Section 7: Feature representations - recognition

PURPOSE
This section aims to enable the student to extend their knowledge of Drawing Interpretation from Engineering Drawings produced to AS1100 standard.

Objectives

At the end of this section you should be able to:

- ☐ Identify symbols used in Engineering Drawing.
  - General
  - Electrical
  - Welding
  - Fluid power
  - Mechanical

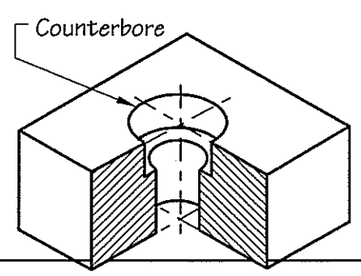
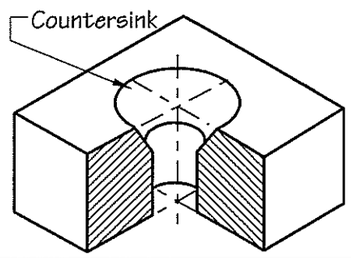
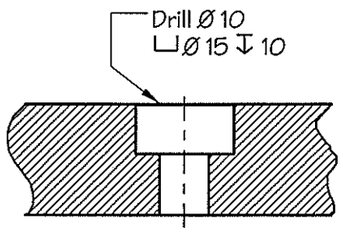
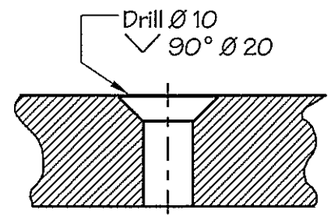
Completion guidance

This section provide an outline of the symbols used in drawings in the objectives stated above. It is expected all students will be able to identify 'general drawing symbols' and those from one of the bulleted list in the objectives. The remaining types of symbols should be covered briefly, so that a student can recognise a drawing or sketch with symbols as being from one of the three remaining areas.

To be effective and competent in the reading of and interpretation of engineering drawings, it is critical that we have a sound awareness of the names given to common features and their function. A lot of these features are designated using abbreviations and symbols in order to save time when producing a drawing, that is CSK - countersink or countersunk, c'bore - counterbore, PCD - pitch circle diameter.

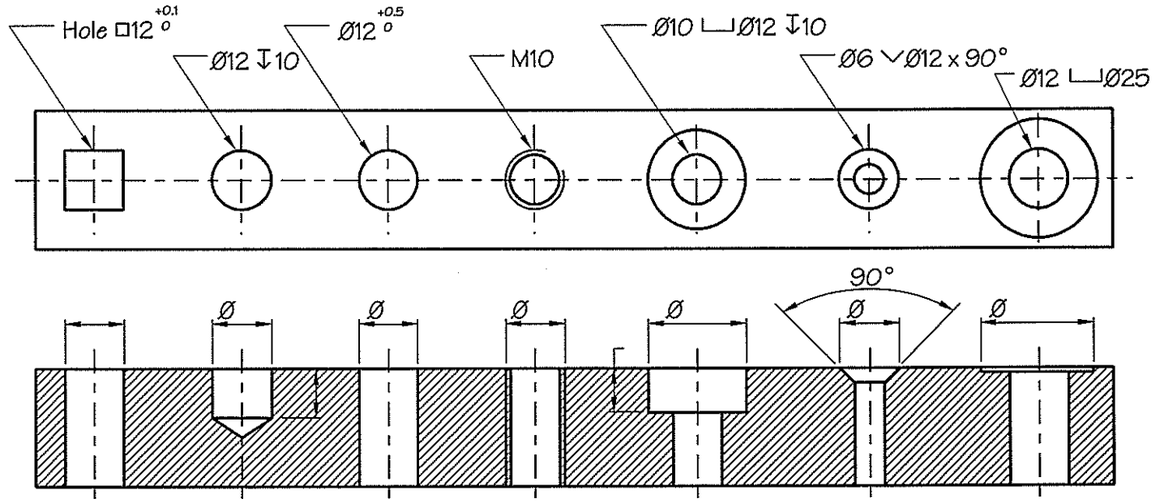
General symbols

Symbol	Feature	Example	Symbol	Feature	Example
Ø	Diameter	Ø 50		Slope and its direction	1:10
R	Radius	R 30	( )	A reference dimension	(620)
℄	Centre line	℄		Dimension not drawn t scale	60
FL	Flat (material)	50 x 20 FL		Countersink (csk)	ø3
PL	Plate (material)	10 PL		Counter bore (cbore)	ø10
□	To indicate square	□75	↧	Depth of a feature	↧5
	A taper and its direction	3:100			

Pictorial representation		
Orthogonal representation		

Exercise 7-1

1. Indicate corresponding dimensions on Section A-A



Section A-A

2. Fill in the missing details on the table below.

Symbol	Description	Symbol	Description
Ø			countersink
	Spotface		Counterbore
□			Depth of feature
		40 x 10 FL	
	5 mm thick plate	℄	

Electrical symbols

Electrical symbols are a graphical representation of a component or item to be used in a diagram. Symbols are seen as a convenient means of representing items in a diagram as they allow:

- A symbol to replace the actual drawing of the item.
- Items with similar appearances, but different functions, to be easily shown.

Standard symbols in Australia comply with ISO (International Standards Organisation). They are shown in Australian Standard 1102 (AS1102) Parts 1 to 15. Some symbols from Parts 1 to 15 are included in this workbook to assist you to identify them on a drawing. SAA HB3 - 1986 is also a useful reference.

Electrical diagrams

There are four basic types of electrical diagrams included in this workbook and used in industry. They are:

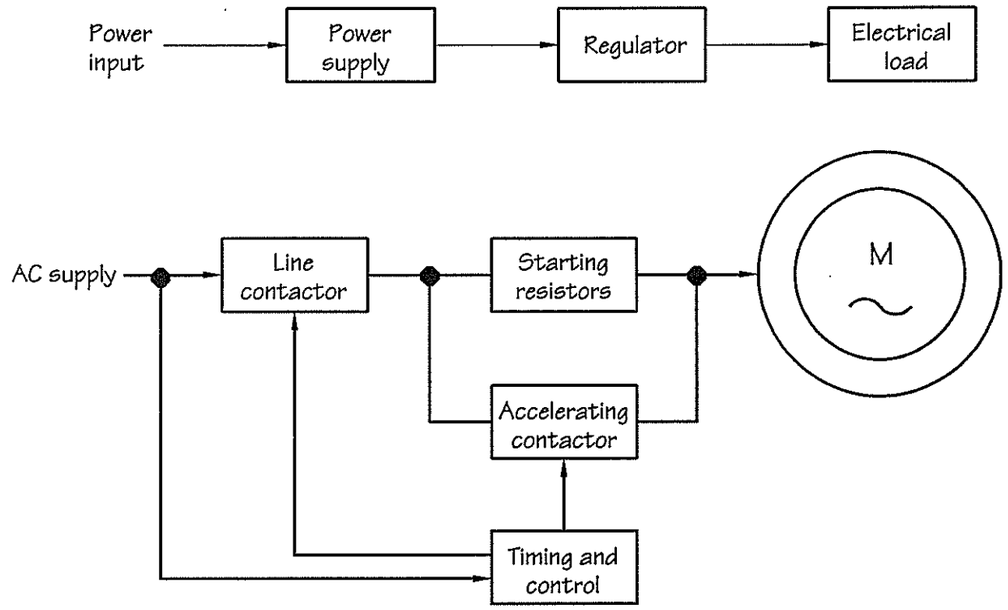
- Block diagrams
- Circuit diagrams
- Wiring diagrams
- Architectural diagrams

Competence in using electrical diagrams is essential for all electrical/electronic students. For detailed knowledge students should complete NE31 Electrical Drawing, Interpretation and Connection.

The work included here is intended to provide a brief overview and some understanding of the application of electrical symbols. Within this module you are expected to be able to explain why standard symbols are used to represent components on electrical diagrams and identify some common electrical symbols.

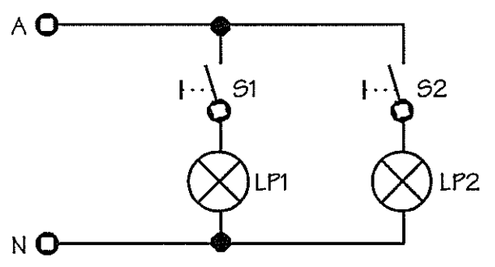
Block diagrams

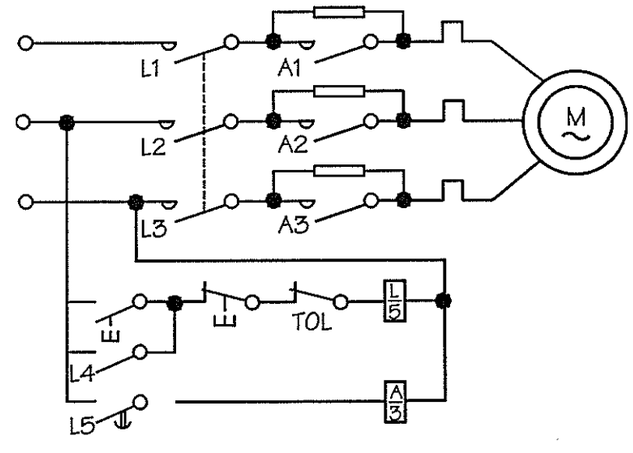
These are simple diagrams intended to aid the understanding of the principle of operation of a circuit or system. A block diagram on its own is of little use as it displays limited information.



Circuit diagrams

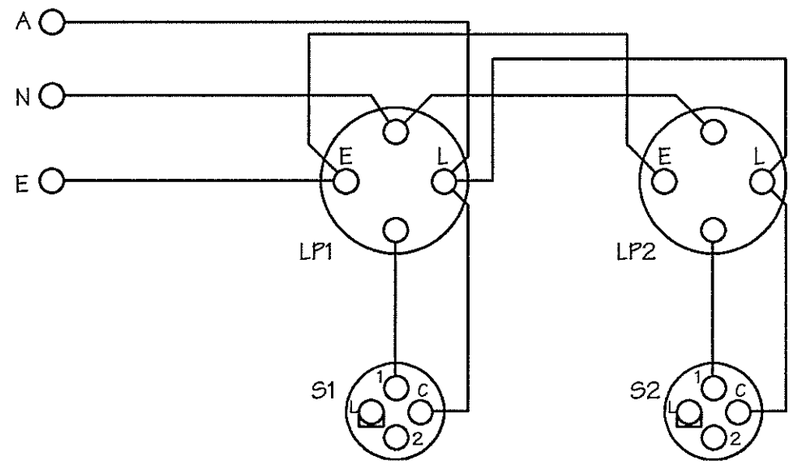
These are detailed diagrams which should describe the operation of a circuit. Circuit diagrams are sometimes called 'schematic diagrams'. Circuit diagrams do not necessarily represent the actual physical layout of the equipment and wiring. Typical circuit diagrams are shown.





Wiring diagrams

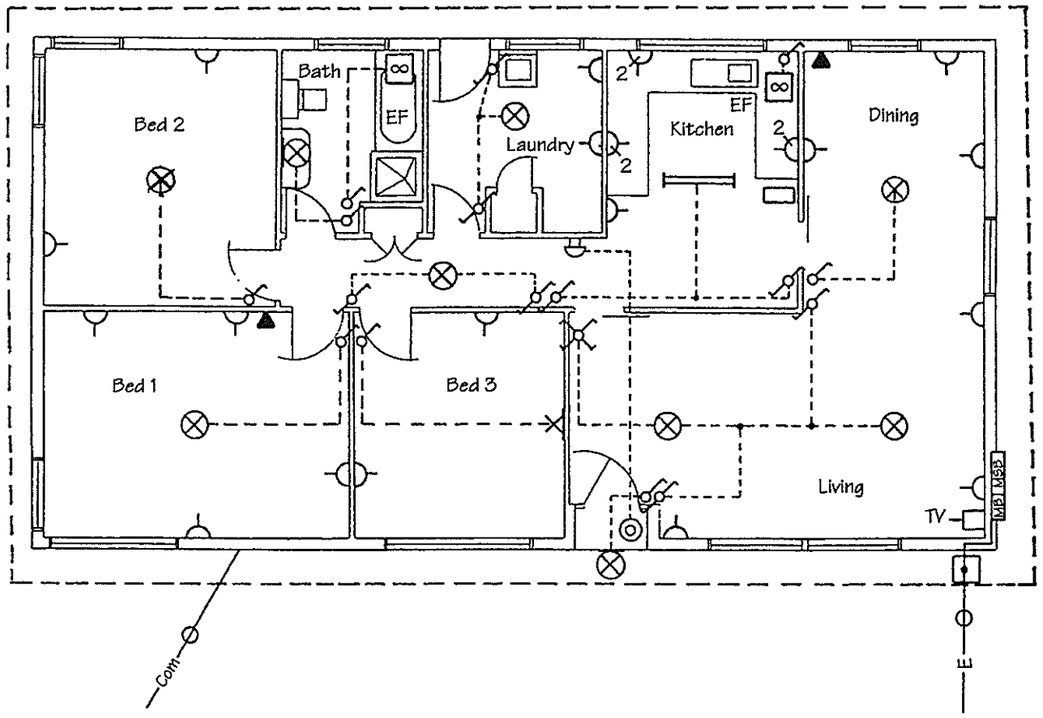
These are detailed diagrams showing the way in which a circuit or system is actually wired and assembled. Components are often drawn in a simplified way in which the outline and external connections (terminals) are shown. All 'terminal to terminal' connections showing the necessary conductors (wiring) required to connect the circuit are shown.



Wiring diagram - basic lighting circuit

Architectural diagrams (layout diagrams)

These show various features related to the construction of a building. A typical diagram is shown. They are also called 'layout or site diagrams'.



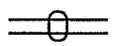
Electrical/Electronic symbols

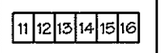
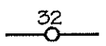
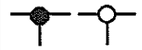
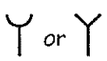
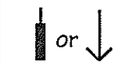
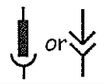
This short table has been assembled from SAA HB3 - 1986 - Electrical & Electronic Drawing Practice for students. For detailed information students should refer to that book or parts 1 to 15 of AS 1102.

Part 1 - General qualifying and supplementary symbols

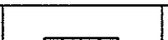
Description	Symbol	Description	Symbol	Description	Symbol
Direct current or steady voltage		Alternating current *General symbol*		Suitable for use on either direct or alternating current	
Positive polarity		Negative polarity		Mechanical, pneumatic or hydraulic connection *General symbol*	
Mechanical coupling *General symbol*		Mechanical interlock		Manually operated *General symbol*	
Operated by pushing		Operated by turning		Emergency switch	
Boundary line		Fault. The same symbol is used on equipment to indicate a dangerous voltage		Filament lamp	
Discharge lamp, gas filled *General symbol*		Signal lamp		Indicator	
Electric bell		Electric buzzer		Primary cell or accumulator. The long line represents the positive pole, the short line the negative pole	
Battery of accumulators or primary cells		The primary symbol may be used to indicate a battery. The nominal voltage should then be indicated		Example of nominal voltage in a battery	
Earth (ground)		Frame or chassis connection			

Part 2 - Conductors and connecting devices

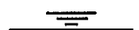
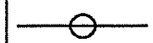
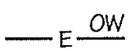
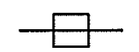
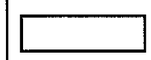
Conductor or group of conductors. A line for a particular path may be emphasised by increasing its thickness		Cable *General symbol*		Two-conductor cable	

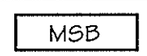
Description	Symbol	Description	Symbol	Description	Symbol
Terminal strip		Terminals or tags may be numbered as shown		Junction of conductors using terminals	
Junction of conductors		Double junction (either method shown may be used)			
Conductors, crossing without electrical connection		Socket (female) or one pole of a socket		Plug (male) or one pole of a plug	
Plug and socket (male and female)					

Part 3 - Resistors, capacitors and inductors

Heater		Variable resistor General symbol		Fixed resistor General symbol	

Part 8 - Symbols for location diagrams

Wiring or cabling in conduit, pipe or duct		Underground line		Overhead line	
Letter symbols for coding cables	E = Electrical power L = Lighting SL= Street lighting COM= Communication	Method of cable installation *Example:* Electric power cable on wall		Wiring or cabling joint	
Example: tee joint		Emergency lighting luminaire		Switchboard, distribution board, frame, panel or cubicle	

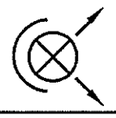
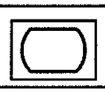
Example: Main switchboard 

Example letter symbols for coding of boards are as follows:

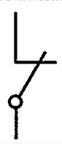
CP	= Control panel	MSB	= Main switchboard
CN	= Control station	PBS	= Push-button station
DBL	= Distribution board light	RCP	= Remote control panel
DSB	= Distribution board	RP	= Relay panel
IC	= Instrument cubicle	SAS	= Security and alarm systems
MB	= Meter board	TB	= Terminal box
MCC	= Motor control centre	TP	= Terminal panel
MK	= Marshalling kiosk		

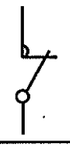
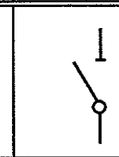
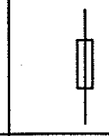
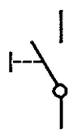
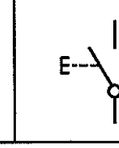
Luminaire or signal lamp		Luminaire fixed to a wall		Emergency lighting luminaire	

Part 8: Symbols for locating devices (continued)

Description	Symbol	Description	Symbol	Description	Symbol
Floodlight		Fluorescent luminaire		*Example:* Luminaire with three lamps	
Electrical appliance General symbol  Example letter symbols for coding of electrical appliances are as follows: AC = Air conditioner BWU = Boiling water unit FH = Fan heater GDU = Garbage disposal unit			*Example:* Air conditioner  H = Heater HD = Hand dryer R = Range SDU = Sanitary disposal unit		
Alternative	 	Lighting outlet position e.g. batten holder		One way switches, single-pole and two-pole	
Two-way switch		Dimmer switch		Push-button switch	
Socket outlet *General symbol*		Socket outlet for telecommunications		Example: Television	
Antenna (aerial) General symbol		Loudspeaker		Radio receiving set	
Television receiving set		Microphone		Electric bell	
Electric buzzer		Horn		Clock	
Generating station, planned		Equipped wall telephone outlet			

Part 11: Switching and protective devices

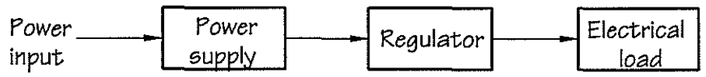
Make contact		Break contact		Changeover contact	
Make contact early to operate		Make contact late to operate		Make contact with spring return	
Make contact without spring return (stay put)		Switch General symbol		Contactor - N/O contact	

Description	Symbol	Description	Symbol	Description	Symbol
Contactor - N/C contact		Circuit breaker		Isolator	
On-load isolator		Limit switch, make contact		Fuse	
fuse switch		Manually-operated switch General symbol		Push-button switch, (non-latching)	

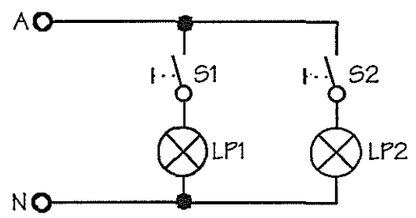
Exercise 7-2

Identify and complete the questions and statements

1. What type of diagram is this?

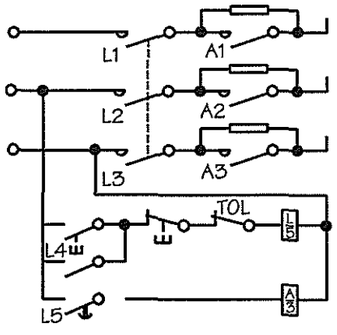


2. What type of diagram is this?

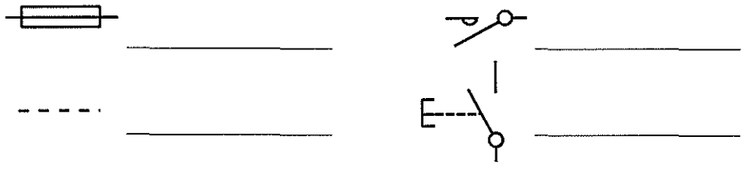


3. Identify these symbols used in the above diagram.

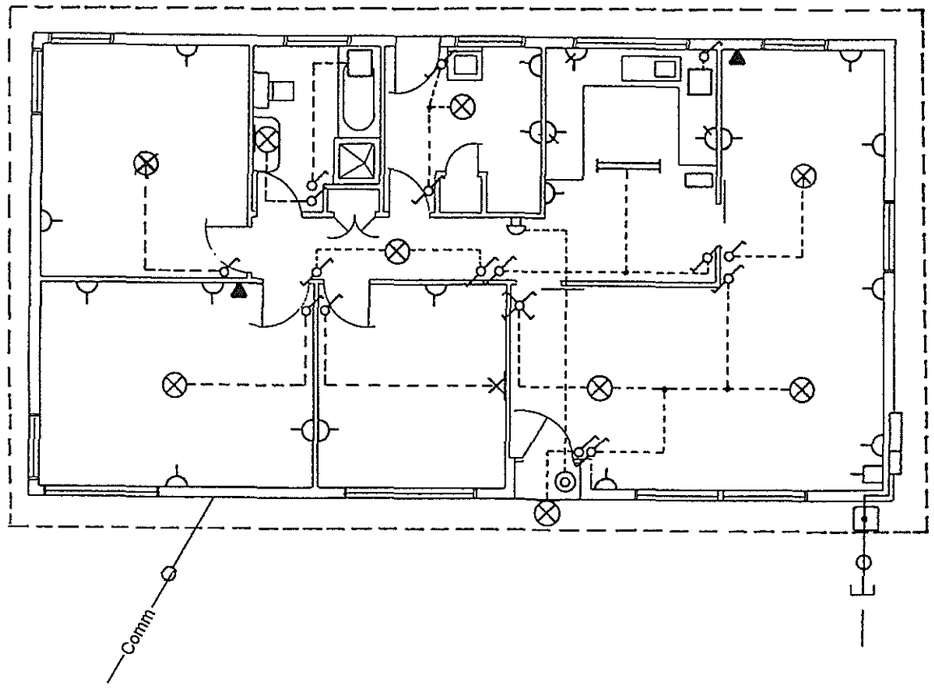
4. Identify the symbols listed below from the supplied diagram.



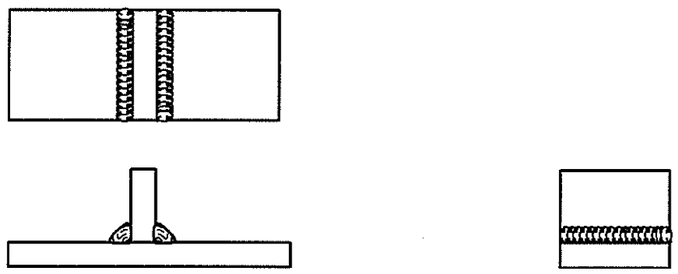
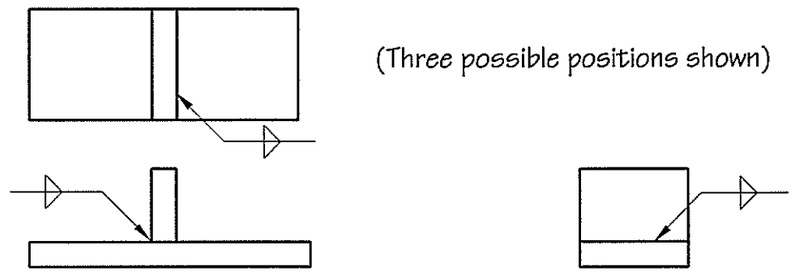
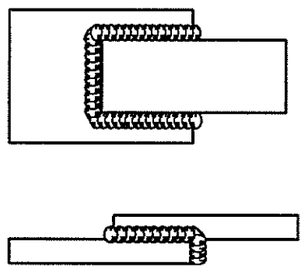
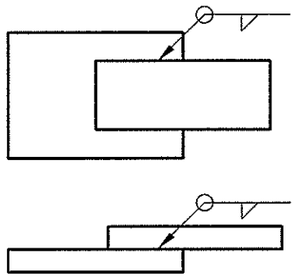
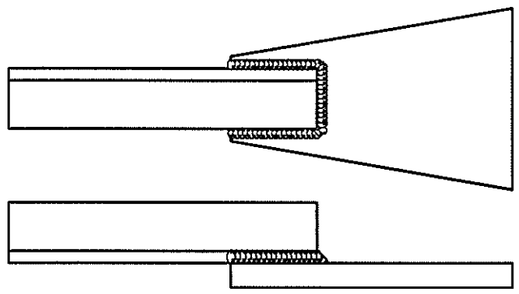
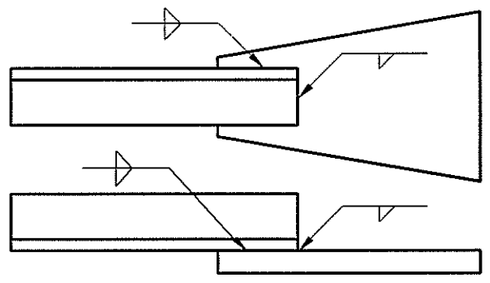
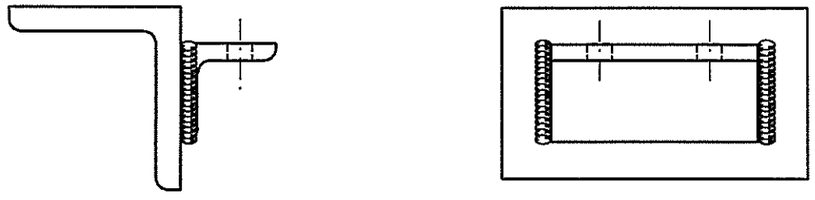
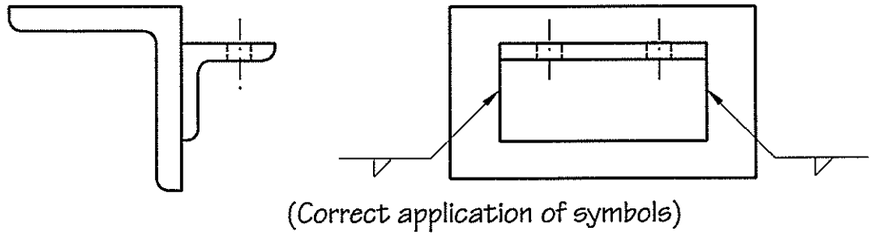
Circuit diagram - motor starter



5. Identify and complete the table showing the symbols used on the diagram.



Description	Symbol	Description	Symbol	Description	Symbol
Luminaire How many are required? _____		Luminaire fixed to a wall How many are required? _____			
		One way switch single pole			
		Push button switch		Socket outlet for television	

Application of welding symbols Drawings showing weld positions as a picture.	Symbolic representation of weld positions Note: Each symbol should be used only once on a real drawing not repeated on views.
	 (Three possible positions shown)
	 (Two possible positions shown)
	 (Two possible positions for each weld symbol shown)
	 (Correct application of symbols)

Welding Symbols

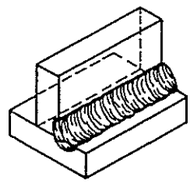
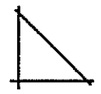
Welding symbols on drawings are shown in:

AS1101 - Graphical Symbols for General Engineering - Part 3 Welding and Non Destructive Examination.

Students should refer to the standard for more detailed information.

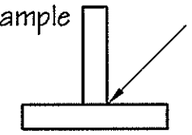
Welds - Fillet Elements of a weld symbol

The symbol

Type of weld	Sketch of weld	Symbol
Fillet		

The arrow

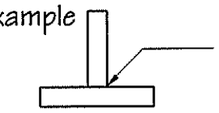
Example



The arrow points to the position of the welded joint.

The line

Example

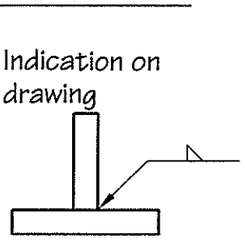


This is a reference line drawn parrallel to the base line of a particular view. The position of the symbol above or beneath this line determines the location of the weld.

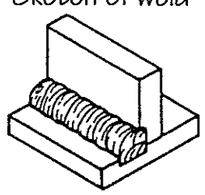
Location of weld symbols

Symbol above the line weld joint opposite side to arrow.

Indication on drawing

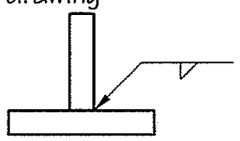


Sketch of weld

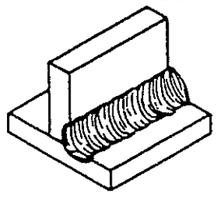


Symbol beneath the line weld joint, the same side as the arrow.

Indication on drawing



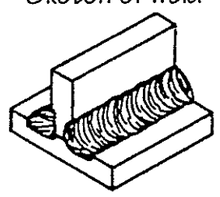
Sketch of weld



Symbol above the line

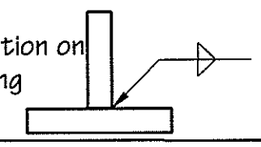
Symbol beneath the line

Sketch of weld



Weld both sides

Indication on drawing

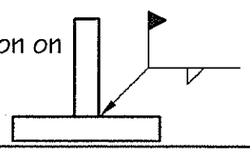


Supplementary symbols

To be welded on site or site weld.

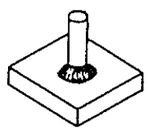
The symbol

Indication on drawing

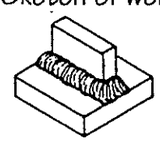


Weld all round

Sketch of weld

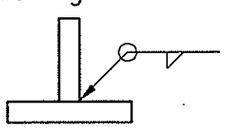


Sketch of weld



Symbol

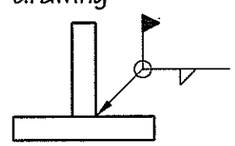
Indication on drawing



Combination of site weld and weld all round.

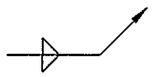
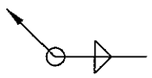
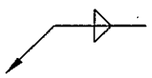
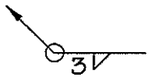
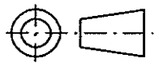
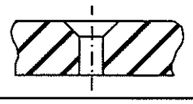
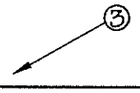
Symbol

Indication on drawing

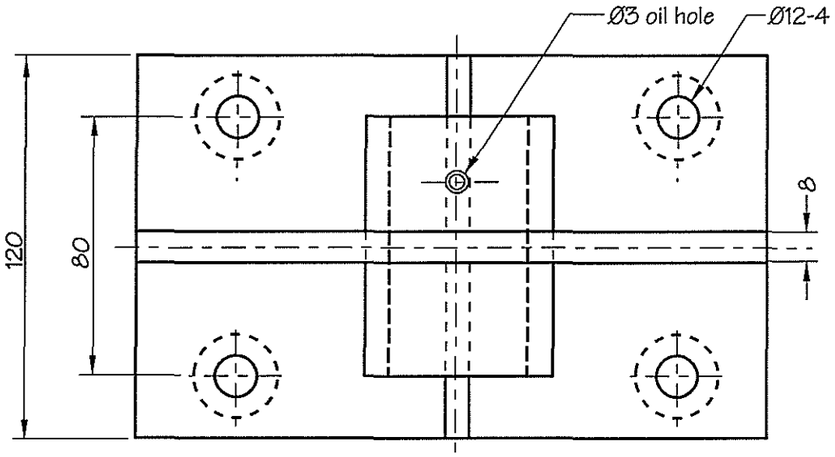


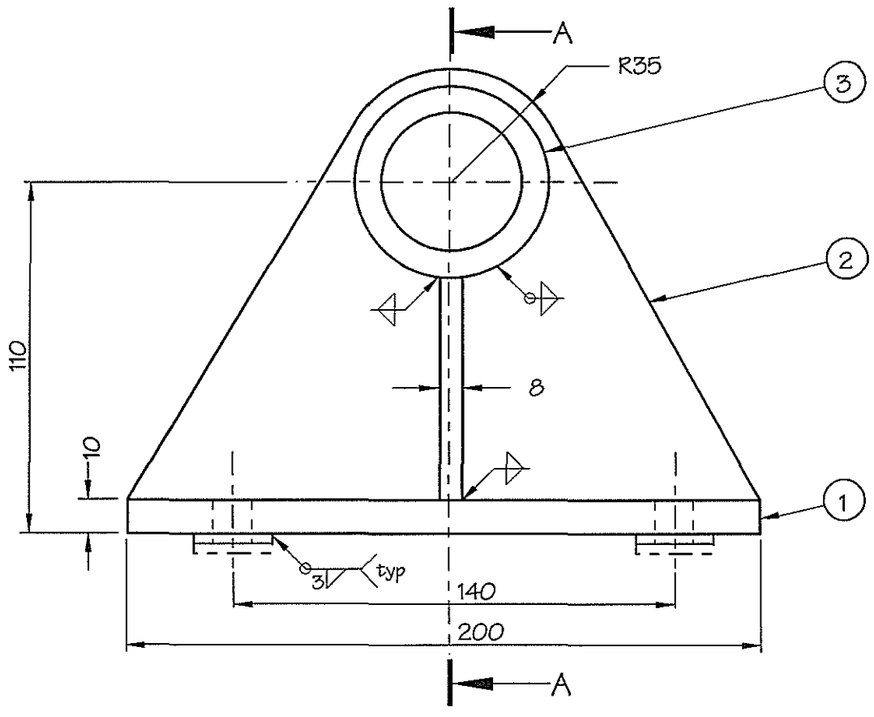
Exercise 7 - 3

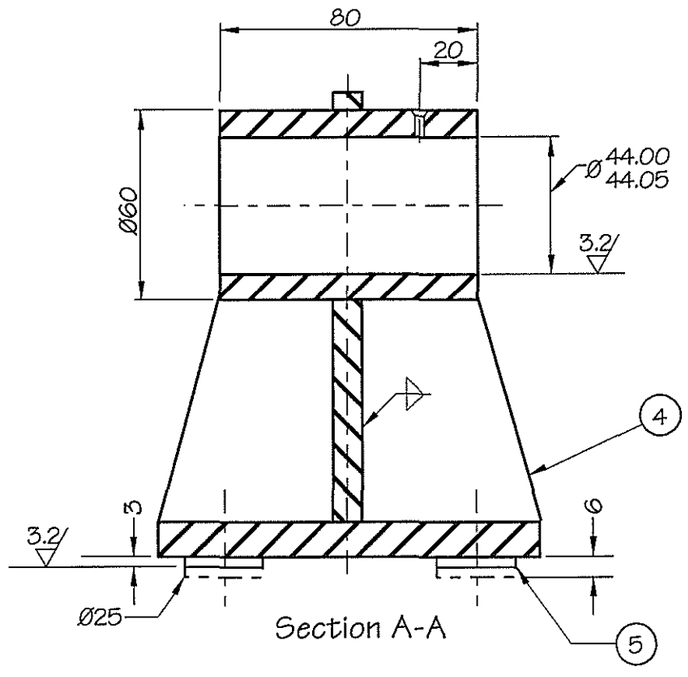
identify and complete the following table of symbols taken from drawing 02 -MF1 - MY82
Sheet MEC076 - 7 - 11

Symbol	Description	Zone
	Fillet weld size 6mm both sides of the web	C3
		C3
		C3
		C3
	Fillet weld size 6mm both sides of the web	C5
UNO		D2
M.S.		D5
		A1
		B5
Ø		B4
	Radius 35	B3
		

DO NOT SCALE
ALL DIMENSIONS IN MILLIMETRES







Section A-A

All welds 6mm fillet UNO

PARTS LIST

ITEM	DESCRIPTION	SIZE	MAT'L
5	ROUND BAR	Ø25x6	MS
4	MINOR WEBS	70x8x56	MS
3	ROUND BAR	Ø60x80	MS
2	MAIN WEB	200x8x135	MS
1	BASE PLATE	200x10x120	MS

ISSUE	DATE	ZONE	CHANGE	ECN	BY	CKD
A	7/3/98		FIRST ISSUE		LZ	BB

AMENDMENTS

UNLESS NOTED OTHERWISE TOLERANCES ARE:

LINEAR: ±0.5

ANGULAR: ±0° - 30'

DRAWING PRACTICE AS 1100

MATERIAL: M.S.

FINISH UNO 12.5

DRAWN LZ
TRACED
CHECKED JB
APPROVED BB
ISSUED 7 - 3 - 98
RECORD OF ISSUE

A

TAFE NSW

MANUFACTURING AND ENGINEERING
EDUCATIONAL SERVICES DIVISION

TITLE

SHAFT SUPPORT BEARING

SCALE 1:2 | SIZE A3 | DRG N° 02 - MF 1 - MY 98 | SHT 1 OF 1

Fluid power symbols

Fluid power symbols are standardised in:
AS1101 - Graphic Symbols for General Engineering Part1 - Hydraulic and Pneumatic Systems
Fluid power is the umbrella term for both hydraulic and pneumatic systems.

In most cases hydraulic circuits can be identified by the simplified general symbol being shown. They also normally show a return to an external reservoir.

Pneumatic circuits can usually be identified by the simplified general symbol being shown. They also normally show a return to an exhaust port.

Fluid flow symbols

Description	Symbol	Description	Symbol	Description	Symbol
Pneumatic		Hydraulic		Outlet pneumatic	

Flow generator symbols

Uni-directional compressor (pneumatic)		Uni-directional hydraulic pump		Electric motor	M
Heat engine (internal combustion engine)	M	Mechanical connection			

Flow generator symbols examples

M		M		M	
Power supply					

Fluid conductor symbols

Working line (feed & return lines)		Drain line (short dashes)		Pilot line (long dashes)	
Flexible working line (a pilot or drain flexible line could also be drawn)		A teed connection (the dot at the join indicates the connection)		A crossed connection (the dot at the join indicates the crossed connection)	
Description	Symbol	Description	Symbol	Description	Symbol

Crossing lines NOT CONNECTED (no dot at the intersection of the lines)		Hydraulic and Pneumatic		Crossing lines not connected (the arc does not indicate a flexible line)	

Fluid storage unit symbols

Atmospheric reservoir		Line ending below the fluid level		Line ending above the fluid level	
Header line					

Gauge symbols

Pressure gauge		Temperature gauge		Flow meter	

Directional control valves

2/2 2 ports/2 positions		3/2 3 ports/2 positions		3/2 3 ports/2 positions	
5/2 5 ports/2 positions		4/3 4 ports/3 positions with a closed centre		4/3 4 ports/3 positions with a open centre	
4/3 4 ports/3 positions with a float centre		4/3 4 ports/3 positions with a tandem centre		5/3 5 ports/3 positions with a float centre	
5/3 5 ports/3 positions with a closed centre					

Manual actuation methods

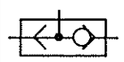
General manual operation		Push button operation		Lever operation	

Silencer symbol		Lubricator symbol			

Air service unit symbols

Detailed symbol		Simplified symbol	

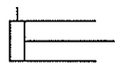
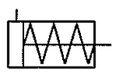
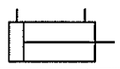
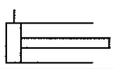
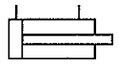
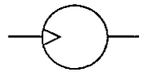
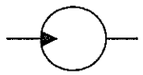
Check, shuttle and stop valve symbols

Description	Symbol	Description	Symbol	Description	Symbol
Shut-off valve		Shuttle valve		Basic check (non-return valve)	
Spring loaded check		Pilot pressure to close check (non-return valve)		Pilot pressure to Open check (non-return valve)	

Pressure control valve actuation methods

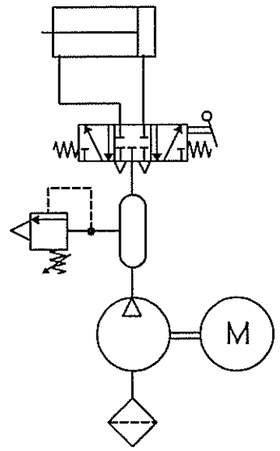
Spring operated		Variable setting			

Actuator symbols

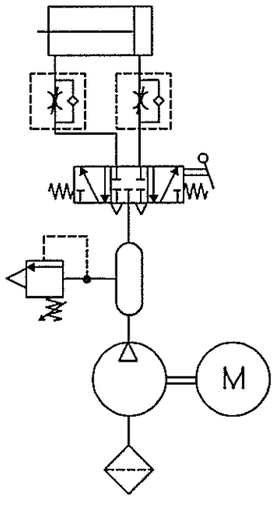
Description	Symbol	Description	Symbol
Single acting load or gravity return piston type cylinder		Single action spring return piston type cylinder	
Double acting piston type cylinder		Single acting load or return ram type cylinder	
Double acting ram type cylinder		Pneumatic motor	
Hydraulic motor			

Examples of pneumatic circuits

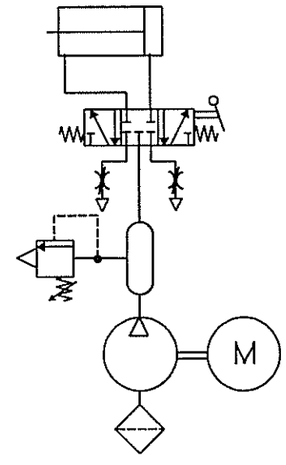
Pneumatic circuit



Meter-out

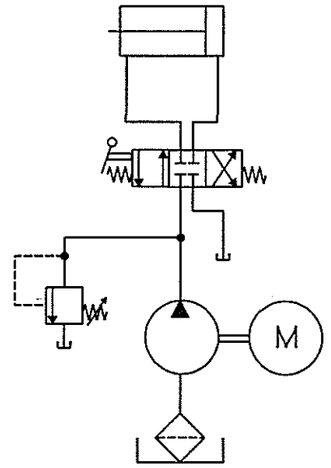


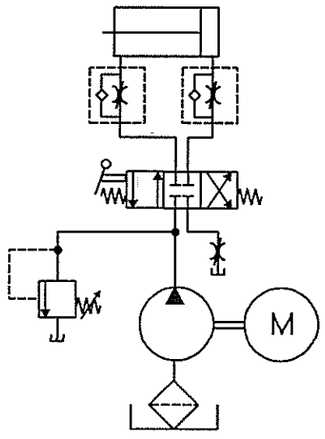
Exhaust throttle



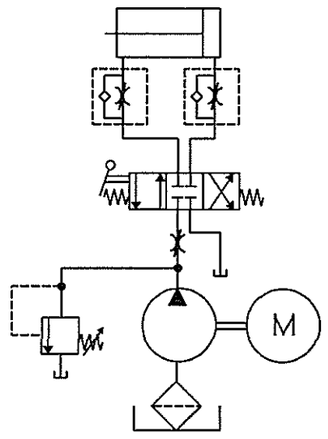
Examples of hydraulic circuits

Hydraulic circuit

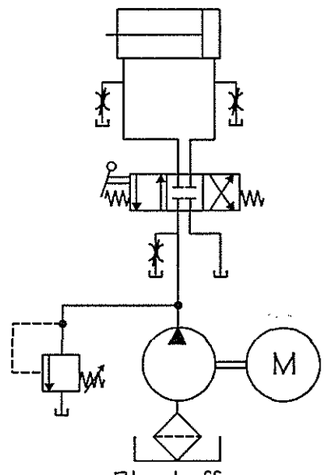




Meter out



Meter in

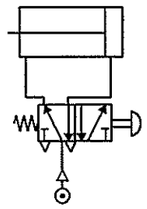


Bleed off

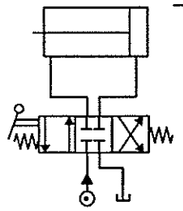
Exercise 7-4

Identify and complete the following questions and statements.

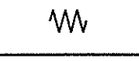
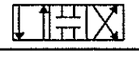
1. What type of circuit is this?



2. What type of circuit is this?

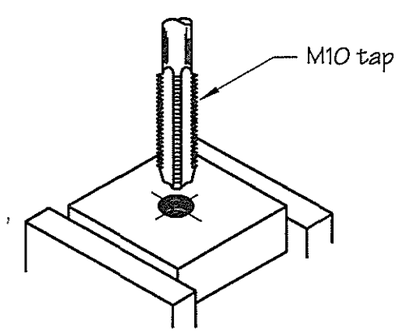
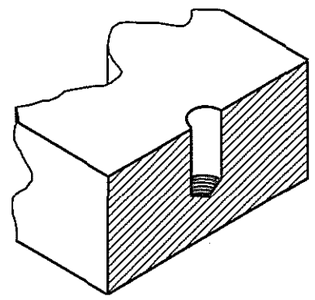
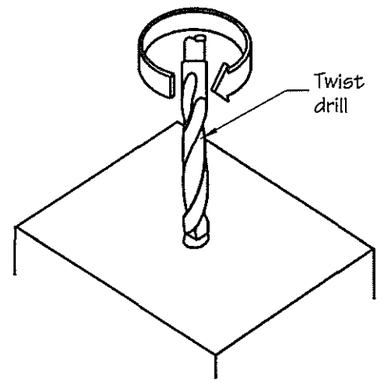
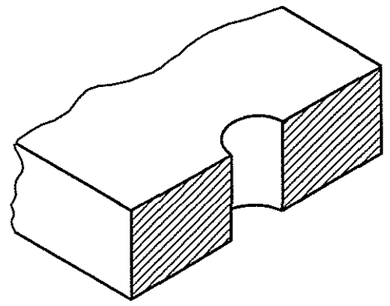
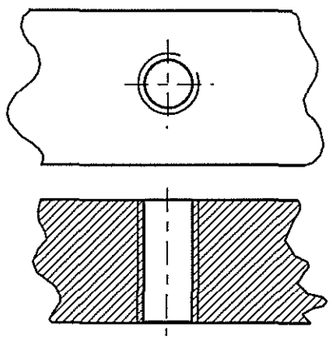
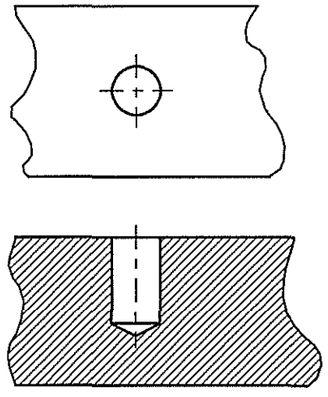
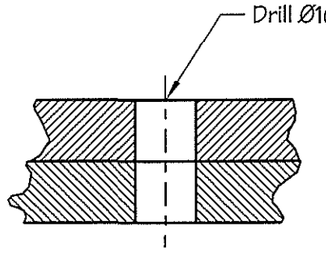
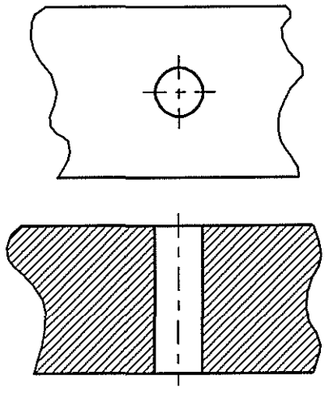


3. Complete the table below using symbols taken from the circuits shown in this section.

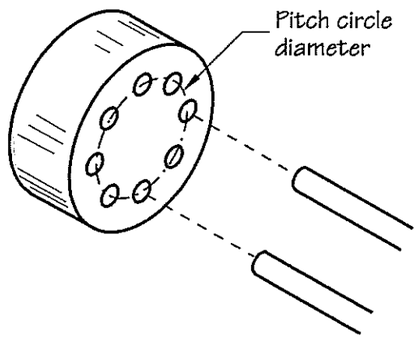
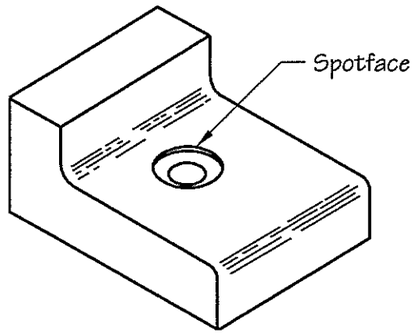
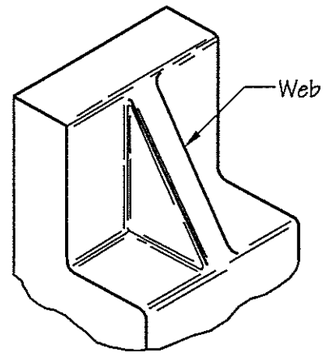
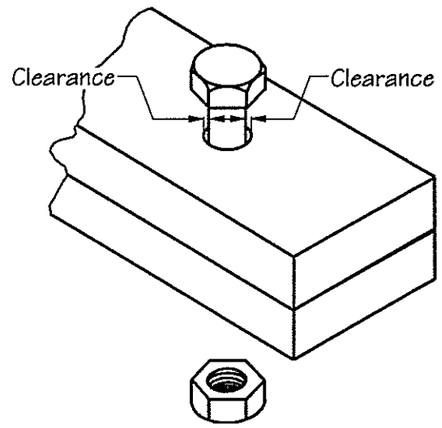
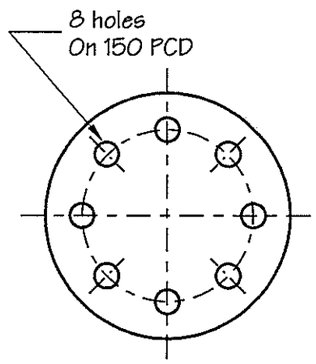
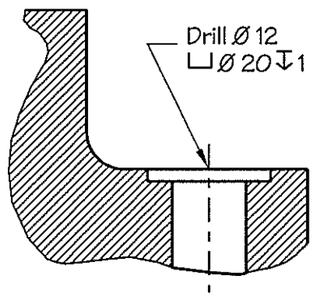
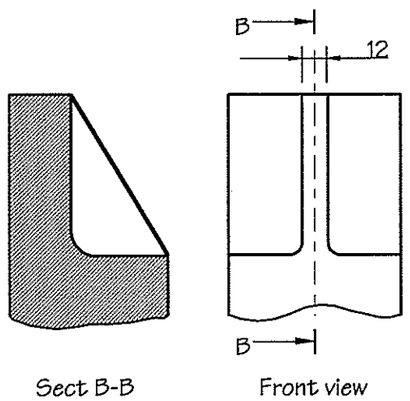
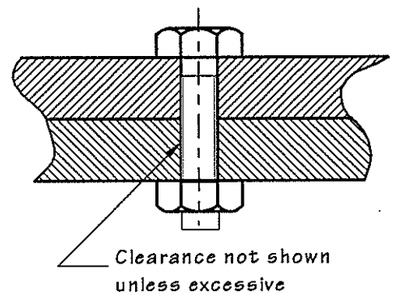
Symbol	Description	Symbol	Description
			Lever operation
			
	Push button operation		
			Atmospheric reservoir
			
			

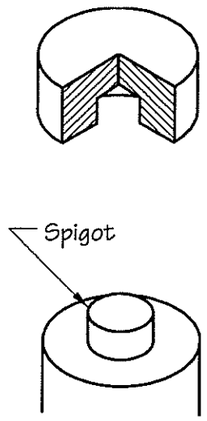
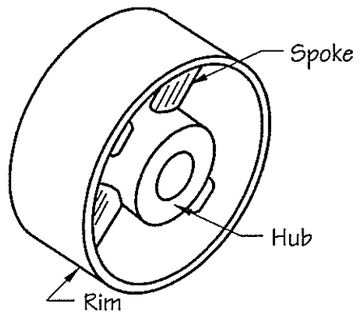
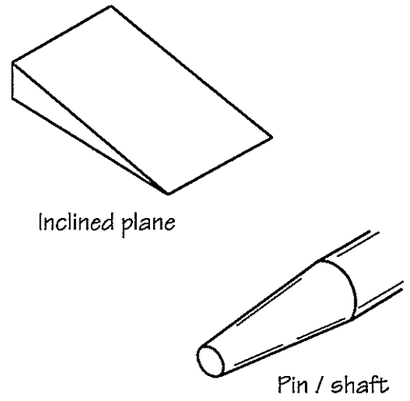
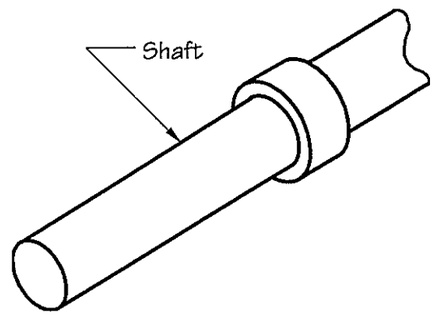
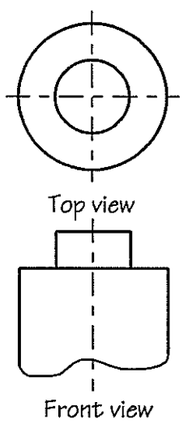
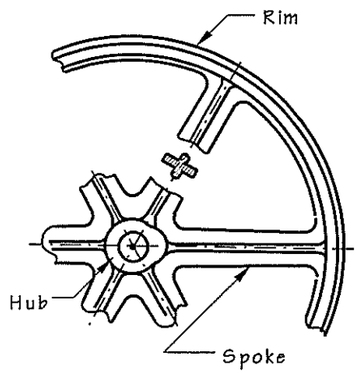
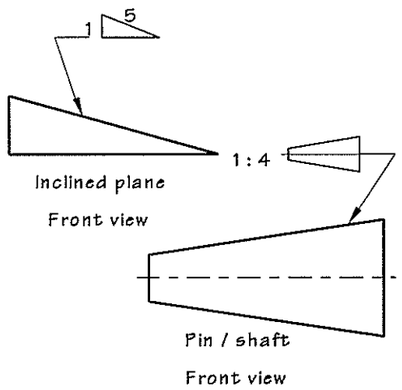
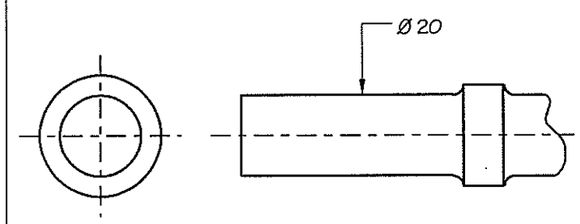
Mechanical symbols

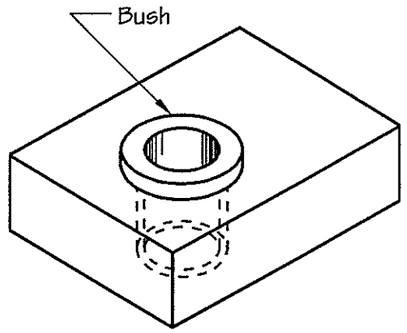
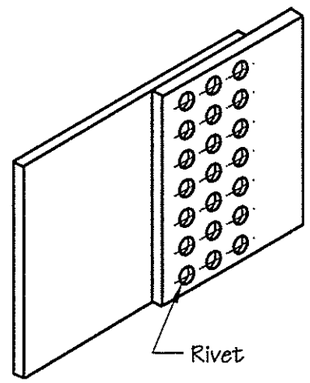
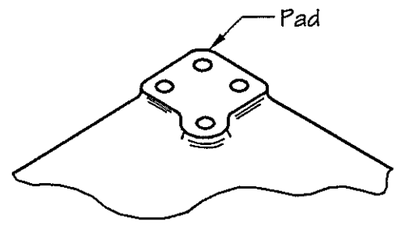
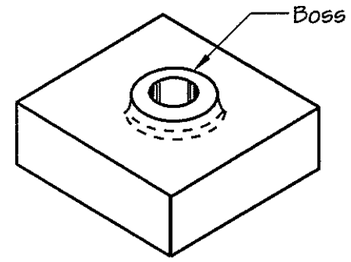
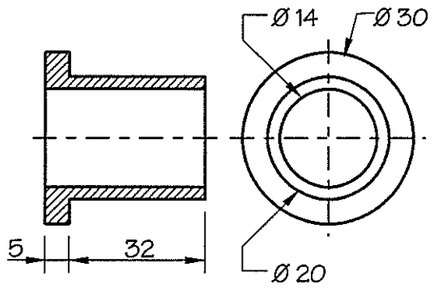
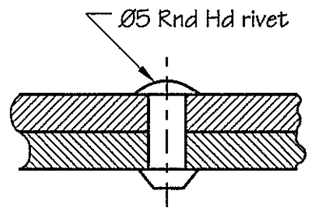
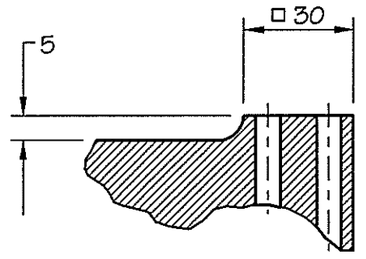
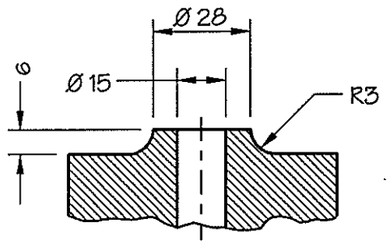
Mechanical symbols are featured in this part of the section. For more detailed information, students should refer to AS1100 - Part 201 - Mechanical Drawing.

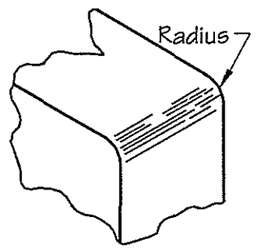
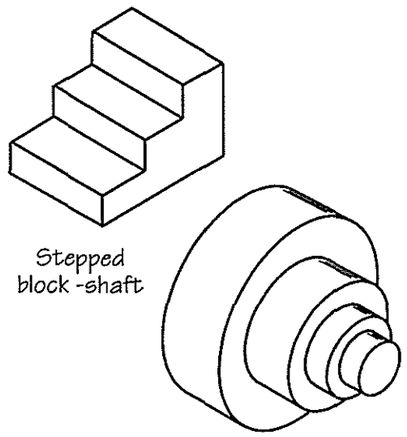
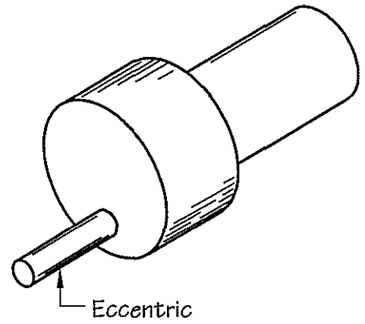
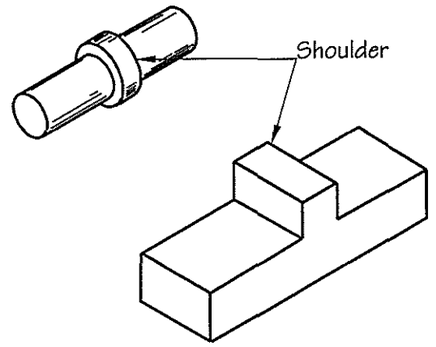
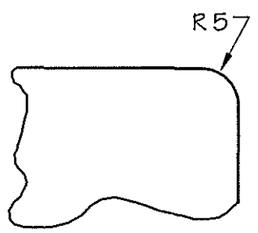
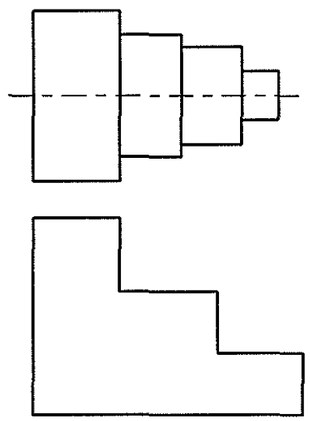
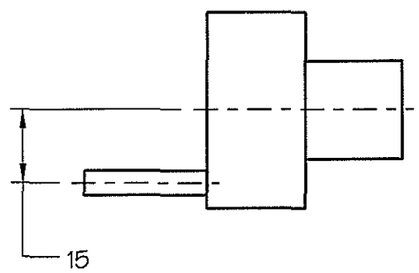
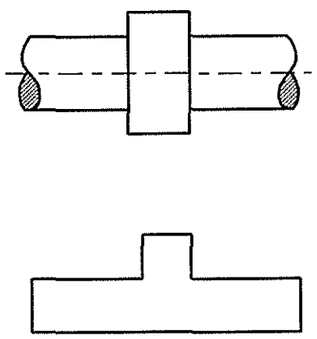
	Physical features			
	Tap	Blind hole	Drill	Through hole
Definition	The cutting tool used to produce internal screw threads	A hole which is partly drilled through an object.	To make a cylindrical hole with a cutting tool called a twist drill.	A hole drilled through the entire thickness of an object.
Pictorial representation				
Orthogonal representation				

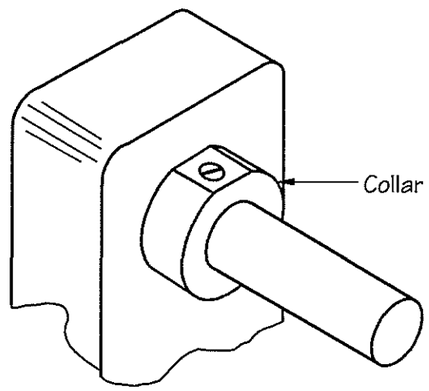
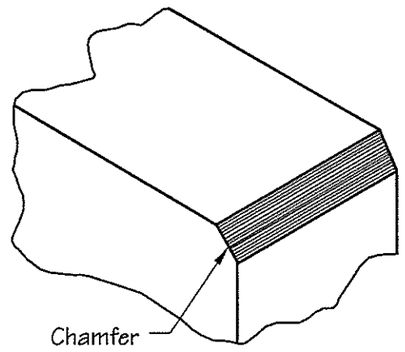
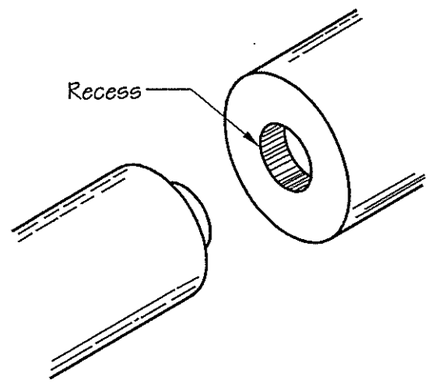
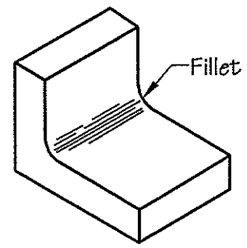
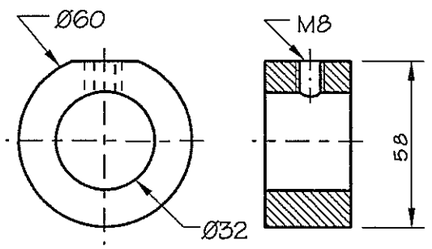
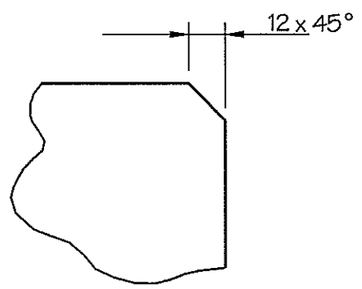
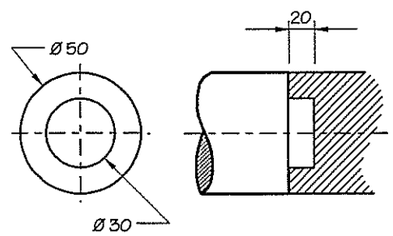
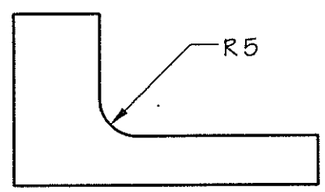
Physical features

	Pitch circle diameter	Spotface	Web	Clearance
Definition	The diameter of a circle centre line on which holes or other features are located.	A circular machined area around a hole at right angles to the axis of the hole.	A thin flat member acting as a brace or support. It increases strength without greatly increasing weight.	That space provided between parts or a mechanical assembly to ensure easy separation of the parts.
Pictorial representation				
Orthogonal representation				

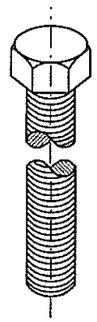
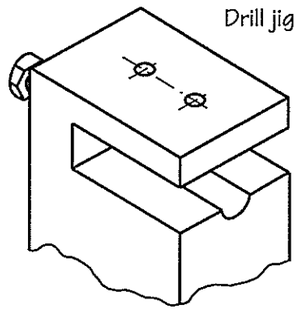
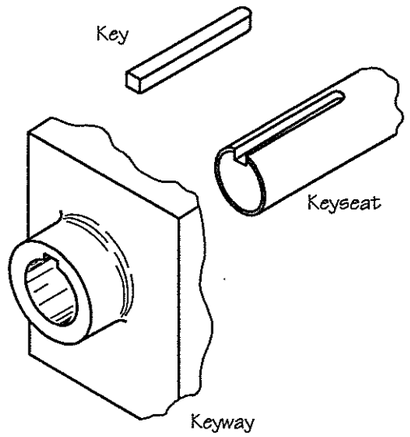
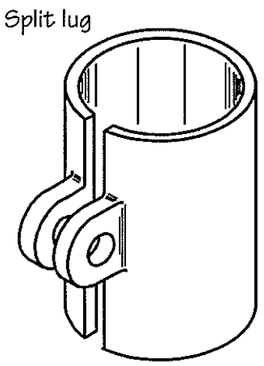
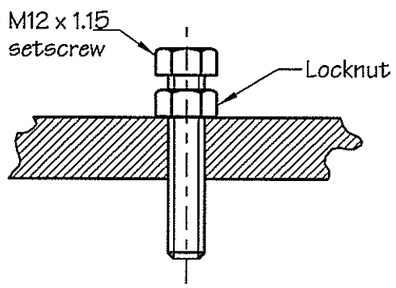
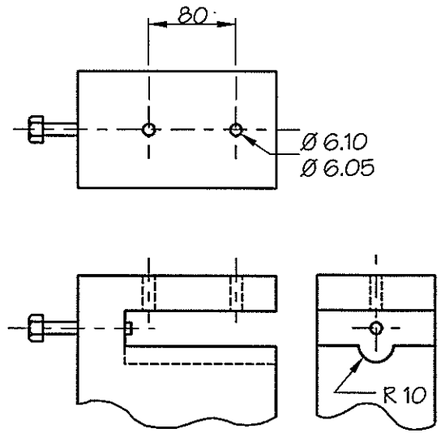
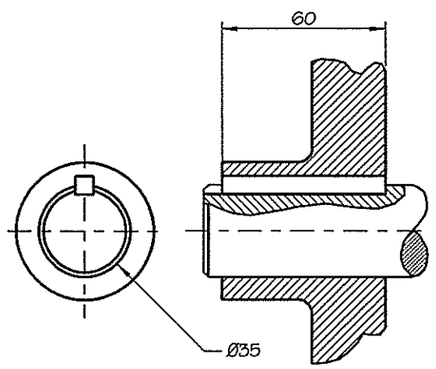
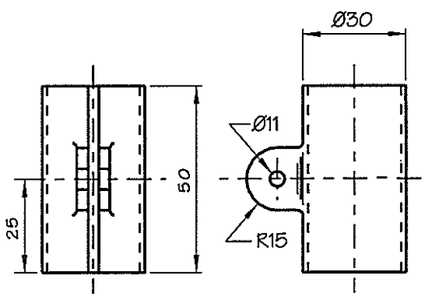
	Physical features			
	Spigot	Spoke	Taper	Shaft
Definition	A protruding cylinder or plug which fits into a mating hole so that parts can be fitted together.	Any one of the bars which connect the rim and hub of a wheel.	1. An incline plane surface. 2. The conical form given to a pin or shaft (like the end of a pencil) or hole.	A cylindrical piece of metal used to carry rotating machine parts such as pulleys or gears, to transmit power or motion.
Pictorial representation				
Orthogonal representation				

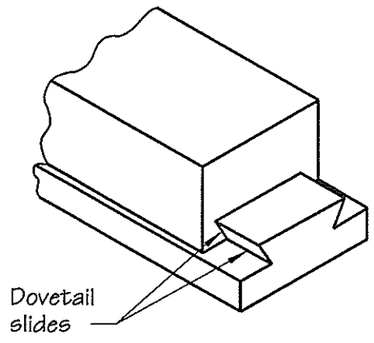
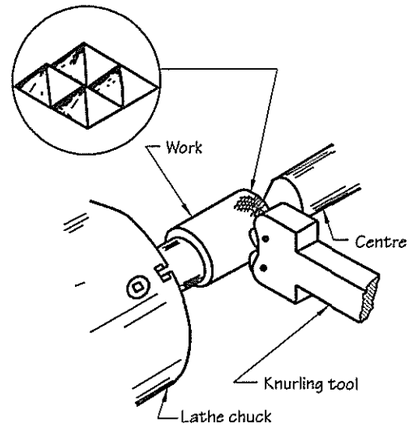
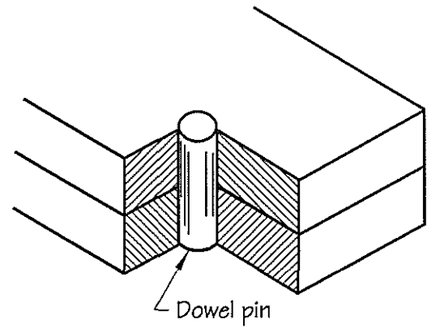
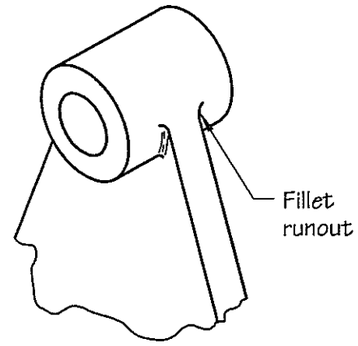
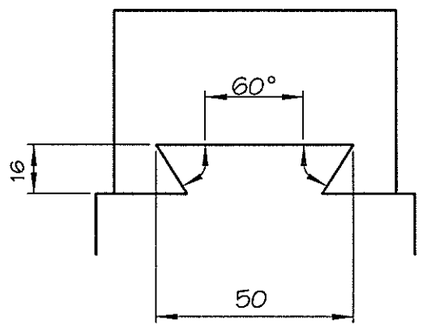
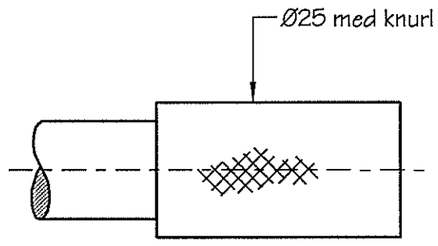
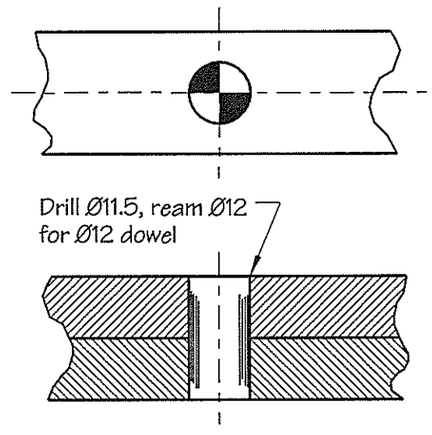
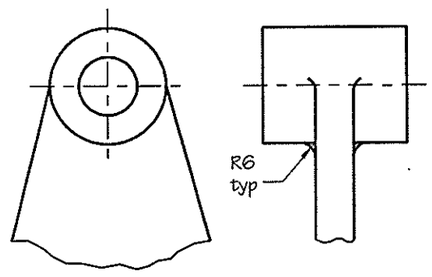
	Physical features			
	Bush	Rivet	Pad	Boss
Definition	A hollow cylindrical lining inserted in a hole in machinery to act as a bearing for a shaft or spindle.	A cylindrical rod of soft metal with one head formed when manufactured. A head is formed on the other end after the rivet has been inserted in the drilled or punched hole of mating parts	A slight irregular shaped projection above the surrounding surface of a casting or forging, usually to provide a bearing surface.	A cylindrical projection on a casting or forging which provides extra thickness for tapping, or a seat for the head of a bolt or screw.
Pictorial representation				
Orthogonal representation				

	Physical features			
	Radius	Stepped	Eccentric	Shoulder
Definition	An external rounded corner formed to enable better fits between parts and to reduce risk of injury.	Having increases in height or diameter shaped like steps.	The position of a shaft whose axis does not coincide with the position of the axis of the main part of the shaft (off-centre).	A raised section of a shaft or surface which prevents movement along the surface or permits bearing against.
Pictorial representation				
Orthogonal representation				

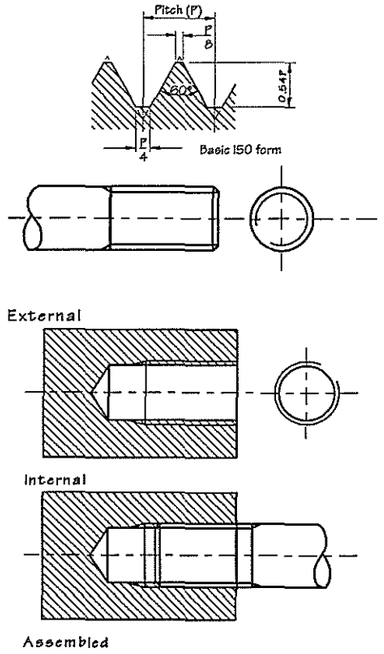
	Physical features			
	Collar	Chamfer	Recess	Fillet
Definition	A circular flange or ring secured on a shaft to prevent sliding.	A flat surface cut on the intersection of two surfaces usually cut at 45°.	The mating hole into which a spigot fits.	An internal rounded intersection of two surfaces which prevents the forming of weakness planes in castings or forgings.
Pictorial representation				
Orthogonal representation				

Physical features

	Setscrew	Jig	Key Keyway Keyseat	Split lug
Definition	A headed fastener usually screwed along its complete length and screwed into a tapped hole rather than a nut, for the purpose of locking or setting.	A holding device that holds work and guides the cutting tool during a machining operation.	Key: A small piece of metal fitted axially partly in hub and shaft to prevent rotation. Keyseat: The slot in a shaft into which the key is fitted. Keyway: A slot in the hub or portion surrounding a shaft to receive a key.	A lug usually projecting from a boss or hub both of which are sawn through to produce a clamping effect when the lugs are clamped together.
Pictorial representation				
Orthogonal representation				

	Physical features			
	Dovetail	Knurl	Dowel pin	Fillet runout
Definition	A wedge-like section which slides in a slot of the same shape preventing lift.	To impress a pattern of dents or lines in a turned surface to provide a better grid.	A cylindrical pin partly located in each of two contacting surfaces to prevent sliding between the surfaces.	A line of intersection formed by the junction of a fillet and another fillet.
Pictorial representation				
Orthogonal representation				

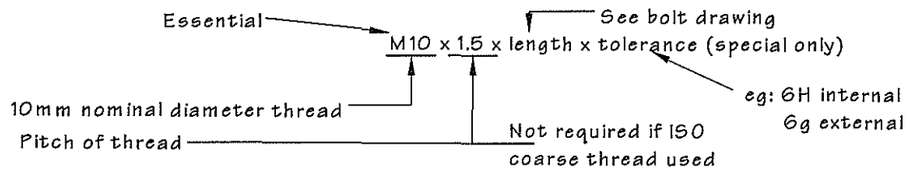
Metric screw threads



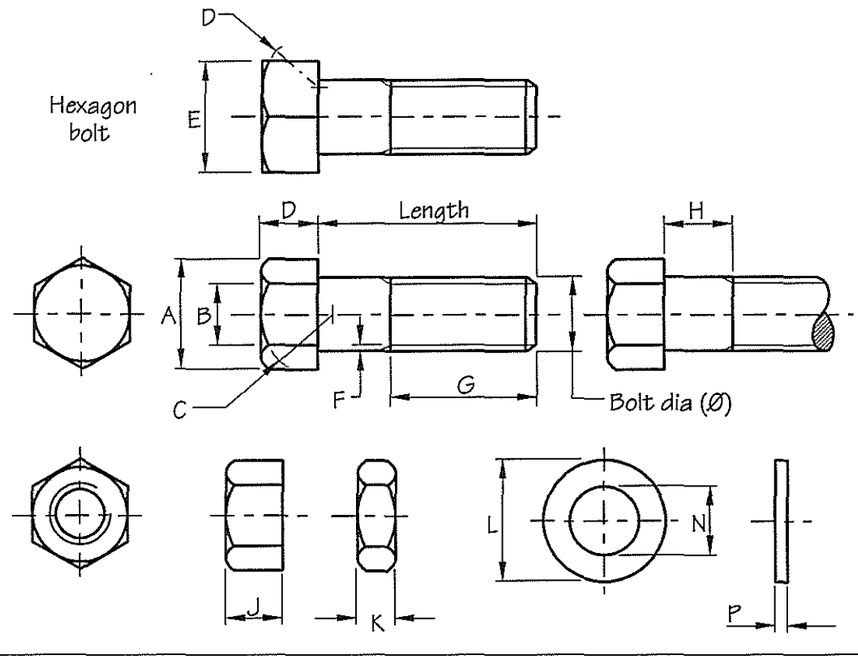
ISO COARSE PITCH SERIES PREFERRED SIZES	
Designation (dia in mm)	Pitch (mm)
M1,6	0,35
M2	0,4
M2,5	0,45
M3	0,5
M4	0,7
M5	0,8
M6	1
M8	1,25
M10	1,5
M12	1,75
M14	2
M16	2
M20	2,5
M24	3
M30	3,5
M36	4
M42	4,5

Specifications

For general purposes in engineering the coarse thread series should be used. The thread is identified by the letter 'M' followed by the thread diameter in millimetres. The pitch of the thread and the length of the thread are only shown in special cases. Where critical control of the thread form is required a tolerance should be specified.

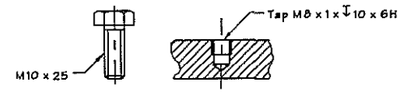


Drawing proportions for metric hexagon bolts, screws, nuts and washers



Bolt dia Ø	A 1.70Ø	B ,5 A	C	D ,7Ø	E 1,5Ø	F	G 2Ø+6	H	J ,8Ø	K,5Ø	L 2Ø	N Ø+1	P
M5	10	5	5	4	8	1	16	3	4	3	10	6	1
M6	12	6	6	5	9	1	18	4	5	3	12	7	1
M8	14	7	8	6	12	1	22	5	6	4	16	9	1
M10	18	9	10	7	15	1	26	5	7	5	20	11	1
M12	20	10	12	8	18	1	30	6	8	6	24	13	1
M14	24	12	14	10	21	2	34	7	10	7	28	15	2
M16	28	14	16	12	24	2	38	8	11	8	32	17	2
M20	34	17	20	14	30	2	46	9	13	10	40	21	2
M24	42	21	24	17	36	2	54	11	16	12	48	25	2

Examples:

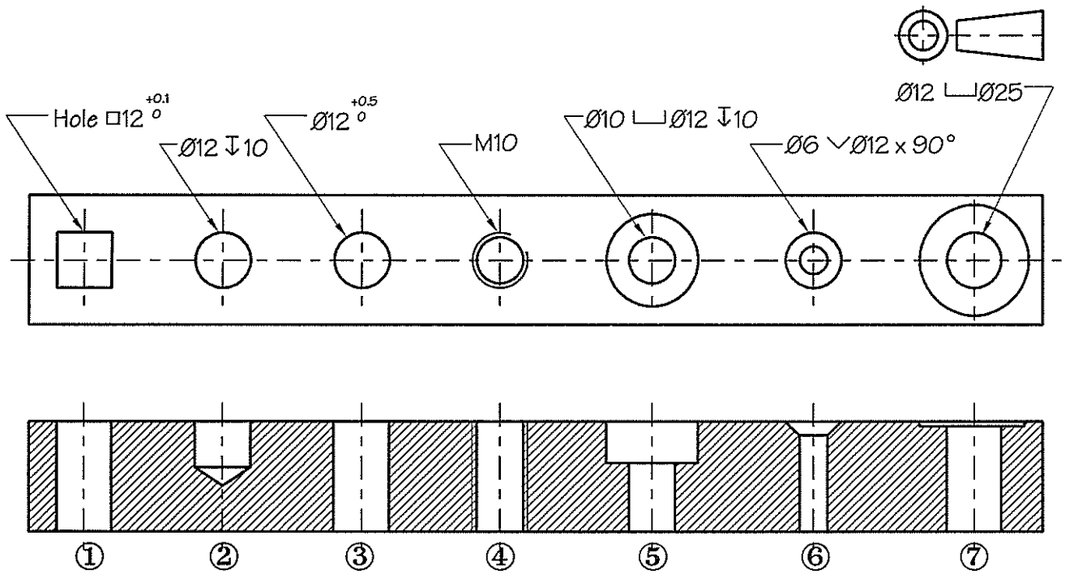


(Simple sizing) (Tolerance sizing)

Exercise 7-5

Complete the following questions and statements.

1. Identify by description the hole types shown.



Hole 1 _____

Hole 2 _____

Hole 3 _____

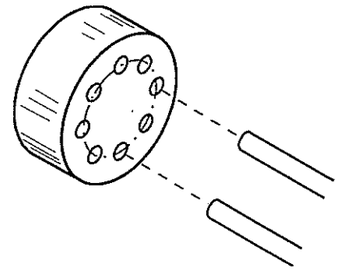
Hole 4 _____

Hole 5 _____

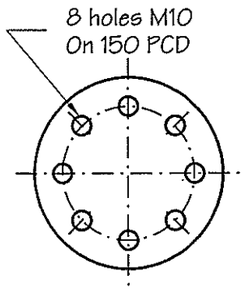
Hole 6 _____

Hole 7 _____

2. What does PCD mean? _____



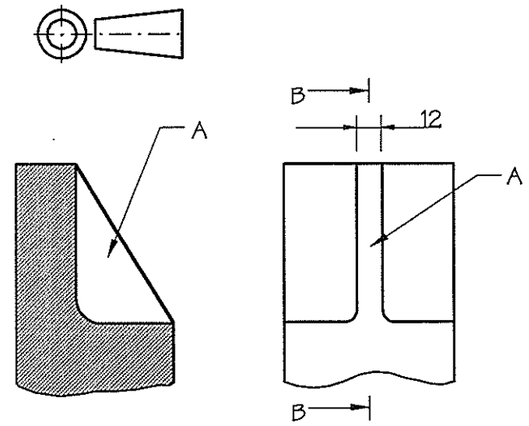
Pictorial



Orthogonal

3. Identify and name the part marked by the arrow A.

_____



Sect B-B

Front view