Identify various conduits and different electrical accessories

Objectives: At the end of this exercise you shall be able to
- **identify and name the conduits and conduit accessories and write their specification and uses.**
- **identify and name the electrical accessories**
- **write the specification and uses of the electrical accessories**
- **draw the electrical accessories IE symbols.**

Requirements

Tools/Instruments

- Insulated screw driver 4mm x150mm - 1 No.
- Insulated connector screw driver 4 mm x100 mm - 1 No.
- Tray 60x30x4 cm - 1 No.
- I.S. books on graphic symbols (B.I.S 2032 all parts) - 1 No.

Materials

- PVC conduit pipe - 19 mm and 25 mm - 3M long - 1 No. each
- GI conduit pipe - 19 mm and 25mm - 3 m long - 1 No. each
- PVC Channel - 20mm and 25mm - 1M long - 1 No. each
- PVC pipe coupling - 19mm & 25mm - 1 No. each
- PVC junction box - 1,2,3 and 4 way -19mm & 25mm - 1 No. each
- PVC bend - 19 mm & 25mm - 1 No. each
- PVC Elbow - 19 mm & 25 mm - 1 No. each
- PVC Tee - 19mm & 25mm - 1 No. each
- GI conduit coupler & Inspection Coupler - 19mm & 25mm - 1 No. each
- GI Elbow & Inspection Elbow - 19mm & 25mm - 1 No. each
- Tees & Inspection Tee - 19mm & 25mm - 1 No. each
- GI junction box -1,2,3 & 4 way square type 19mm & 25mm - 1 No. each
- S.P. switch 6A 250V flush type, single way - 1 No.
- S.P. switch 6A 250V flush type two way - 1 No.
- S.P. switch 6A 250V mounting type single way - 1 No.
- S.P. switch 6A 250V mounting type two-way - 1 No.
- Tube light starter holder 6A - 1 No.
- Combined tube and starter holder 6A - 1 No.
- Tube light holder - 6A - 1 No.
- Brass batten-holder 6A 250V - 1 No.
- Bakelite batten-holder 6A 250V - 1 No.
- Brass pendent-holder 6A 250V - 1 No.
- Bakelite pendent-holder 6A 250V - 1 No.
- 3-pin 6A wall socket, mounting type - 1 No.
- 3-pin 16A wall socket, mounting type - 1 No.
- 3-pin 6A wall socket, flush type - 1 No.
- 3-pin 16A wall socket, flush type - 1 No.
- 2-pin 6A wall socket, flush type - 1 No.
- 2-pin 6A mounting type - 1 No.
- Ceiling rose 6A 250V 2 plate - 1 No.
- Ceiling rose 6A 250V 3 plate - 1 No.
- Fan regulator - 1 No.
- Kit-kat fuse 16A 250V - 1 No.
- Intermediate switch 6A 250V - 1 No.
- 3-pin 6A 250 V plug - 1 No.
- 3-pin 16A 250 V plug - 1 No.
- Terminal plate 16A 250 V 3- way - 1 No.
- I.C.D.P. switch 16A 250V - 1 No.
- I.C.T.P. switch 16A 400V - 1 No.
- Neutral link 16 amps - 1 No.
- I.C. cutouts 16A 250V - 1 No.
- Distribution box 4-way - 1 No.
- Bell-Push/switch 6A, 250V flush type - 1 No.
- Bell-Push/switch 6A, 250V mounting type - 1 No.
- HRC Fuse - 16A - 1 No.
- Iron connector - 5A - 1 No.
- Toggle switch 6A - 1 No.
- MCB 1,2 & 3 Pole - 1 No. each

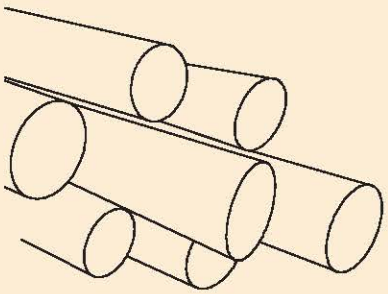
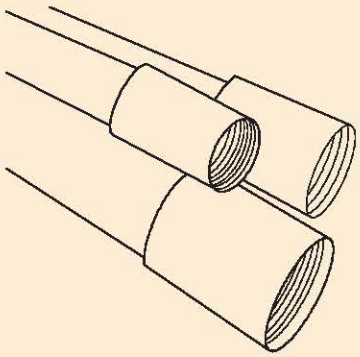
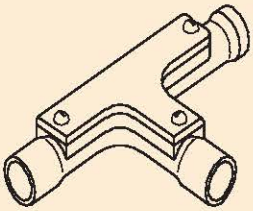
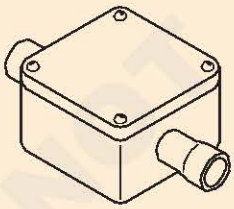
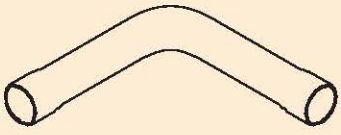
PROCEDURE

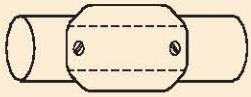
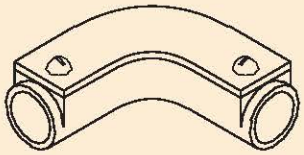
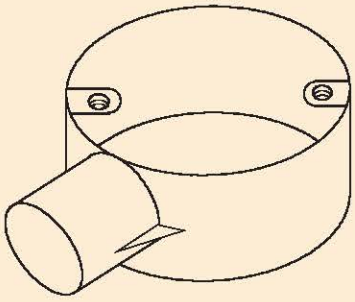
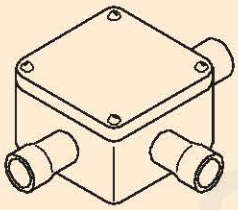
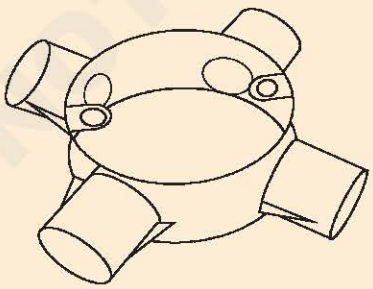
TASK 1 : **Identify various conduit and conduit accessories**

1 Identify each items and write the name in the table. (Fig 1 to Fig 10)

2 Write the specification and use of each conduit & conduit accessory in the column given.

Conduit Pipe & Conduit accessories

Sketch	Name	Specification	Use
Fig 1  ELN2270-H1			
Fig 2  ELN2270H2			
Fig 3  ELN2270-H3			
Fig 4  ELN2270-H4			
Fig 5  ELN2270-H5			

Sketch	Name	Specification	Use
Fig 6  ELN22270H6			
Fig 7  ELN22270H7			
Fig 8  ELN22270H8			
Fig 9  ELN22270HA			
Fig 10  ELN22270HB			

TASK 2 : **Identify electrical accessories and write their names**

1 Identify each accessory and write the name in the table 2 (Fig 11 to 28)

Different manufacturers design the outline of accessories differently to suit various conditions. However, the Power contact positions of the accessories remain the same. As such there should not be much difficulty in identifying the accessories.

On the other hand, single way and two-way switches as well as two and three plate ceiling roses look alike. A careful look at the rear of the accessory will make the identifying process much easier.

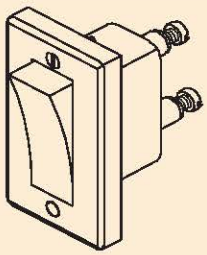
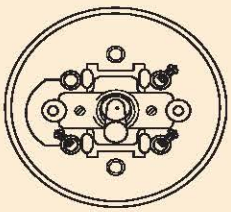
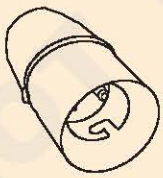
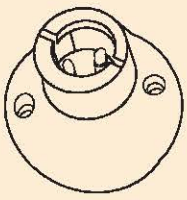
2 Write the specification of each accessory in the column given by the side of each (accessory) figure.

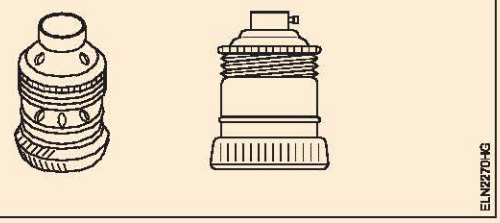
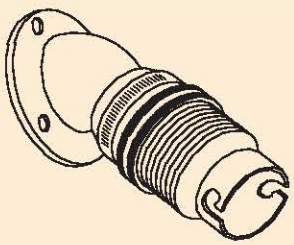
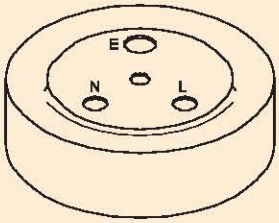
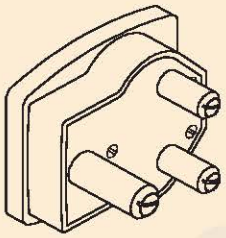
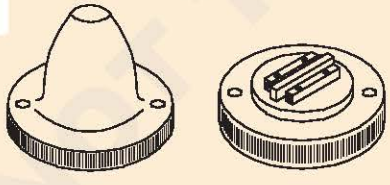
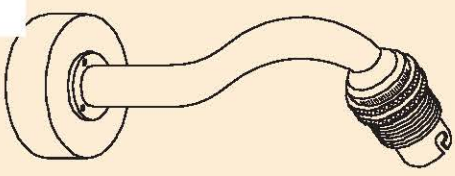
Most of the specifications can be collected from the markings on the accessory itself. Otherwise try to get them from an approved catalogue or approach the instructor for guidance.

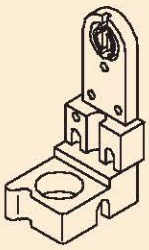
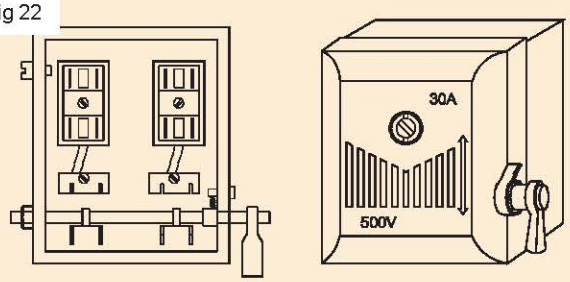
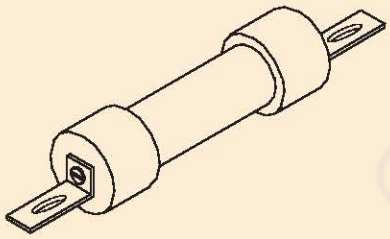
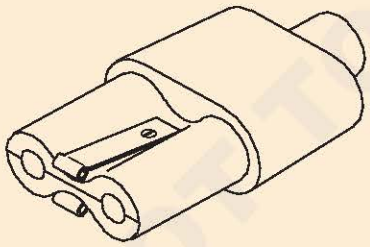
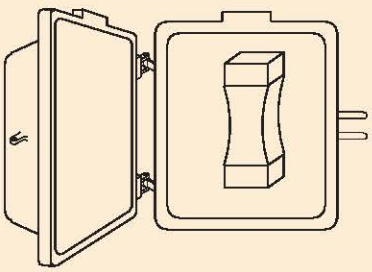
3 Identify the I.E symbols used for the accessory from the related theory or B.I.S. books and sketch the symbols in the columns/spaces provided.

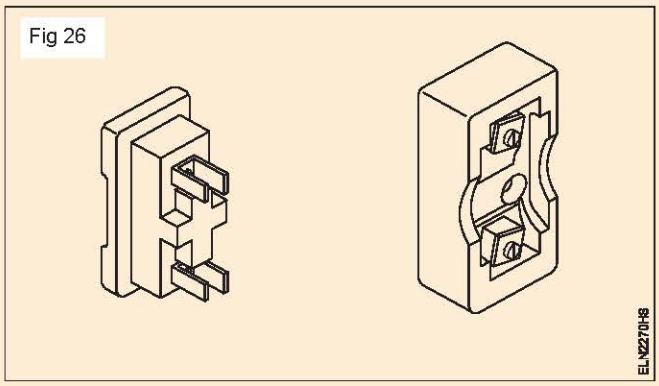
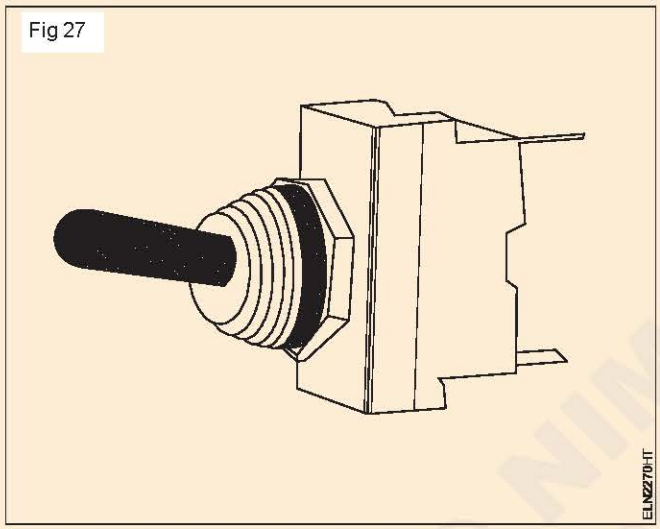
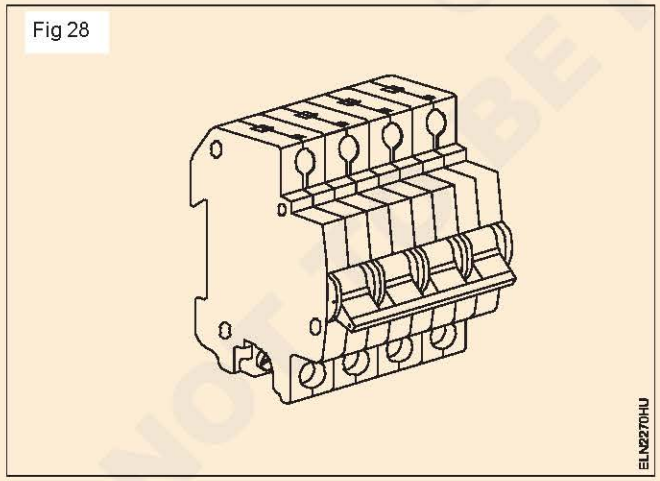
4 Show the completed sheets of specifications, identification and symbols to the instructor and get his approval.

Table 2 - **Electrical accessories**

Sketch	Name	Specification	Use	IE Symbol
Fig 11 				
Fig 12 				
Fig 13 				
Fig 14 				

Sketch	Name	Specification	Use	IE Symbol
Fig 15 				
Fig 16 				
Fig 17 				
Fig 18 				
Fig 19 				
Fig 20 				

Sketch	Name	Specification	Use	IE Symbol
Fig 21  ELN2270HN				
Fig 22  ELN2270HO				
Fig 23  ELN2270HP				
Fig 24  ELN2270HQ				
Fig 25  ELN2270HR				

Sketch	Name	Specification	Use	IE Symbol
Fig 26 				
Fig 27 				
Fig 28 				

Practice cutting, threading of different sizes of conduits and laying installations

Objectives: At the end of this exercise you shall be able to

- **cut metal conduit pipes of heavy gauge to the required dimensions**
- **fasten the conduit pipe in the pipe vice and prepare the conduit ends for threading**
- **cut the threads on heavy gauge metal conduit,according to requirements using a conduit die set**
- **fix the conduit accessories to the pipes according to the pipe size using the threaded method**
- **fix the conduit with the necessary clamps and spacers on surface installation in accordance with the B.I.S.recommendations**
- **draw cables in the metallic conduit pipes**
- **bond the conduit pipes at joints and junctions**
- **earth the conduit as per B.I.S. recommendations**
- **prepare metal boxes and fix Power accessories**
- **terminate the cable ends at the accessories according to the wiring diagrm**
- **test the wiring.**

Requirements

Tools/Instruments

- Screwdriver 200mm with 5mm blade - 1 No.
- Connector screwdriver 100mm with 3mm blade - 1 No.
- Pipe vice 50 mm - 1 No.
- Steel rule 300 mm - 1 No.
- Hacksaw with a blade of 24 teeth per 25 mm (25 TPI) - 1 No.
- Flat file bastard 250 mm - 1 No.
- Half round file 2nd cut 200 mm - 1 No.
- Reamer 16 mm - 1 No.
- Oil can 250ml - 1 No
- Conduit stock and dies for 19 mm & 25 mm conduit - 1 Set
- Wire brush 50 mm - 1 No.
- Plumb bob with thread - 1 No.
- Electrician's knife DB 100 mm - 1 No.
- Poker 200 mm - 1 No.
- Ball peen hammer 500 grams - 1 No.
- Hand drilling machine 6 mm capcity with 4 mm drill bit - 1 Set
- Scriber 200 mm - 1 No.
- Combination pliers 200 mm - 1 No.

Materials

- Conduit pipe, heavy gauge 19 mm dia. - 6 m
- Conduit pipe, heavy gauge 25 mm dia - 3 m
- Metal Box 90 mm Square of hexagonal type with top cover - 4 Nos.
- Conduit pipe inspection Tee 19 mm - 3 Nos.
- Conduit elbow 19 mm - 4 Nos.
- Conduit bend 19 mm - 1 No.
- Conduit junction box 3-way 19 mm - 4 Nos.
- T.W. spacers 60mm long 19 mm width and 12mm thick - 25 Nos.
- Tinned copper wire 14 SWG - 12 mts.
- Earth clamps, tinned copper suitable for 19 mm pipe with bolt, nut and washers - 3 doz.
- G.I. saddles 19 mm - 25 Nos.
- Wood screws and machine screws assorted - as reqd.
- P.V.C. aluminium cable 1.5 sqmm 250 V grade - 18 mts.
- S.P.T. switch 6A 250V - 1 No.
- Two-way Flush type switch 6A 250V - 3 Nos.
- Ceiling rose 2-way 6A 250V - 4 Nos.
- Pendent-holder, bakelite 6A 250V - 4 Nos.
- B.C. bulbs 40W, 230V - 4 Nos.
- Colour chalk - 1 piece
- Terminal plate 16 amps 3-way - 1 No.
- G.I. wire as fish wire 14 SWG - 6 mts.
- P.V.C. bushes suitable for 19 mm pipe - 40 Nos.
- Conduit check-nut 19 mm - 8 Nos.
- Lubricant coconut oil - 100 gm
- Cotton Waste - as reqd.

PROCEDURE

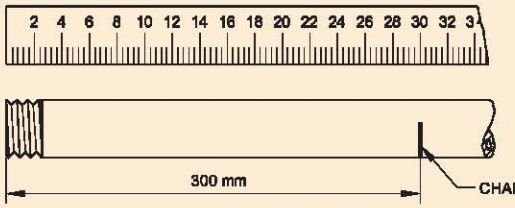
TASK 1: **Preparation of conduit pipe for cutting**

Assume the job needs a 300 mm long conduit drop but a standard length pipe of 3000 mm is only available. Normally both the ends of a standard length pipe will have threads. To make the required conduit drop, the standard length 3000 mm pipe is to be cut for a length of 300 mm and threaded again at one end.

Cutting could be done either by pipe cutters or with hacksaws. In practice, cutting with a hacksaw is popular, and the method is explained below.

1 Measure 300mm from the threaded end of the 19 mm pipe and mark it with chalk as shown in Fig 1.

Fig 1



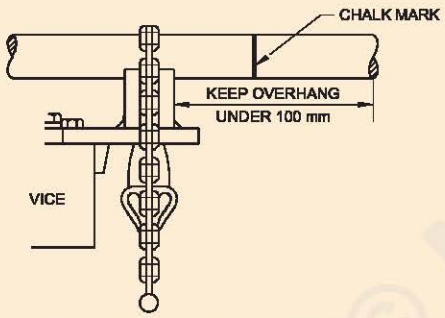
MEASURE THE PIPE LENGTH

ELN2271H1

2 Open the jaw of the vice and insert the pipe so that it is horizontal and parallel to the jaw serrations.

3 Keep the chalk mark of the pipe within 100 mm of the vice as shown in Fig 2.

Fig 2



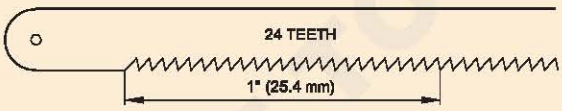
GRIP THE PIPE IN THE VICE FOR SAWING OPERATION

ELN2271H2

4 Close and tighten the vice jaw.

5 Select a hacksaw with a blade having 24 teeth per 25mm (25 TPI), as shown in Fig 3.

Fig 3



HACK SAW BLADE

ELN2271H3

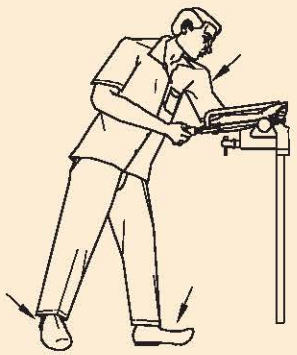
Ensure that the hacksaw blade is firmly tightened in the frame and that the teeth point in the forward direction.

6 Take up the hacksaw and position yourself, as shown in Fig 4, with your left shoulder pointing in the direction of the cut.

7 Grip the hacksaw handle with the right hand and position the hacksaw blade on top of the cutting line.

8 Prepare to cut by guiding the blade with the thumb of your left hand exactly on the cutting line against the saw blade as shown in Fig 5.

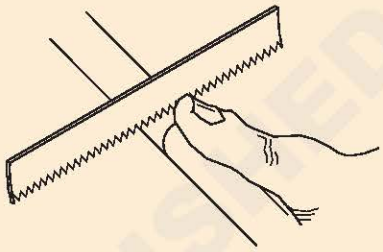
Fig 4



HACK SAWING - POSITION OF SAWING

ELN2271H4

Fig 5



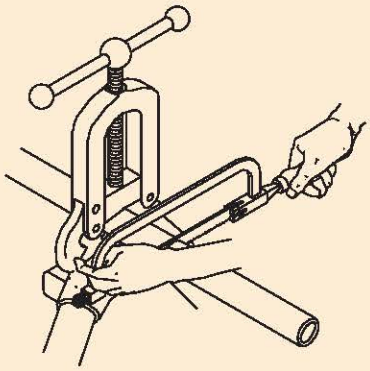
USE THUMB AS A GUIDE INITIALLY

ELN2271H5

9 When the initial cut has been made, move the left hand to the front end of the hacksaw frame and use both hands for the cutting operation as shown in Fig 6.

10 When sawing, use the full length of the blade, increasing gradually the pressure on the forward stroke, and releasing the pressure as the blade is drawn back. (Fig 6)

Fig 6

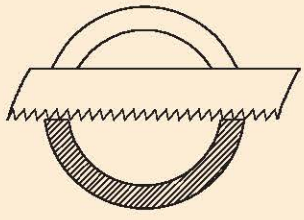


HOLDING SAW WHILE SAWING

ELN2271H6

11 Saw with steady, even strokes, keeping the blade upright and square to the cut as shown in Fig 7.

Fig 7

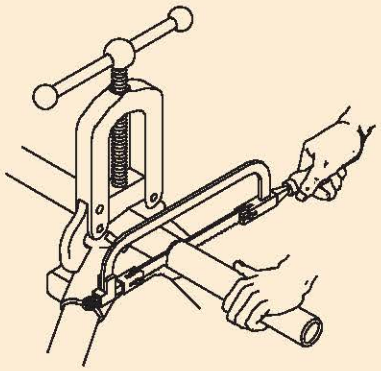


HOLD THE STRAIGHT

ELN2271H7

12 When getting near to the end of the cut, the conduit must be supported with your left hand as shown in Fig 8. Finish the cut.

Fig 8



END OF SAWING

ELN2271H8

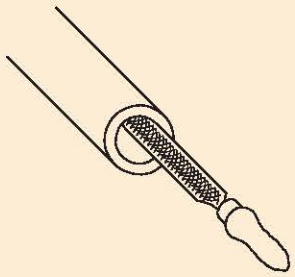
Support the free end of the conduit to prevent the blade of the hacksaw from being damaged.

13 Use a reamer or half round file to remove the inside burrs as shown in Fig 9.

14 Use the flat portion of the half round file to smoothen the sharp edges. (Fig 10)

15 Again follow the steps 2 to 14 for cut the 300 mm long from the threaded end of 25 mm dia. 3 m long pipe.

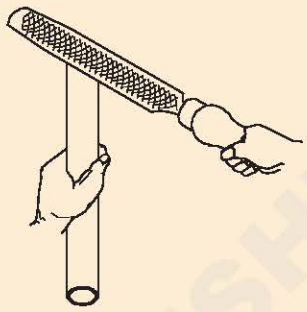
Fig 9



REMOVAL OF BURRS

ELN2271H9

Fig 10



REMOVAL OF SHARP EDGES

ELN2271HA

16 Clean the hacksaw and vice after the end of the work and keep them in their respective places.

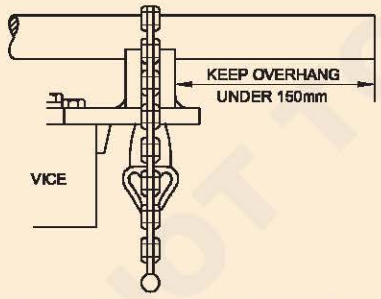
TASK 2 : **Preparation of conduit pipe for threading**

1 Open the jaw of the vice and insert the 19 mm dia pipe so that it is horizontal and parallel to the jaw serrations.

2 Keep the end of the tube within 150 mm of the vice.

3 Close and tighten the vice as shown in Fig 11.

Fig 11



HOLD THE PIPE IN THE PIPE VICE FOR THREADING OPERATION

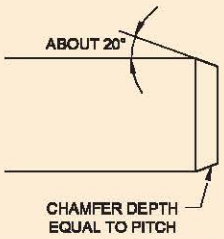
ELN2271H8

4 File the end of the tube flat and chamfer the outer edge to an angle of about 20° as shown in Fig 12.

Make the depth of the chamfer equal to the pitch of the thread (1.5 mm for conduit).

5 Choose the correct dies and stock suitable for the pipe to be threaded. (Fig 13 shows the conduit stock and dies set)

Fig 12



BEFORE THREADING, CHAMFER THE EDGE OF THE PIPE

ELN2271HC

Assembly drawing for the quick cut stock and dies is given in Fig 13. The die size is engraved on the die itself. Check the size with that of the pipe. The handle of the stock is not shown in the picture for clarity.

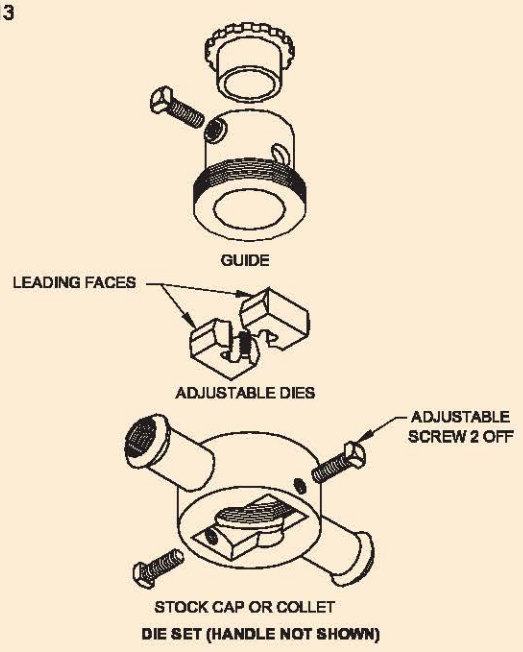
6 Insert each half of the die in the cap(stock) with the chamferred threads (leading faces) being adjacent to the guide.

7 Screw the guide into position.

8 Adjust each adjusting screw equally to make the die halves centralized to the pipe axis.

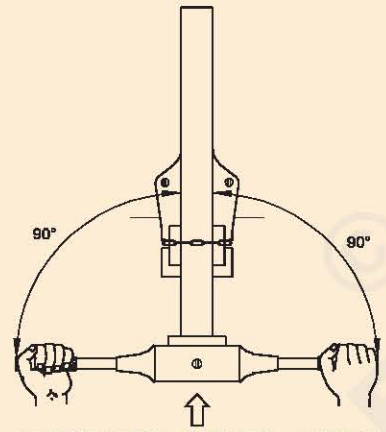
9 Slide the stock guide over the end of pipe, adjust the adjusting screws such that the dies just grip the pipe evenly on both sides.

Fig 13



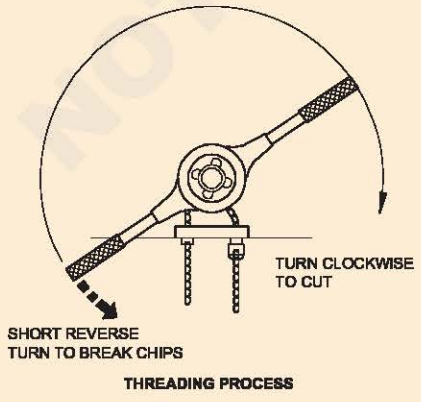
10 Apply pressure to the stock and keep the handles at right angles to the pipe as shown in Fig 14.

Fig 14



11 Rotate the handles clockwise in a plane at right angles to the pipe axis as shown in Fig 15.

Fig 15



12 Apply the lubricant to the part to be threaded after the thread has been started.

The lubricant allows the die to cool off the heat developed and thereby helps the edges to stay sharp and to produce a better thread finish.

13 Make one or two complete turns in a clockwise direction.

Check whether the stock is at right angle to the pipe axis.

14 As indicated by the increased resistance of rotation, ease the handle as frequently as necessary, back in an anticlockwise direction for half a turn.

Reverse turning is necessary to break off long cuttings and to clear the cutting edges of the die.

15 Apply the lubricant at frequent intervals.

Use a brush to remove the metal burrs from the die.

16 Remove the stock. Check the length and fit of the thread by screwing on the female fittings (coupling etc.).

The length of the thread should be sufficient to fit half way into the couplings and fully into the other fittings.

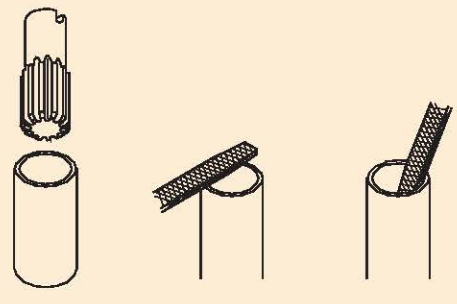
17 If the thread is not smooth (i.e. tight in the fittings) mount the stock and tighten the adjusting screws by half turn evenly and repeat working steps 10 to 16.

18 Remove any burrs or sharp edges from inside the end of the pipe with a reamer or half round file as shown in Fig 16, and file off the sharp edges, if any.

19 Again follow the steps from 2 to 18 in the task-2 for thread the 25 mm dia conduit pipe.

20 Clean the die stock and vice. Keep them in their respective places.

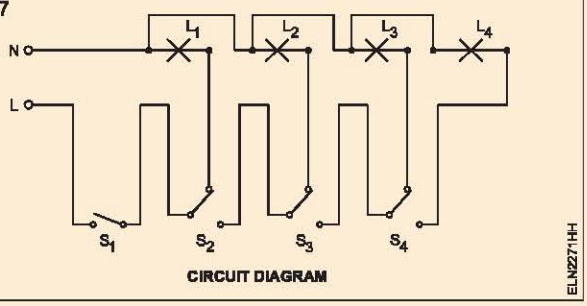
Fig 16



TASK 3 : **Install and wire up in metal conduit in the lighting circuit for godown**

1 Form the circuit with the required wiring accessories as per circuit diagram (Fig 17) on the workbench.

Fig 17

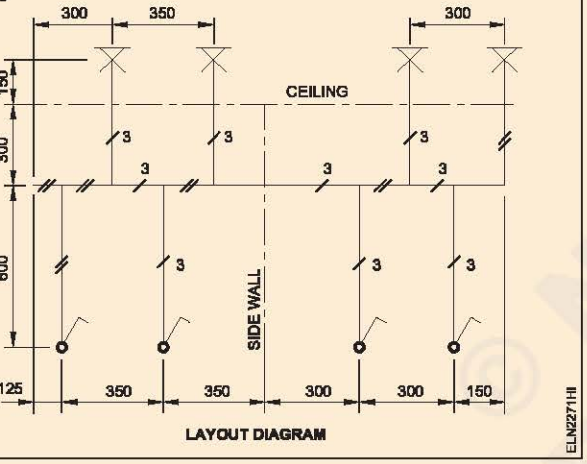


2 Get the circuit approved by the instructor.

If it is incorrect, trace the circuit and correct it.

3 Mark the layout on I.P.C. (Installation Practice Cubicle) as per the layout given in Fig 18

Fig 18



4 Select the required conduit fittings as per the layout.

5 Measure the length of the conduit pipes required for each run as per the layout.

Take into consideration the length of accessories to be used in various places along with the conduit threads while taking conduit measurements.

6 Cut the length of the conduit as per markings and remove the burrs.

While marking on the conduit pipe for cutting, consider the economical way to utilize the pipes without much wastage in the lengths.

7 Cut threads in the pipes and remove the burrs.

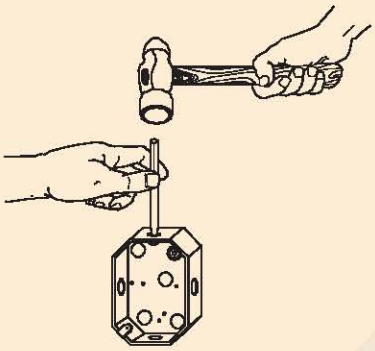
8 Prepare the T.W. spacers with through holes for fixing on the I.P.C. and pilot holes to fix the saddles.

9 Fix the T.W. spacers as per the layout.

10 Fix the conduit pipe and conduit accessories as per the layout by means of saddles.

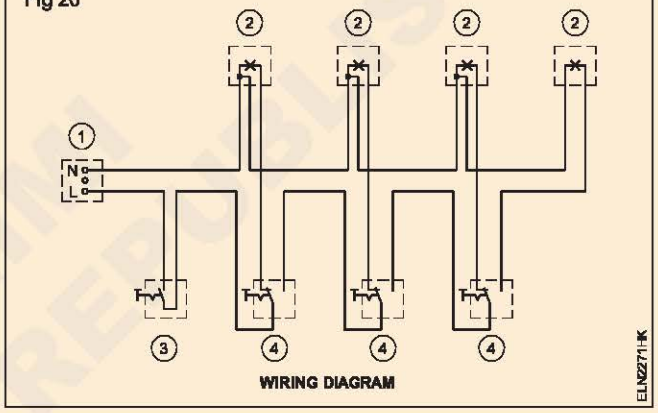
Knock out the holes in the square/hexagonal metal boxes for conduit pipe terminations as shown in Fig 19.

Fig 19



11 Measure and cut the cables as per the cable route given in the wiring diagram. (Fig 20)

Fig 20



Make an allowance in cable lengths for terminations.

12 Provide bushes in the conduit ends.

13 Insert the given fish wire in the pipe run for drawing cables.

Drawing of cables should be done stage by stage, taking each run one by one, and consolidating the number of cables in each run.

14 Skin the cables and mark each cable legibly at both ends.

15 Group the cables as per cable route and cable runs and fasten them to the fish wire as shown in Fig 21.

Check the continuity of cables before fastening the cables to the fish wire.

16 Pull the cables by means of the fish wire, and, at the same time push the cables from the other end as shown in Fig 22.

Fig 21

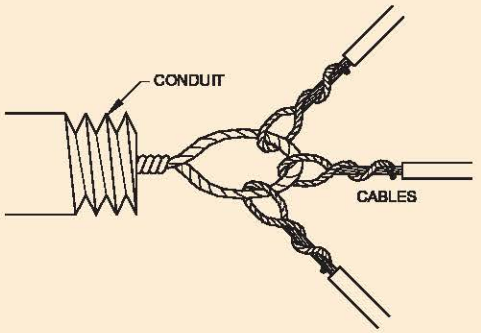
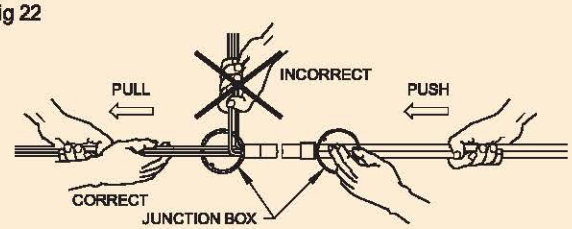


Fig 22



You may require a helper while drawing cables. There should not be any kink or twist in the cables while drawing the cables through the conduit pipe. For long conduit runs, it is better, the drawing of the cables is done in stages, firstly from one end to the inspection type accessory, and then from the inspection type accessory to the end of the conduit, and so on.

17 Prepare top covers of the square metal boxes for fixing the accessories by drilling through holes for cable entry and accessory fixing.

18 Fix the ceiling roses on the one-way junction boxes.

Ceiling roses can be fitted directly on the one-way junction boxes, using the machine screws provided for fixing the cover.

19 Prepare the cable ends and terminate them in the accessories as per Fig 17 and 20, and cable markings done as per step 14.

20 Fix the accessories with machine screws.

21 Close the top covers of the metal boxes.

22 Close the inspection windows of the inspection type accessories.

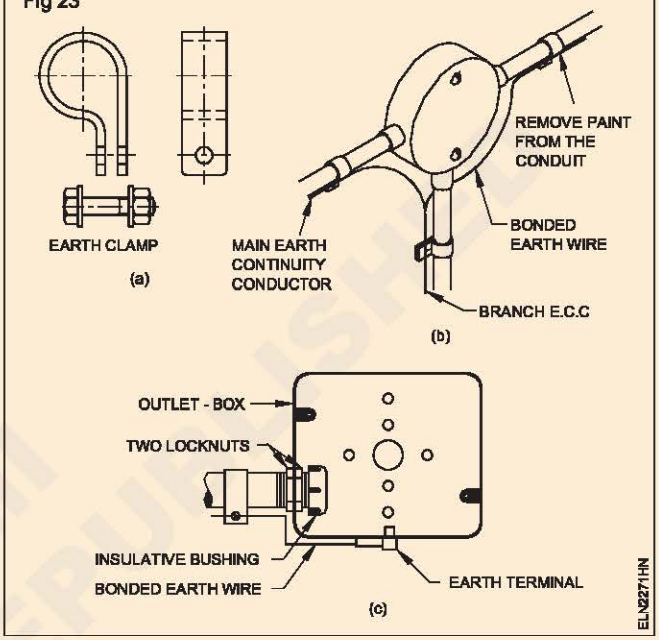
23 Run the given earth wire along the conduit pipe by means of earth clamps and terminate at the junction boxes and metal boxes. (Fig 24)

It is necessary to follow the looping system to avoid joints in the earth wire runs.

As an alternate to the looping method, the bonding system could be used. Wherever accessories are used, bonding by earth clamps and earth wire as shown in Fig 23 is recommended.

Remove the paint on the surface of the conduit, the copper wire and the clamps before fixing.

Fig 23



24 Prepare the pendent-holders and connect the cables to the ceiling roses.

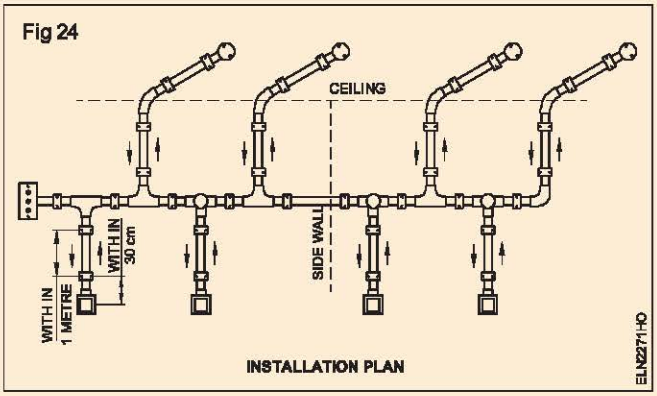
25 Fix the bulbs.

A completed installation looks as shown in Fig 24.

26 Get the wiring checked by the instructor.

27 Connect the supply and test the wiring.

Fig 24



Prepare test boards/extension boards and mount accessories like lamp holders, various switches, sockets, fuses, relays, MCB, ELCB, MCCB Etc.

Objectives: At the end of this exercise you shall be able to
- **identify and use Power accessories like double-pole switch and indicating neon lamp**
- **select the correct size of board to mount specified accessories**
- **position the accessories and mount them on the T.W. board**
- **wire up and test the test board. / Extension Board.**

Requirements

Tools/Instruments

- Combination pliers 200 mm - 1 No.
- Screwdriver 200 mm with 5 mm blade - 1 No.
- Screwdriver 150 mm with 3 mm blade - 1 No.
- Poker 200 mm - 1 No.
- Firmer chisel 12 mm - 1 No.
- Try square 150 mm - 1 No.
- Tenon-saw 300 mm - 1 No.
- Gimlet 5 mm dia. 200 mm - 1 No.
- Ball peen hammer 250 gms - 1 No.
- 4 mm drill bit - 1 No.
- Connector screwdriver 100 mm - 1 No.
- Hand drilling machine 6 mm capacity - 1 No.
- Mallet 75mm dia. head with handle - 1 No.
- Steel Rule 30 cm - 1 No.
- Key hole saw 200 mm - 1 No.

Materials

- T.W. hinged box 375x250x80 mm - 1 No.
- B.C. batten lamp-holder 6A 250V - 2 Nos.
- Flush mounting 250V 6A 3-pin socket - 3 Nos.
- Flush mounting 250V 6A S.P.T. switch 250V, 6A - 2 Nos.
- PVC copper cable 3/20 - 2 m
- 14 SWG G.I. wire - 1 m
- 12 mm No.5 wood screws - as reqd.
- 20 mm No.6 wood screws - as reqd.
- 25 mm No.6 wood screws - as reqd.
- Neon lamp flush-mounting 250V with holder 6A - 1 No.
- BC bulb 60W, 250V - 1 No.
- Kit-kat fuse-carrier with base flush-type 16A 250V - 1 No.
- Insulated terminals non-detachable 4 mm plug entry - 3 Nos.
- Flush mounting type D.P. switch 250V 20A with neon indicator - 1 No.
- Twin twisted flexible wire 23 / 0.2mm - 5 metre

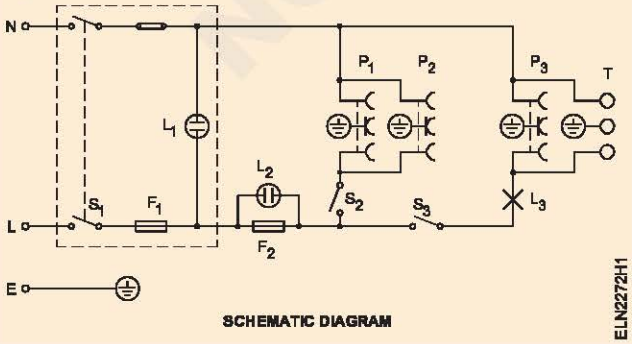
PROCEDURE

TASK 1 : **Prepare the test board / Extension board**

1 Identify the D.P. switch, its incoming/outgoing terminals and its operation. Identify a neon lamp and its connection.

2 Form the circuit as per the schematic diagram Fig 1, using a flexible wire for the testing circuit.

Fig 1



SCHEMATIC DIAGRAM

3 Get the formed circuit checked by the instructor.

If incorrect, make necessary changes.

4 Effect supply and test the circuit.

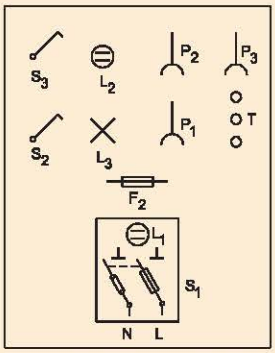
5 Place the accessories on a cardboard to suit the technical and aesthetic aspects and draw a layout. Select the size of the T.W. board accordingly.

6 Compare the layout drawn by you with the layout given in Fig 2 and discuss with your co-trainees about their merits and de-merits.

7 Mark the position of the double-pole switch and other accessories on the T.W. board as per the given layout (Fig 2) and the supplied drawing of the front panel. (Fig 3)

8 Cut profiles for fixing the accessories to the T.W. board and drill holes for cable entries, insulated terminals and fixing screws, and make pilot holes wherever necessary.

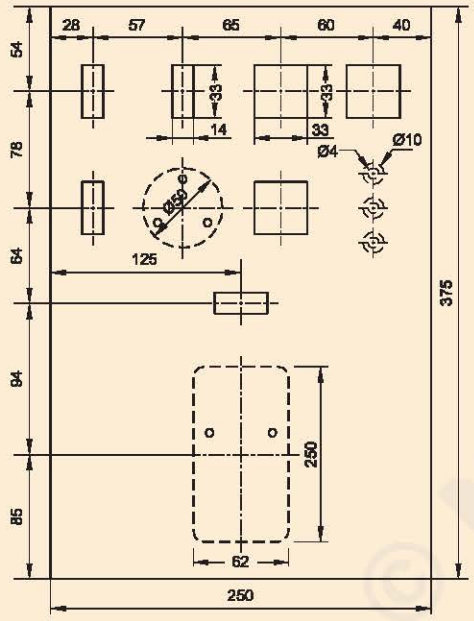
Fig 2



TEST BOARD-LAYOUT DIAGRAM

ELN2272H2

Fig 3



TEST BOARD FRONT PANEL DRAWING SHOWING THE PROFILE

ELN2272H3

9 Fix the Power accessories on the T.W. board.

10 Fix three numbers of insulated terminals.

11 Measure and cut cables for harnessing, according to the circuit diagram. (Fig 1)

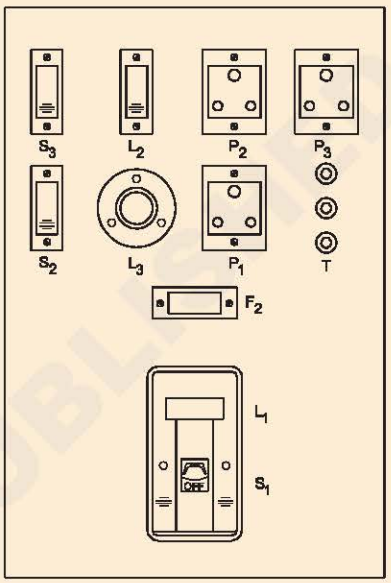
Use the B.I.S. recommended colour code for cable connections within the test board.

12 Route the connecting cables between accessories neatly, harness (strap - bunch) the cables.

13 Connect the accessories and the insulated terminals after identifying phase and neutral.

14 Connect the earth wire with earthing terminals of socket outlets, one of insulated terminals and the double pole switch. A completed test board will look as shown in Fig 4.

Fig 4



FRONT PANEL VIEW OF THE TEST BOARD

ELN2272H4

15 Provide bulbs in the lamp-holders.

16 Get the approval from your instructor and test the test board.

Draw layouts and practice in PVC casing - capping, conduit wiring with minimum to more number of points of minimum 15 metre length

Objectives: At the end of this exercise you shall be able to
- **mark the layout on the work station/location**
- **prepare PVC channel as per the marked layout**
- **fix the PVC channel and other PVC accessories**
- **run the cable as per the circuit diagram**
- **fix the top cover on the casing**
- **prepare & fix the PVC boxes**
- **mount the switches, fan regulator, socket on the switch board**
- **connect the end terminals to load as per the circuit diagram & test it.**

Requirements

Tools and Instruments

- Electrician tool kit - 1 No.
- Hacksaw frame with blade - 1 No.
- Rawl jumper No.14 - 1 No.
- Screw driver 100mm - 1 No.
- Steel tape 5 m - 1 No.
- Steel Rule 300mm - 1 No.
- Electric/Hand drilling machine (capacity 6mm) - 1 No.
- Twist drill bit 5mm - 1 No.

Material required

- PVC casing and capping 25mm x 10 mm - 20mtrs
- PVC round block - 90 mm x 40 mm - 3 Nos.
- T.W. box 250 mm x 100 mm with Sunmica cover - 1 No.
- Terminal plate 16 Amps - 3 way - 1 No.
- Single pole one way switch-6A,230V Flush type - 4 Nos.
- Electronic fan regulator - socket type - 1 No.
- 3 Pin socket - 6A 250V Flush type - 1 No.
- Batten lamp holder - 6A, 250V - 2 Nos.
- Ceilling rose 6A, 250V - 1 No.
- PVC insulated aluminimum cable 1.5 sq. mm - 100 mtr.
- Wood Screw No. 6 X12 mm - 20 Nos.
- Wood Screw No.6 X 20 mm - 7 Nos.
- PVC Casing and capping Elbow -25 mm - 1 No.
- PVC casing and capping Tee (3 way) - 2 Nos.
- PVC Casing and capping internal coupler - 3 Nos.
- Colour chalk / pencil - 1 No.
- PVC insulation tape roll 20mm -1 Roll

PROCEDURE

1 Analyze the layout diagram Fig 1 showing the location of fittings, accessories and their distances.

2 Draw the wiring diagram for the given circuit as per layout plan. Check the correctness of the wiring diagram with the help of Fig 1 (supplied by the instructor).

3 List out the materials required for this wiring along with complete specifications and quantity required for this wiring.

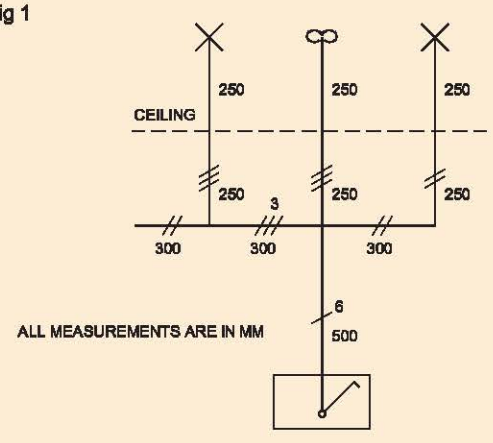
4 Check your material list with that of supplied list.

Hand over the list to the instructor for checking and get the approval.

5 Collect the materials as per the list.

6 Mark the layout as per the work station/location. Cut and prepare the casing as per the installation plan diagram.

Fig 1



LAYOUT DIAGRAM

7 Drill holes in the PVC channel for fixing with a gap of 60cm using drilling machine.

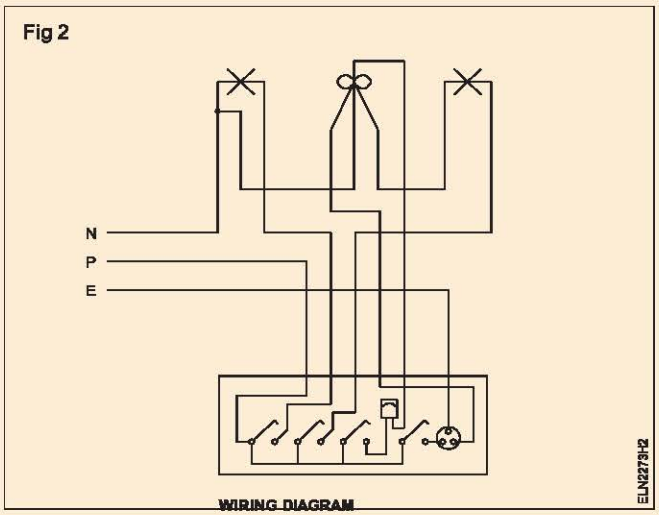
8 Place the PVC channel in the route mark coinciding with the jumper holes for fixing.

9 Prepare the joints on PVC channel (refer layout).

10 Fix the PVC channel on the work station as per the layout.

11 Run the cable into the PVC channel as per wiring diagrams (Fig 2)

Fig 2



12 Fix the cover on the channel.

13 Mark and cut the PVC boxes for the channel entries.

14 Drill holes for cable entry and take out cables as per installation plan.

15 Terminate the cable in accessories and mount the switches, regulator & socket over the switch box.

16 Test the circuit for insulation resistance, continuity test & polarity.

Only after obtaining satisfactory results of the above test, circuit to be energised.

17 Connect the circuit with supply and test it.

18 Repeat the wiring steps using PVC conduit pipe for a 15 meter length.

Wire up PVC Conduit wiring to control one lamp from two different places

Objectives: At the end of this exercise you shall be able to
- **form the circuit using two-way switches to control one lamp from two different places**
- **cut the profiles in a wooden board according to marking for flush-type accessories**
- **wire up a circuit in PVC conduit pipe to control one lamp from two different places.**

Requirements

Tools/Instruments

- Cross Peen hammer 250 gms - 1 No.
- Insulated screwdriver 200 mm width 5 mm blade - 1 No.
- Insulated screwdriver 150 mm width 5 mm blade - 1 No.
- Electrician's knife (100 mm) - 1 No.
- Connector screwdriver 100 mm - 1 No.
- Mallet 5 cm dia. -500 gram - 1 No.
- Gimlet 5 mm dia. 200 mm long - 1 No.
- Hand drilling machine 6 mm capacity - 1 No.
- Drill bit 3 mm to 5 mm - 1 each
- Try square 150 mm - 1 No.
- Bradawl 150 mm - 1 No.
- Insulated combination pliers 200 mm - 1 No.
- Hacksaw frame with blade (24 TPI) - 1 No.
- Steel rule (300 mm) - 1 No.

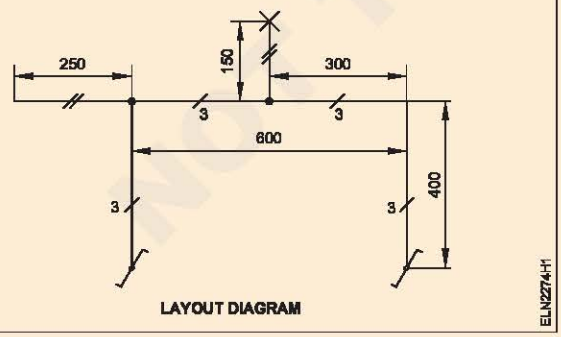
Materials

- PVC conduit pipe -19 mm dia. - 2 mtrs
- PVC terminal box - 1 No.
- Wood screws No.6x12 mm - 3 Nos.
- Wood screws No.6x20 mm - 4 Nos.
- PVC--Insulated aluminium cable 1.5 sq mm. 250V grade - 6 m
- Flush mounting two-way switch 6A, 250V - 2 Nos.
- Batten lamp-holder, 6A, 250V - 1 No.
- Terminal plate 3-way - 1 No.
- Bulb 40W, 250V, BC type - 1 No.
- PVC round block (90mm x 40 mm) - 1 No.
- PVC box 100 mm x 100 mm - 2 No.
- PVC 'Tee' 19 mm - 2 Nos.
- Marking Pen/Pencil/Chalk - as reqd.
- Marking thread - as reqd.
- PVC Insulation tape - 1 Roll
- Self tapping screw (20 mm) - as reqd.
- PVC bend 19mm - 2 mtrs

PROCEDURE

1 Estimate the tools and materials required for the job according to the layout (Fig 1) and the wiring diagram. (Fig 3) Compare the list with the given list. Discuss with your co-trainees/instructor about the variations between the two lists.

Fig 1



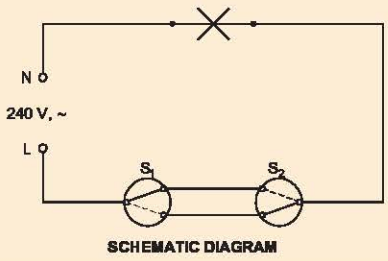
2 Collect materials as per the list.

3 Identify and confirm the switches received are two-way switches only.

4 Identify the terminal points, cable entry holes and fixing holes of the switches and batten lamp-holders.

5 Form the circuit as per the schematic diagram shown in Fig 2.

Fig 2



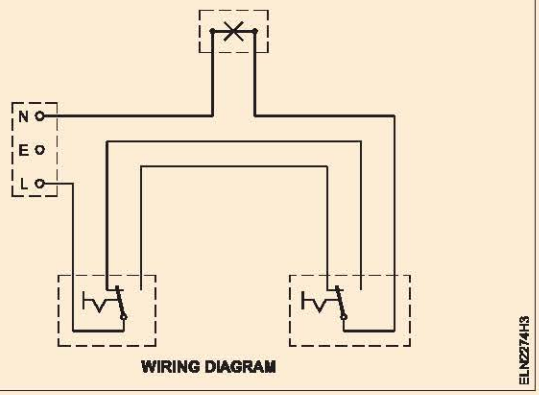
Get the approval of the instructor. If necessary, make alterations in the connections.

6 Connect the supply, check the function of the circuit and note the results in Table 1.

TABLE 1

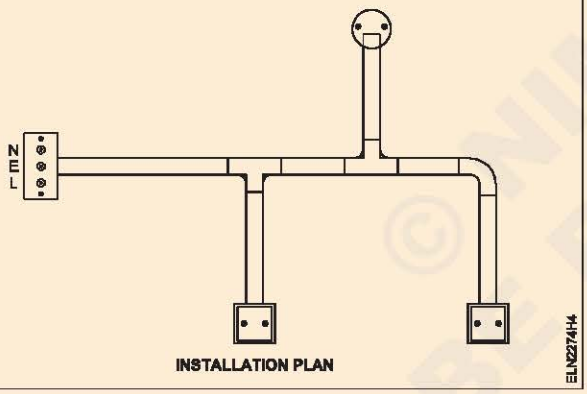
S_1, S_2 position up	
S_1, S_2 position down	
S_1 up and S_2 down	
S_1 down and S_2 up	

Fig 3



7 Mark the layout points on the building as per the installation plan (Fig 4)

Fig 4



8 Cut the required length of PVC pipes as per the layout marking.

Take into consideration the length of bends, tees and corners in appropriate places to reduce the measured length of the P V C conduits.

9 Mark the posistion of the saddles on the building and fix them loosely on one side only.

Observe the N.E. Code for the distance between saddles. In the case of brick/concrete walls, the wooden plugs (gutties) are to be fixed flush with the walls, cemented and cured.

10 Fix the PVC pipe and accessories in the saddle and tighten the saddle screws. Cut the cables according to the wiring diagram (Fig 2)

Keep an extra 200 to 300 mm for termination

11 Insert the cables in the pipes and fittings and push / draw the cables to the other end of the pipes according to the wiring diagram (Fig 3)

For longer lengths of PVC conduit runs, use fish wire/curtain spring to pull the cables through the conduits.

12 Mark the entry profile of the conduit in the round block and boxes. Based on the conduit entry position, position the accessories on the round block, mark the through holes for cable entry, and the pilot holes for fixing the accessories.

13 Prepare the conduit entry profile, drill/make through and pilot holes in the round block and boxes.

14 Insert the cables through the cable entry holes of the round blocks and boxes and fix the round block and boxes on the building.

15 Connect the cable ends to the accessories according to the wiring diagram and fix the accessories on round blocks and boxes.

The completed installation should look as per the installation plan shown in Fig 4

16 Test the circuit after getting the approval of the instructor.

Wire up PVC conduit wiring to control one lamp from 3 different places

Objectives: At the end of this exercise you shall be able to

- **verify and draw the intermediate switch connections in alternate positions of the knob**
- **drawa schematic diagram to show one lamp being controlled from 3 different places based on the I.M. switch connections**
- **form the given circuit with the intermediate switch**
- **cut and lay the PVC pipes as per dimensions with the required number of bends, elbows and different types of junction boxes in the ceiling and the wall**
- **draw the cables through pipe according to the wiring diagram**
- **fix the accessories on boards and terminate the cables in accessories**
- **test the circuit.**

Requirements

Tools/Instruments

- Hacksaw frame 300mm with 24 TPI blade - 1 No.
- Steel tape roll 5 Meter - 1 No.
- Insulated Screwdriver 250mm with 4mm blade width - 1 No.
- Insulated Screwdriver 150mm with 3mm blade width - 1 No.
- Insulated Connector screw driver 100mm with 3mm blade width - 1 No.
- Plumb bob with thread - 1 No.
- Try square 250mm - 1 No.
- Ball peen hammer 250 grams - 1 No.
- Poker 4mm dia. 200mm - 1 No.
- Gimlet 4 mm dia. 200mm - 1 No.
- Electrician's D.B knife 100 mm - 1 No.
- Cutting pliers, insulated 200mm - 1 No.
- Hand drilling machine, 6mm capacity - 1 No.
- S.S. drill bit 3mm and 4mm - 1 each
- Side cutting pliers 150mm - 1 No.
- Firmer chisel 12 mm - 1 No.

Materials

- PVC pipe 20mm dia. - 4 mtrs
- PVC bend 20mm dia. - 2 Nos.
- PVC elbow 20mm dia. - 1 No.
- PVC Tee 20mm dia. - 3 Nos.
- Saddles 20mm dia. heavy gauge - 10 Nos.
- Wood screws No.6 12mm - 40 Nos.
- Wood screws No.6 18mm - 8 Nos.
- PVC cable 1.5 sq.mm 250V grade - 15 m
- T.W. round blocks with box 90 x 40mm - 4 Nos.
- Terminal plate 3-way - 1 No.
- S.P.switch 2-way Flush type 6A 250V - 2 Nos.
- Intermediate switch 6A 250V - 1 No.
- Bakelite batten-holder of B.C. type 6A 250V - 1 No.
- B.C. lamp 40W 250V - 1 No.

PROCEDURE

TASK 1 : **Ascertain the connections of an intermediate switch**

1 Collect the accessories and materials for the exercise.

2 Identify the mode of connections to the terminals with respect to the position of the knob and draw the connection diagram in your record book.

3 Keeping the above connections as the base, draw a schematic diagram to control one lamp from three different places, in your record book.

4 Show the connections to your instructor and get his approval.

TASK 2 : **Form the circuit on the workbench/trainer board**

1 Form the circuit according to the approved diagram on the workbench/trainer board.

2 Show the circuit to the instructor and get his approval.

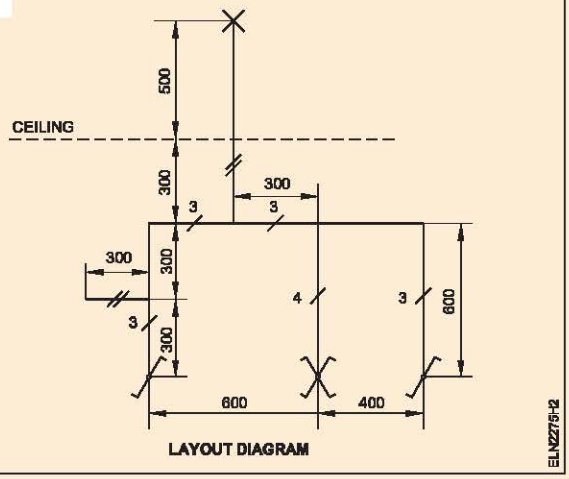
3 Operate the switches as given in Table and note down the results in Table.

Position of S_1 knob	Position of S_2 knob	Position of S_3 knob	Condition of lamp
↑	↑	↑	ON/OFF
↓	↑	↑	
↓	↓	↑	
↓	↓	↓	
↑	↓	↓	
↑	↑	↓	
↓	↑	↑	
↓	↑	↓	

TASK 3 : **Execute PVC conduit wiring**

1 Mark the layout on the installation practice cubicle as per the layout given in Fig 1.

Fig 1



2 Cut the required length of P V C pipes as per the layout marking.

Take into consideration the length of bends, tees and corners in appropriate places to reduce the measured length of the P V C conduits.

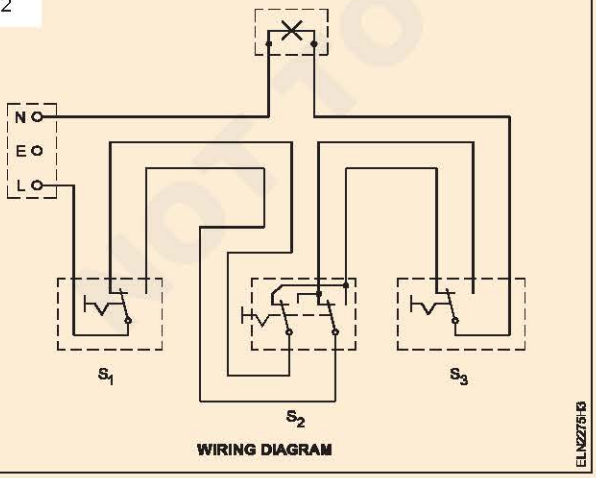
3 Mark the position of the saddles in the I.P.C. and fix them loosely on one side only.

Observe the N.E. Code for the distance between saddles. In the case of brick/concrete walls, the wooden plugs (gutties) are to be fixed flush with the walls, cemented and cured.

4 Fix the PVC pipe and accessories in the saddle and tighten the saddle screws.

5 Cut the cables according to the wiring diagram. (Fig 2)

Fig 2



Keep an extra 200 to 300mm for termination.

6 Insert the cables in the pipes and fittings and push/draw the cables to the other end of the pipes according to the wiring diagram. (Fig 2)

For longer lengths of P V C conduit runs, use fish wire/curtain spring to pull the cables through the conduits.

7 Mark the entry profile of the conduit in the round block.

8 Based on the conduit entry position, position the accessories on the round block, mark the through holes for cable entry, and the pilot holes for fixing the accessories.

9 Prepare the conduit entry profile, drill/make through and pilot holes in the round block.

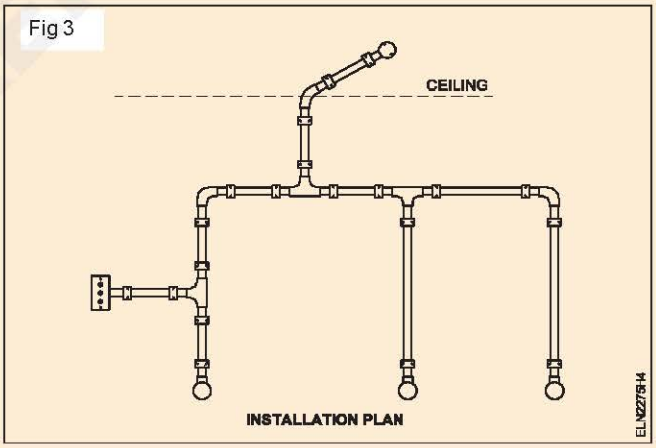
10 Insert the cables through the cable entry holes of the round blocks and fix the round block on boards.

11 Connect the cable ends to the accessories according to the wiring diagram and fix the accessories on the T.W. round blocks.

The completed installation should look as per the installation plan shown in Fig 3.

12 Test the circuit after getting the approval of the instructor.

Fig 3



Wire up PVC Conduit wiring and practice control of sockets and lamps in different combinations using switching concepts

Objectives: At the end of this exercise you shall be able to
- **determine the size of the cable for power wiring**
- **cut non-metallic conduit pipes**
- **fix the accessories to the pipes according to the pipe size with the tight grip method**
- **fix conduit with the necessary clamps and spacers on surface installation in accordance with I.S. recommendations**
- **draw wires with non-metallic conduit pipes**
- **wire up the power circuits in P.V.C. conduit**
- **test the circuit.**

Requirements

Tools/Instruments

- Insulated combination pliers 200mm - 1 No.
- Insulated screwdriver 200mm width 4mm blade - 1 No.
- Insulated side cutting pliers 150mm - 1 No.
- Electrician's knife 100 mm - 1 No.
- Bradawl 150mm - 1 No.
- Ball peen hammer 250 grams - 1 No.
- Hacksaw with 24 TPI blade - 1 No.
- Firmer chisel 6mm x 200mm - 1 No.
- File rasp half round 200 mm basted with handle. - 1 No.
- Flat file rasp 200mm - 1 No.
- Neon tester 500V - 1 No.
- Drill bits 6mm, 3mm - 1 No. each
- Hand drilling machine 6mm capacity - 1 No.

Materials

- PVC pipe 20 mm dia. - 11 mts
- 3-way junction box 25 mm - 3 Nos.
- 20mm sadles - 19 Nos.
- TW Box 200 x 150 x 40mm - 4 Nos.
- PVC sheathed aluminium cable 4 sq mm. 250 V - 52 mts
- Copper wire 14 SWG - 13 mts
- SPT switch 16A 250V - 2 Nos.
- 3-pin socket 16A 250V - 2 Nos.
- 3-pin socket with switch 16A 250V - 2 Nos.
- T.W. wooden spacers - 20 Nos.
- Terminal plate 16 A 6-way - 1 No.
- Wood screws No. 6 x 25 mm - 20 Nos.
- Wood screws No. 6 x 12 mm - 40 Nos.
- PVC elbow 20 mm - 1 No.
- Surface-mounting type Kit-kat fuse 16A, 250V - 2 Nos.

PROCEDURE

TASK 1: **Determine the size of cable for power wiring**

1 Ascertain the load particulars of each socket, assuming each socket is feeding one room air-conditioner of 1.5 ton capacity.

2 Determine the number of circuits, the size of cables for the circuit and branch circuits.

Refer to I.E. regulations, NE code and I.S. recommendations regarding socket connections, loading and maximum number of sockets per circuit.

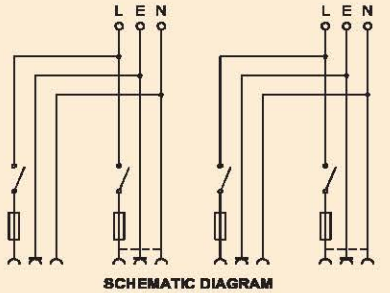
TASK 2 : **Form the circuit and test it**

1 Form the circuit on the workbench/trainer board with the required accessories as per schematic diagram. (Fig 1)

2 Get the approval from your instructor.

3 Effect supply and test the circuit.

Fig 1



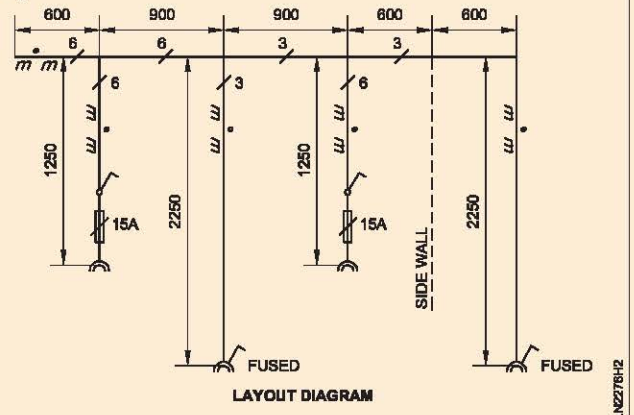
SCHEMATIC DIAGRAM

ELN2276H1

TASK 3 : **Wire the power circuit with P V C conduit**

1 Mark the layout on I.P.C. as per the layout diagram. (Fig 2)

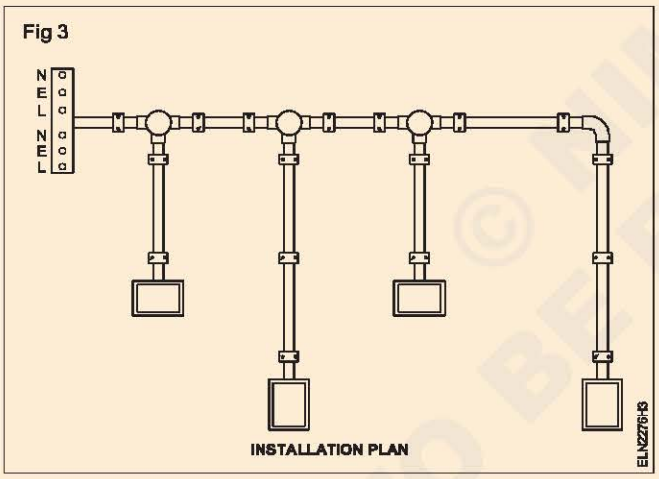
Fig 2



2 Cut the PVC conduit according to the layout by taking the length of the fittings into consideration.

3 Fix the wooden spacer on the layout marking as per installation plan shown in Fig 3, with the help of 25mm wood screws.

Fig 3

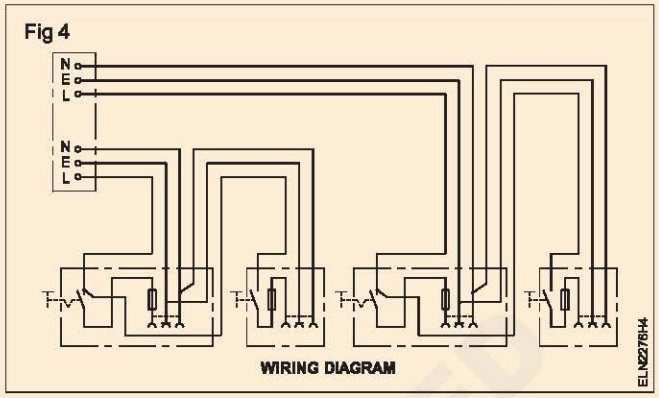


4 Fix the saddles on one side only on the wooden spacers.

5 Cut the cable length according to the route length taking into consideration the layout diagram, Fig 2 and the wiring diagram, Fig 4.

Keep an extra length of 200 to 300 mm in each cable run.

Fig 4



6 Fix the PVC conduits and accessories in the saddles and tighten the saddles by means of wood screws.

7 Insert the cables and the earth wire in the pipe and fittings, and push the wires to the other end of the pipe.

8 Prepare wooden boxes for conduit terminations, for fixing accessories and for taking cable terminations.

9 Fix the base of the boxes on the I.P.C. and fix the cover on the boxes after inserting the cables in the respective holes.

Expansion of the acronym I.P.C. is Installation Practice Cubicle/Wiring cabin/Wiring booth.

10 Connect the cable ends to the accessories and fix the accessories to the boxes with screws.

11 Connect the earth wire. (The completed installation should look as shown in Fig 3.)

The minimum size of earth wire, 14 SWG, tinned copper must be used.

12 Get the approval of the instructor.

13 Test the circuit.