical Properties of Materials

Hardness: resistant to penetration and scratching

Elasticity: deforms, then returns to its original shape

Resilience: resists shocks

Fragility: breaks easily

Stiffness: resists deformation

Metals

Ductility: stretches without breaking and retains its new shape

Malleability: can be flattened or bent without breaking and retains its new shape



Constraints Exerted on Materials

Constraint	Effect on the Material	Symbol
Compression	Crushing	
Tension	Stretching	
Torsion	Twisting	
Bending	Folding or bending	
Shearing	Tearing or splitting	



Non-Mechanical Properties of Materials

- Electrical conductivity
- Thermal conductivity
- Lightness (low density)
- Chemical neutrality
- Heat resistance
- Corrosion resistance

Types of Materials



Ceramics

Recognised for the following properties:

- Hardness
- Stiffness
- Fragility
- Chemical neutrality
- Heat resistance
- Corrosion resistance



Plastics: Thermoplastics

Recognised for the following properties:

- Resilience
- Elasticity
- Chemical neutrality
- Corrosion resistance
- Remouldable if heated




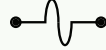






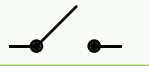
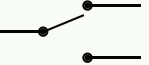

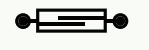


Plastics: Thermosets

Recognised for the following properties:


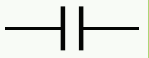

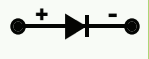



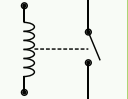


- Hardness
- Stiffness
- Resilience
- Corrosion resistance
- Heat resistance
- Maintains its stiffness when heated
- (Cannot be remoulded!)

Technological World Review – Applied Science and Technology (AST) – Cont.

Electrical Functions	
Function	Example and Symbol
Power supply	Battery  Electrical outlet 
Conduction	Conducting wire 
Insulation	Plastic sheath
Protection	Fuse  Circuit breaker
Energy transformation	Light bulb (Electrical → Radiant) 
	Heating element (Electrical → Thermal) 
	Motor (Electrical → Mechanical) 
	Indicator light (Electrical → Radiant) 
	Audible warning device (Electrical → Mechanical) 
	Speaker or alarm (Electrical → Mechanical) 
Control	Examples of unipolar switches
	Rocker switch 
	Double-throw switch 
	Push-button switch 
	Magnetic switch 

A unipolar switch has only 1 contact that closes the switch.

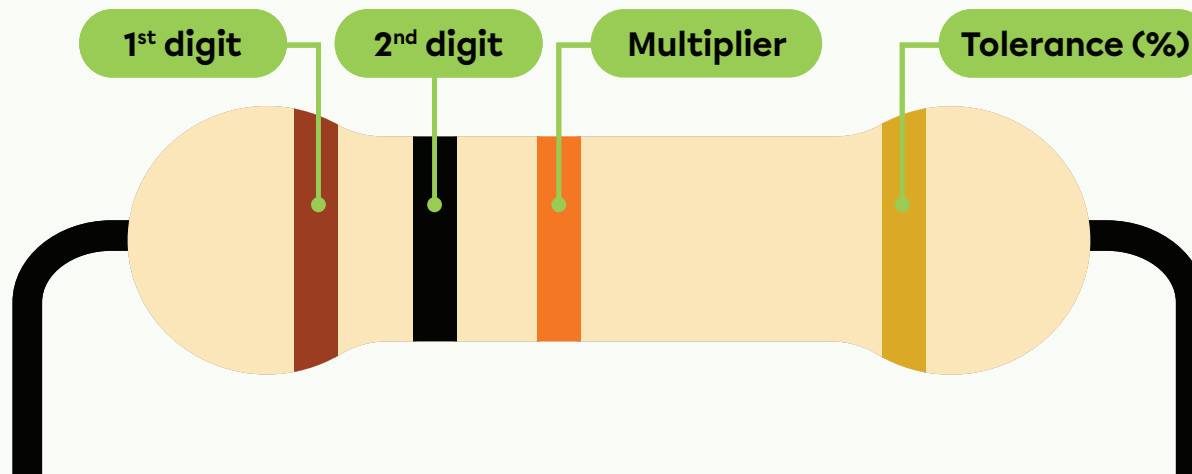
Machining Techniques	
Technique	Description
Cambering	Permanently bending a material to give it a curved shape
Bending	Permanently bending a material to give it an angled shape
Threading	Engraving threads around a cylindrical part
Tapping	Engraving threads inside a previously drilled material
Drilling	Making a round hole in a material

Other Electrical Components and Their Functions		
	A capacitor accumulates electrical charges, then discharges by rapidly releasing them.	
	A diode allows current to flow in one direction only.	
	A light-emitting diode (LED) is a diode that emits light.	
	A relay opens and closes an electrical circuit in response to a signal from another electrical circuit nearby.	
	A resistor reduces the flow of current in an electric circuit.	



The Colour Code for Determining the Resistance of a Resistor

	Black	Brown	Red	Orange	Yellow	Green	Blue	Purple	Grey	White	Gold	Silver
Digit	0	1	2	3	4	5	6	7	8	9		
Multiplier	1	10	10^2	10^3	10^4	10^5	10^6					
Tolerance (%)	20										5	10



The 1st band is brown: the 1st digit is 1.
The 2nd band is black: the 2nd digit is 0.
The 3rd band is orange: the multiplier is 10^3 .
The 4th band is gold: the tolerance is $\pm 5\%$.

$R = 10\,000\ \Omega \pm 5\%$
The resistance is between $9\,500\ \Omega$ and $10\,500\ \Omega$.



Guiding Control

Types of Guiding Control	Symbol
Rotational	
Helical	
Translational	



Adhesion and Friction

Two surfaces in contact can slide over each other.

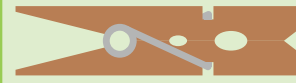
- There is **adhesion** if there is **no** movement.
- There is **friction** if there is movement.



Linking

A link always has 4 of 8 possible characteristics. Here are 2 examples.

Two-Piece Wooden Clothespin



- Indirect
- Flexible
- Removable
- Partial

Screwdriver Handle and Shaft



- Direct
- Rigid
- Permanent
- Complete



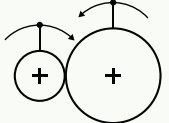
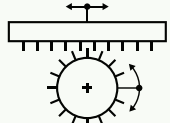
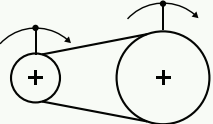
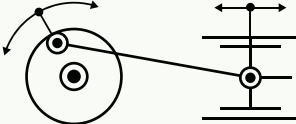
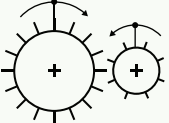
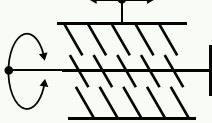
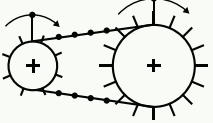
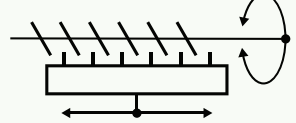
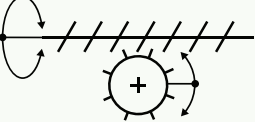
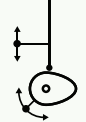



Degrees of Freedom of Links

Degrees of freedom are the six possible independent motions between parts in a technical object.

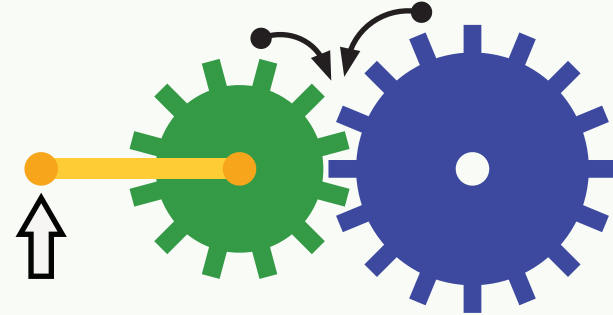
Translation	<ul style="list-style-type: none"> • Along the x-axis • Along the y-axis • Along the z-axis 	
Rotation	<ul style="list-style-type: none"> • Along the x-axis • Along the y-axis • Along the z-axis 	

Mechanisms

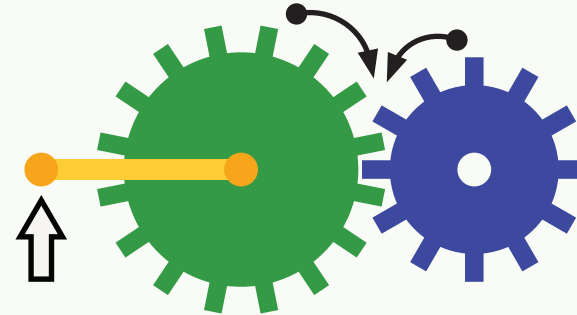
 Motion Transmission	 Motion Transformation
Friction gears (R) 	Rack and pinion (R) 
Belt and pulleys (R) 	Connecting rod and crank (R) 
Sprocket wheels (R) 	Screw gear system (R) 
Sprocket wheels and chain (R) 	Worm and rack (R) 
Worm and worm gear (R) 	Cam and roller (R) 
 Legend	
R Reversible R Non-reversible	

Speed Changes

There is a **decrease** in speed if the movement is transmitted from a small wheel to a large wheel (Ratio < 1).



There is an **increase** in speed if the movement is transmitted from a large wheel to a small wheel (Ratio > 1).



$$\text{Gear ratio} = \frac{\text{Number of teeth on the driving gear}}{\text{Number of teeth on the driven gear}}$$

$$\text{Diameter ratio} = \frac{\text{Driving wheel diameter}}{\text{Driven wheel diameter}}$$

A **wheel and worm gear** mechanism always results in a **decrease** in speed.

$$\text{Speed ratio} = \frac{1}{\text{Number of teeth on the driven wheel}}$$



Caution!

A cam is said to be **eccentric** when its rotational axis is off-centre.

The further the axis is from the centre, the greater the amplitude of the follower's movement.

