

Student Name.....

Group .....



**Practical Exercises**

**City and Guilds 5357**

**Industrial Wiring Skills**

## Exercise No. 9 a

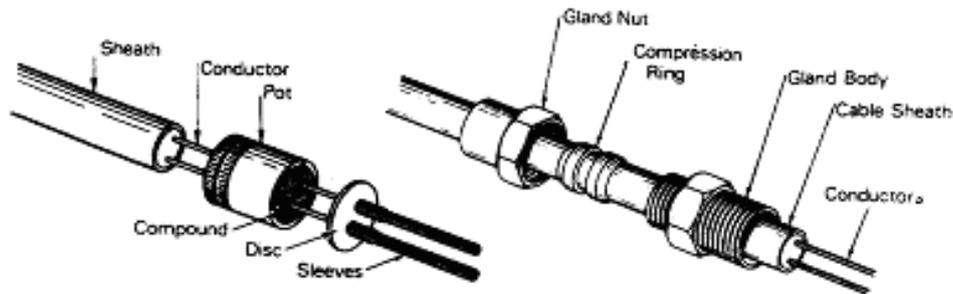
### Mineral Insulated Cable (Basic Techniques)

Student Name ..... Start Date.....

#### Instruction to Trainee

Cut a 700 mm long piece of 2 core light gage mineral insulated cable (MI) and terminate each end. One end using a stripping tool, the other using a 'T' bar. Correctly fit gland and seal to each, polarity test and identify conductors. Finally insulation resistance test the cable and record results.

#### **TERMINATION**



Insulation resistance result L/N \_\_\_\_\_ L/CPC \_\_\_\_\_ N/CPC \_\_\_\_\_

<b>Marking Criteria</b>	<b>Stripping tool</b>	<b>'T' bar</b>
Job carried out in a safe manner		
Cable stripped to a suitable length		
Square burr free end		
Undamaged cable sheath		
Correctly fitted gland		
Correctly fitted pot		
Correctly crimped pot		
Cable ends sleeved		
Conductors identified		
Insulation resistance recorded		
Work area tidy		
<b>Assessor Feedback and Learner Response</b>		

Assessor ..... Date .....

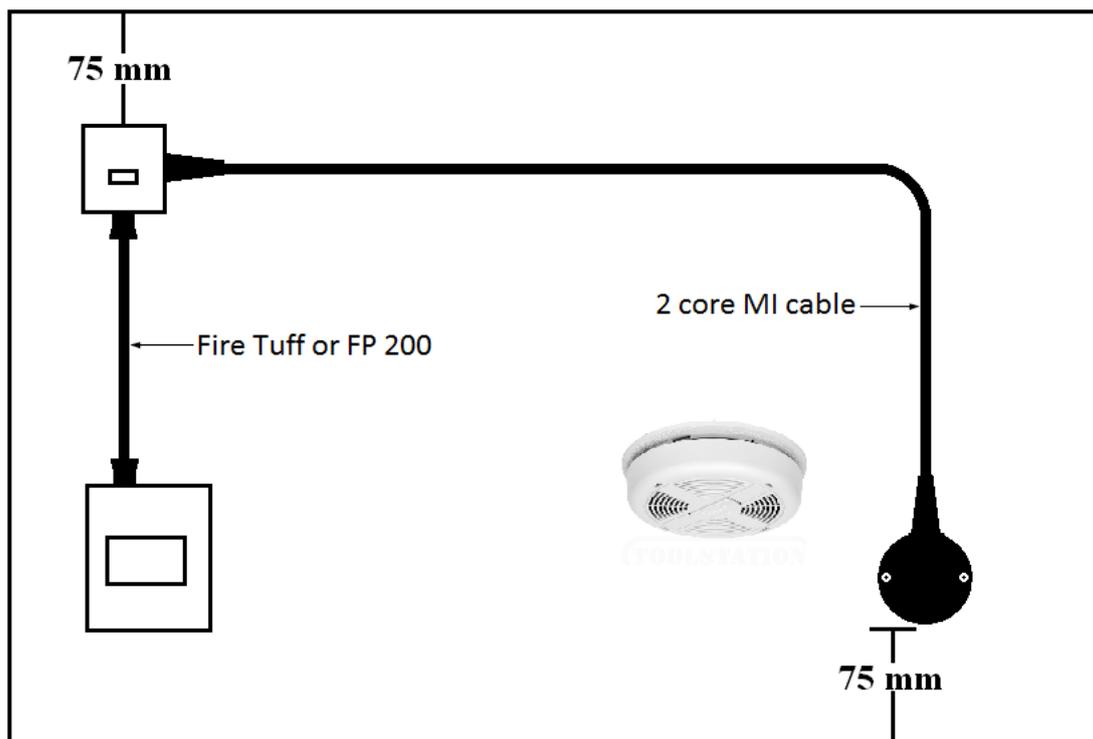
## Exercise No. 9 b

### FP 200 and Mineral Insulated Cable (Clipping)

Student Name ..... Start Date .....

#### Instruction to Trainee

On a surface identified by your instructor, fix a 2 way consumers unit, a surface metal clad fuse connection unit and a 20 mm metal termination box. Wire with 1.5mm<sup>2</sup> two core and cpc fire tough and 1.mm<sup>2</sup> two core sheathed MI the circuit shown below. Clip the sheathed MI using sheathed clips fixed with black jap No8 slotted screws, fix the fire tough using 7mm round red clips. When terminating the MI one end should have an earth tail pot and the other a standard pot. Make sure cables are clipped straight, flat and with smooth bend.



### Material Requisition

Name: ..... Job No: 9b ..... Date or Time Required: .....

Quantity Required	Description
	<b>Mineral Insulated (MICC) 1.0mm<sup>2</sup> Light Gauge 2 Core PVC Red Sheathed Cable</b>
	<b>Red FP 200 1.5 mm<sup>2</sup> 2 Core and CPC Cable Red Sheathed Cable (Or Fire Tuff)</b>
	<b>Mineral Insulated (MICC) 2L1 Pots</b>
	<b>Mineral Insulated (MICC) 2L1 Earth Tail Pots</b>
	<b>Mineral Insulated (MICC) 2L1 Glands</b>
	<b>20mm Red Stuffing Gland</b>
	<b>20mm Galvanised Steel Terminal Box (Standard)</b>
	<b>3/4" No8 Pozi Round Headed Screws</b>
	<b>13 Amp Metal Clad Fuse Connection Unit (Includes BS1362 13 Amp Fuse)</b>
	<b>BS 1362 3 Amp Cartridge Fuse (Plug top Fuse)</b>
	<b>7mm Red Round Clips</b>
	<b>6 Amp BS EN 60898 Type B Circuit Breaker</b>

### Material Requisition

Name: ..... Job No: 9b ..... Date or Time Required: .....

Quantity Required	Description
	<b>Red (Eyelet) Ring Crimps</b>
	<b>Red PVC Covered 'P' Clips</b>
	<b>Mains Powered Battery backed Up Smoke Detector</b>
	<b>6mm Blue and Green/Yellow PVC Over Sleeving</b>
	<b>Green/Yellow 1.5mm<sup>2</sup> Single Thermoplastic (PVC) Stranded Cable</b>
	<b>M4 16 mm Brass Screws</b>
	<b>M4 6 mm Brass Screws</b>
	<b>Brown 10mm<sup>2</sup> Double Insulated Thermoplastic (PVC) Meter Tails</b>
	<b>Blue 10mm<sup>2</sup> Double Insulated Thermoplastic (PVC) Meter Tails</b>
	<b>Green/Yellow 10mm<sup>2</sup> Single Insulated Thermoplastic (PVC) Stranded Cable</b>
	<b>Wiska Gland 10mm<sup>2</sup>/10mm<sup>2</sup>/10mm<sup>2</sup> Tails</b>
	<b>Consumer Unit Blanks and Blind Gromets As Required</b>

Exercise No. 9 b

FP 200 and Mineral Insulated Cable (Clipping)

**Test Results**

Circuit description	Fuse size and type	Cable size mm <sup>2</sup>		Ring Final Circuit Continuity Ω			Continuity Ω R1+R2	Insulation resistance M Ω			Polarity ✓
		Live	CPC	r1	rn	r2		L/N	L/E	N/E	

Continuity of protective bonding conductor \_\_\_\_\_

Exercise No. 9 b

FP 200 and Mineral Insulated Cable (Clipping)

<b>Marking Criteria</b>	<b>MI</b>	<b>FP 200</b>
Job carried out in a safe manner		
Cables stripped to a suitable length		
Square burr free ends		
Undamaged cable sheath		
Correctly fitted glands		
Correctly fitted pots		<b>N/A</b>
Cable ends sleeved		
Conductors identified		<b>N/A</b>
Cables clipped straight and flat		
Acceptable clipping distance		
Acceptable bending radius		
Correct dimensions		
Circuit test results completed		
Correct torque settings		
Worked safely		
Work area tidy		
<b>Assessor Feedback and Learner Response</b>		

Assessor ..... Date.....

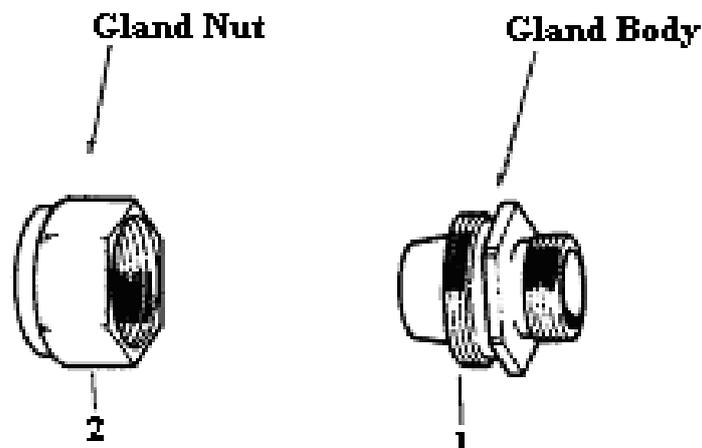
Exercise No. 10 a

Steel Wire Armour (Basic Technique)

Student Name ..... Start Date .....

Instruction to Trainee

Cut a 700 mm long piece of 3 core steel wire armour (SWA) and terminate the end.



Marking Criteria	Completed
Job carried out in a safe manner	
Cable stripped to a suitable length	
Undamaged cable sheath	
Squarely cut armouring	
Correctly fitted gland	
Work area tidy	
<b>Assessor Feedback and Learner Response</b>	

Assessor ..... Date .....

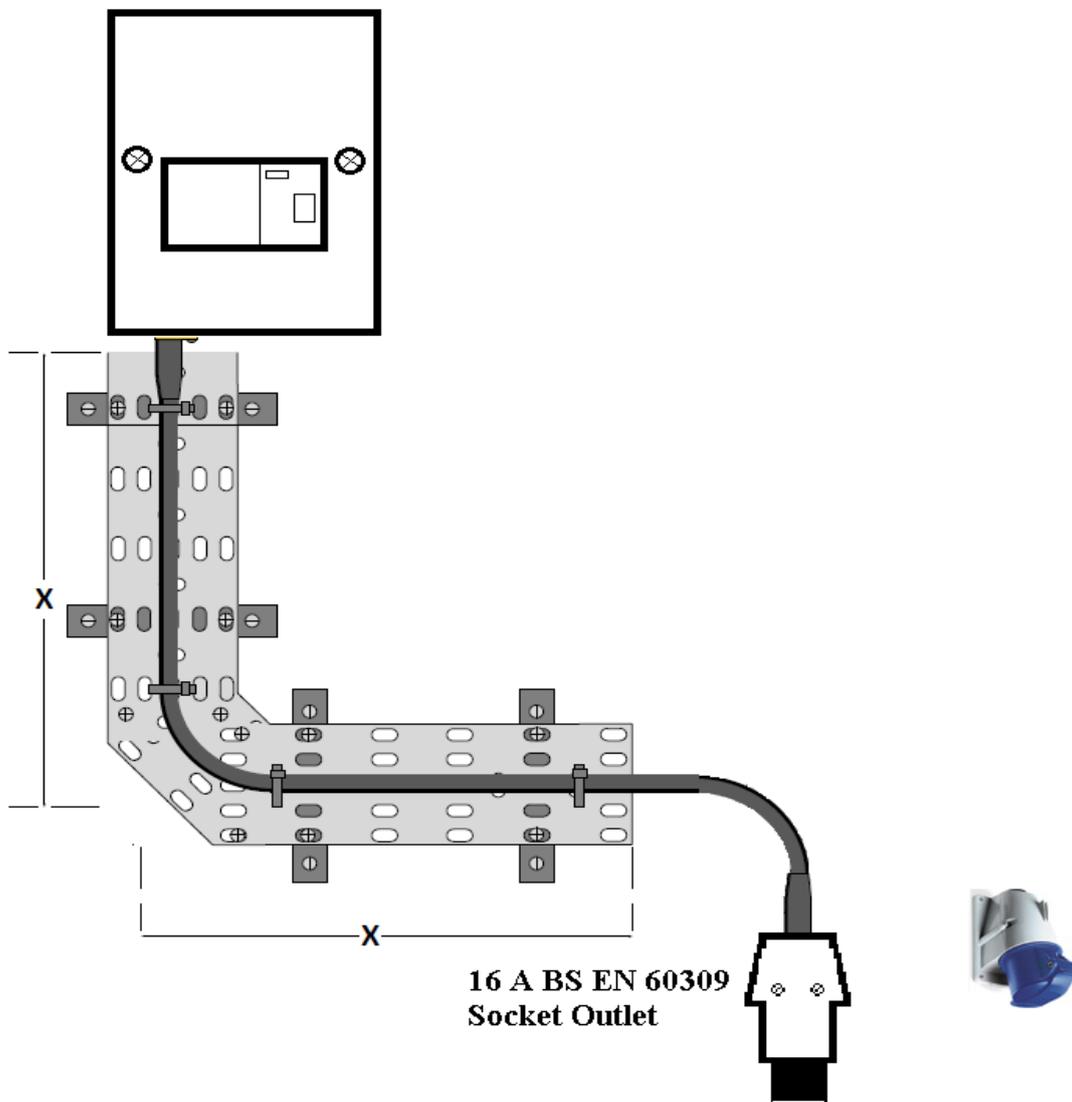
## Exercise No. 10 b

### Steel Wire Armour on Cable Tray

Student Name ..... Start Date.....

#### Instruction to Trainee

On a wooden surfaces fix one 63 amp metal clad consumer unit and one 16 amp BS EN 60309 socket outlet. Wire between with three core SWA fixed on 100mm cable tray.



**Dimensions may alter**

### Material Requisition

Name: ..... Job No: Ex N° 10b ..... Date or Time Required: .....

Quantity Required	Description
	<b>BW 20s Gland Kit Comprising of 2 Glad Bodies, 2 Gland Nuts, 2 Earthing Rings, 2 Lock Nuts, 2 Shrouds</b>
	<b>2.5mm<sup>2</sup> SWA 3 Core Thermosetting PVC Cable</b>
	<b>2 Way Metal Clad Consumer Unit With A 63 Amp 30 mA Main RCD Switch</b>
	<b>IP 44 16 Amp BS EN 60309 Socket Outlet</b>
	<b>N°6 Cable Cleats</b>
	<b>1½" N°8 Slotted Black Round Headed Screws</b>
	<b>¾" N°8 Pozi Round Headed Screws</b>
	<b>M6 Nuts And Bolts 16mm Long</b>
	<b>Blue (Eyelet) Ring Crimps</b>
	<b>Green/Yellow 2.5mm<sup>2</sup> Single Thermoplastic (PVC) Stranded Cable</b>
	<b>6mm Blue and Green/Yellow PVC Over Sleeving</b>

### Material Requisition

Name: ..... Job No: Ex N° 10b ..... Date or Time Required: .....

Quantity Required	Description
	<b>Brown 10mm<sup>2</sup> Double Insulated Thermoplastic (PVC) Meter Tails</b>
	<b>Blue 10mm<sup>2</sup> Double Insulated Thermoplastic (PVC) Meter Tails</b>
	<b>Green/Yellow 10mm<sup>2</sup> Single Insulated Thermoplastic (PVC) Stranded Cable</b>
	<b>16 Amp BS EN 60898 Type B Circuit Breaker</b>
	<b>Wiska Gland 10mm<sup>2</sup>/10mm<sup>2</sup>/10mm<sup>2</sup> Tails</b>
	<b>Consumer Unit Blanks and Blind Gromets As Required</b>
	<b>100mm Galvanised Light Gauge Steel Cable Tray</b>
	<b>41mm By 20mm Uni-Strut</b>
	<b>M6 Short Spring Nuts (Zebz)</b>
	<b>M6 Penny Washers</b>
	<b>4.8mm By 160mm PVC Cable Ties Metal as Required</b>

Exercise No. 10 b

Steel Wire Armour (Clipping)

**Test Results**

Circuit description	Fuse size and type	Cable size mm <sup>2</sup>		Ring Final Circuit Continuity Ω			Continuity Ω R1+R2	Insulation resistance M Ω			Polarity ✓
		Live	CPC	r1	rn	r2		L/N	L/E	N/E	

Continuity of protective bonding conductor \_\_\_\_\_

Exercise No. 10 b

Steel Wire Armour (Clipping)

<b>Marking Criteria</b>	<b>Peer Marked</b>	<b>Completed</b>
Job carried out in a safe manner		
Cable stripped to a suitable length		
Undamaged cable sheath		
Squarely cut armouring		
<b>Correctly fitted gland and tight PASS or FAIL</b>		
Termination's tight		
Termination's doubled over		
Cables clipped straight and flat		
Acceptable clipping distance		
Cable run vertically		
Correct dimensions		
Circuit test results completed		
Correct torque settings		
Worked safely		
Work area tidy		
<b>Assessor Feedback and Learner Response</b>		

Assessor ..... Date .....

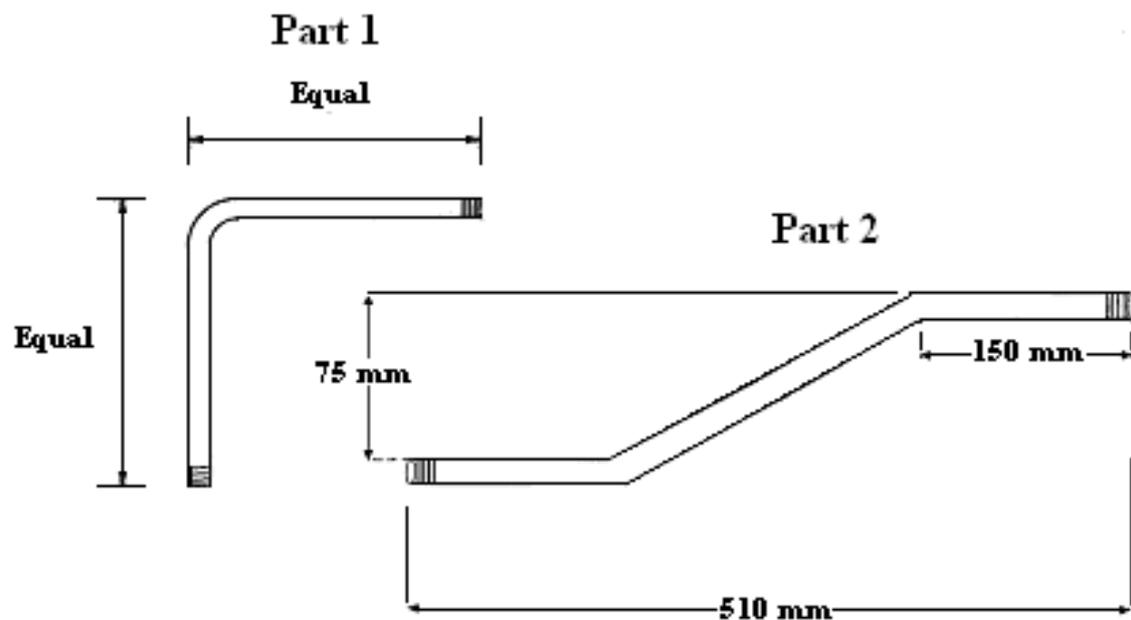
## Exercise No. 11 a

### Steel Conduit (Basic Technique)

Student Name ..... Start Date .....

#### Instruction to Trainee

Cut two pieces of 20 mm steel conduit 600 mm long and then thread all four ends. In the first length, put a 90° bend in it so each side is of equal length without cutting. In the second length, put a double set in, to the dimension given below.



Exercise No. 11 a

Steel Conduit (Basic Technique)

<b>Marking Criteria</b>	<b>Straight</b>	<b>Bend</b>	<b>Set</b>
Job carried out in a safe manner			
Conduit cut to length			
Conduit end cut square			
<b>All burrs removed PASS or FAIL</b>			
Conduit threaded correctly			
Correct dimensions			
Worked safely			
Work area tidy			
<b>Assessor Feedback and Learner Response</b>			

Assessor ..... Date .....

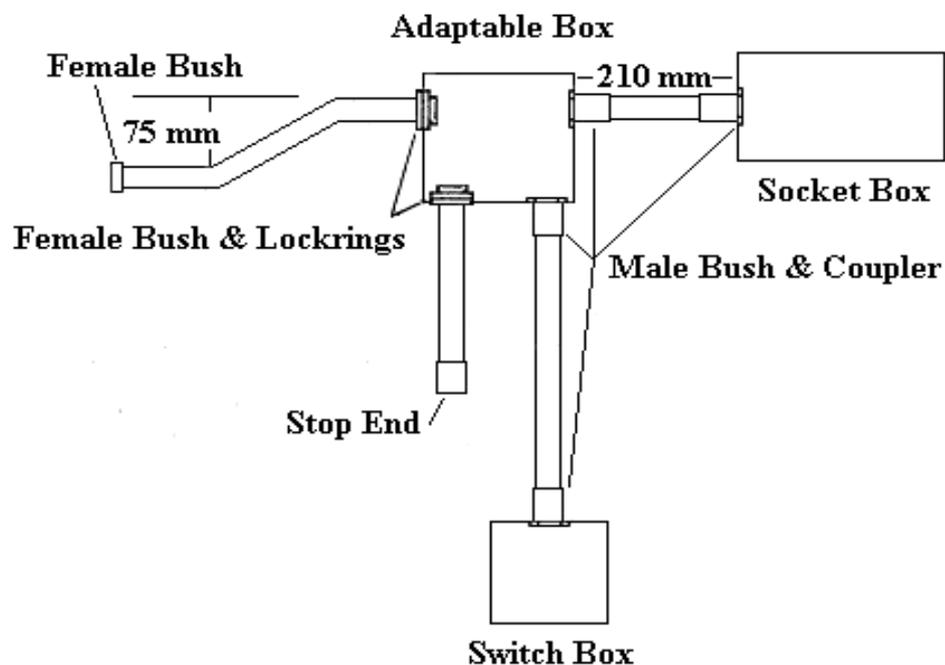
## Exercise No. 11 b Parts 1 and 2

### Steel Conduit (Termination's and Fixing)

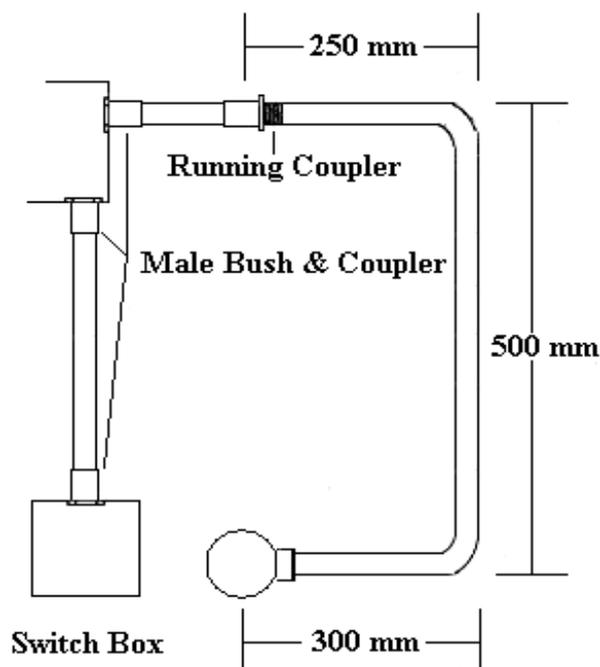
Student Name ..... Start Date .....

#### Instruction to Trainee

On a surface identified by your instructor, fit part 1 an adaptable box and 20 mm steel conduit to the dimensions given below. Part 2 remove the twin metal socket box and extend the conduit system by adding the 'U' bend to the dimensions given below.



## PART 2



### Material Requisition

Name: ..... Job No: Ex N° 11b..... Date or Time Required: .....

Quantity Required	Description
	<b>20mm Seam Welded Galvanised, Heavy Gauge Steel Conduit</b>
	<b>100mm x 100mm x 50mm Galvanised Steel Adaptable Box</b>
	<b>20mm Galvanised Spacer Bar Saddles</b>
	<b>20mm Galvanised Steel Couplers</b>
	<b>20mm Brass Male Bushes</b>
	<b>20mm Brass Female Bushes</b>
	<b>20mm Steel Locking Rings</b>
	<b>20mm Galvanised Steel Termination Box</b>
	<b>Metal Clad Surface Light Switch Box</b>
	<b>Metal Clad Surface Twin Socket Box</b>
	<b>20mm Brass Stop End</b>

### Material Requisition

Name: ..... Job No: Ex N° 11b..... Date or Time Required: .....

Quantity Required	Description
	<b>3/4" N°8 Pozi Round Headed Screws</b>
	<b>3/4" N°8 Pozi Countersunk Screws</b>
	<b>Cutting Compound</b>

Exercise No. 11 b Parts 1 and 2

Steel Conduit (Termination's and Fixing)

<b>Marking Criteria</b>	<b>Peer Marked</b>	<b>Completed</b>
Job carried out in a safe manner		
Conduit cut to length		
Conduit ends cut square		
All burrs removed		
<b>Correctly fabricated 90° bends PASS or FAIL</b>		
All accessories undamaged and assembled		
Correct and tight termination of conductors		
Conduit termination's tight		
Conduit threaded correctly		
Correct dimensions		
Material requisition completed		
Worked safely		
Work area tidy		
<b>Assessor Feedback and Learner Response</b>		

Assessor ..... Date .....

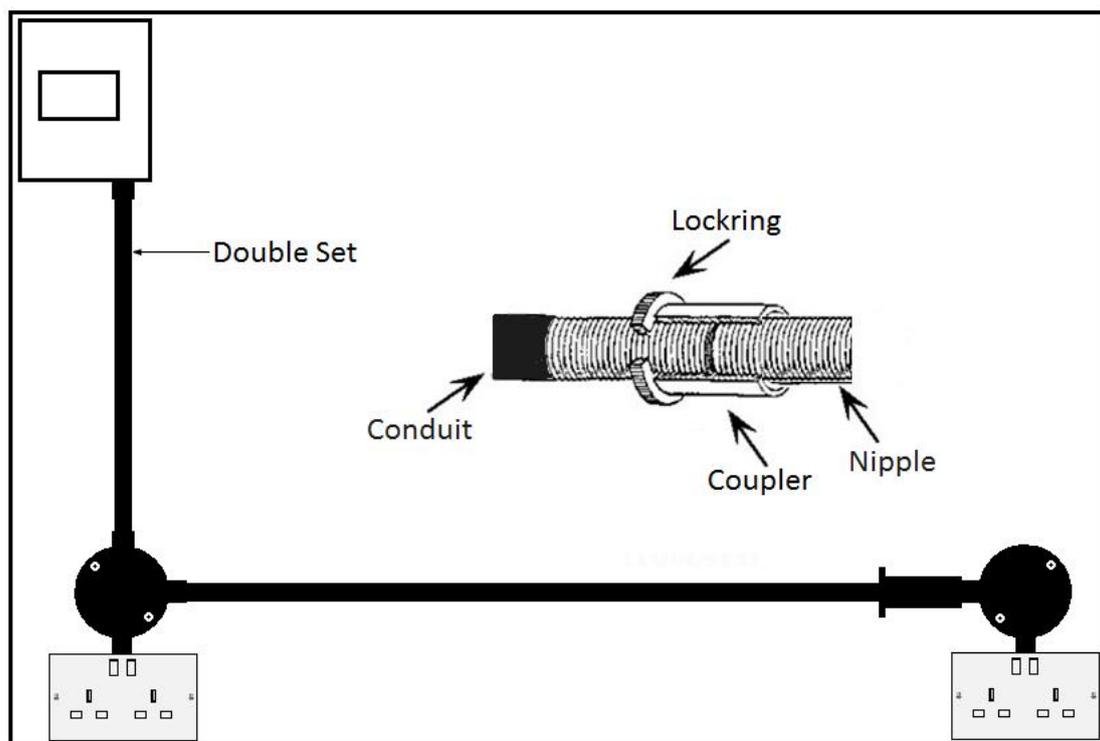
Exercise No. 11 c

Steel Conduit (Socket Circuit)

Student Name ..... Start Date .....

Instruction to Trainee

On a surface identified by your instructor, produce in 20mm galvanised conduit the circuit shown below and wire as an A1 ring final socket circuit.



**Circuit must be tested**

### Material Requisition

Name: ..... Job No: Ex N° 11c..... Date or Time Required: .....

Quantity Required	Description
	<b>20mm Seam Welded Galvanised, Heavy Gauge Steel Conduit</b>
	<b>2 Way Metal Clad 45 Amp Consumer Unit (RCD main switch not required)</b>
	<b>20mm Galvanised Spacer Bar Saddles (Ask Tutor If Required Plus 3/4" No8 Pozi Counter Sank Screws)</b>
	<b>20mm Galvanised Steel Couplers</b>
	<b>20mm Brass Male Bushes</b>
	<b>20mm Steel Locking Rings</b>
	<b>20mm Galvanised Angle Box (standard)</b>
	<b>20mm Galvanised Steel Tee Box (standard)</b>
	<b>13 Amp BS 1363 Metal Clad Switched Twin Socket Outlets (Includes Box)</b>
	<b>3/4" No8 Pozi Round Headed Screws</b>
	<b>BS EN 60898 32 Amp Type B Circuit Breaker</b>

### Material Requisition

Name: ..... Job No: Ex N° 11c..... Date or Time Required: .....

Quantity Required	Description
	<b>Brown 2.5 mm<sup>2</sup> Single Thermoplastic (PVC) Stranded Cable</b>
	<b>Blue 2.5 mm<sup>2</sup> Single Thermoplastic (PVC) Stranded Cable</b>
	<b>Green and Yellow 2.5 mm<sup>2</sup> Single Thermoplastic (PVC) Stranded Cable</b>
	<b>Galvanised Steel Conduit Box Lids</b>
	<b>M4 16 mm Brass Screws</b>
	<b>Brown 10mm<sup>2</sup> Double Insulated Thermoplastic (PVC) Meter Tails</b>
	<b>Blue 10mm<sup>2</sup> Double Insulated Thermoplastic (PVC) Meter Tails</b>
	<b>Green/Yellow 10mm<sup>2</sup> Single Insulated Thermoplastic (PVC) Stranded Cable</b>
	<b>Wiska Gland 10mm<sup>2</sup>/10mm<sup>2</sup>/10mm<sup>2</sup> Tails</b>
	<b>3.5mm Box Screws (If Not Supplied With Sockets)</b>
	<b>Consumer Unit Blanks and Blind Gromets As Required</b>

Exercise No. 11 c

Steel Conduit (Socket Circuit)

**Test Results**

Circuit description	Fuse size and type	Cable size mm <sup>2</sup>		Ring Final Circuit Continuity Ω			Continuity Ω R1+R2	Insulation resistance M Ω			Polarity ✓
		Live	CPC	r1	rn	r2		L/N	L/E	N/E	

Continuity of protective bonding conductor \_\_\_\_\_

$$R_1 + R_n = \frac{\text{End to end line } r_1 + \text{End to end neutral } r_n}{4}$$

**Calculating R<sub>1</sub> + R<sub>2</sub>**

$$R_1 + R_2 = \frac{\text{End to end line } r_1 + \text{End to end c.p.c } r_2}{4}$$

Exercise No. 11 c

Steel Conduit (Socket Circuit)

<b>Marking Criteria</b>	<b>Peer Marked</b>	<b>Completed</b>
Job carried out in a safe manner		
Conduit cut to length		
Conduit ends cut square		
All burrs removed		
All accessories undamaged and assembled		
Correct and tight termination of conductors		
Acceptable amount of spare at termination		
Termination's doubled over		
Conduit termination's tight		
Conduit threaded correctly		
Correct dimensions		
Circuit functional		
Circuit test results completed		
Schedule of inspection completed		
Material requisition completed		
Correct torque settings		
Worked safely		
Work area tidy		
<b>Assessor Feedback and Learner Response</b>		

Assessor ..... Date .....

## METAL CONDUIT

Metal conduit comes in **3.75-metre** lengths.

The 2 main types of conduit are **seam welded** and **solid drawn**

The 4 common sizes of conduit are **16mm**, **20mm**, **25mm** and **32mm**.

The 2 most common conduit finishes are **black enamel** and **galvanised**.

The minimum number of teeth per inch (25mm) of a hacksaw blade used to cut conduit is **24**.

A lubrication used in the threading of conduit is **tallow**.

During the threading of conduit the stocks and dies must be turned anti-clockwise after 2 to 3 full turns; this breaks off the curls of metal to prevent **damage** to the thread.

After cutting and threading of conduit the ends must be **reamed** to prevent **damage** to the cables during the installation process.

The conduit system must be fully erected before the **cables** can be installed.

The conduit is **threaded** when connecting conduit to the spout of an accessory.

When connecting conduit to a box you use a **coupler** and male **bush**.

Where the finish on metal conduit is damaged it must be **painted** to prevent **corrosion**.

The minimum-bending radius for 20mm conduit is **50mm**, which is **two** and **half** times the outside diameter of the conduit.

Metal conduit can be used as which circuit conductor **CPC**.

What conditions are the following saddles used

Two hole saddle:

**Smooth surfaces**

Spacer bar saddle:

**Uneven brickwork**

Distance saddle:

**Damp conditions**

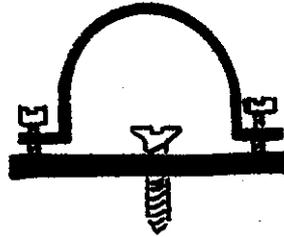
Hospital saddle:

**For cleaning behind**

## ***Conduit Fixings***



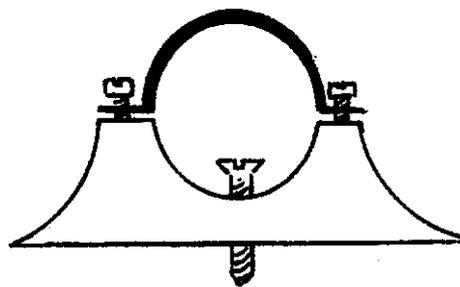
**2 Hole Saddle**



**Spacer Bar Saddle**



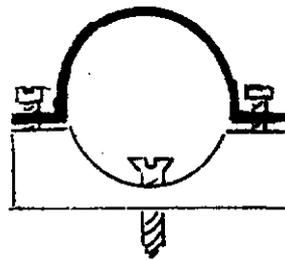
**1 Hole Saddle**



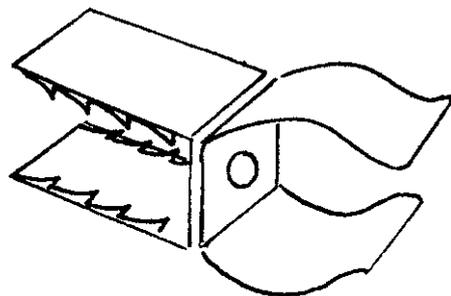
**Hospital Saddle**



**Crampet**

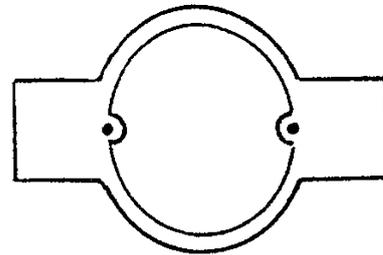
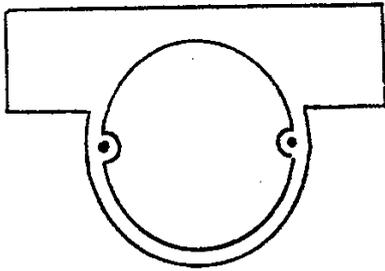


**Distance Saddle**

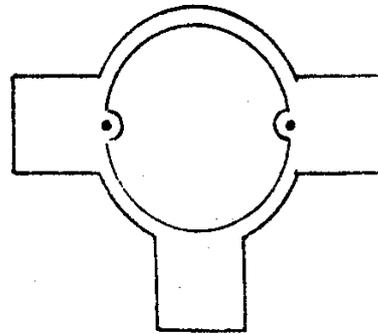
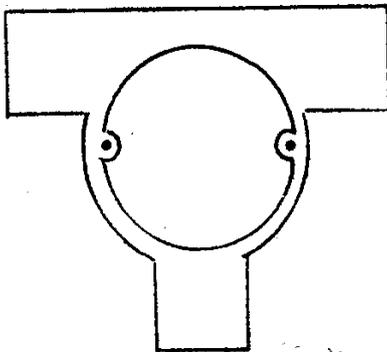


**Girder Clip**

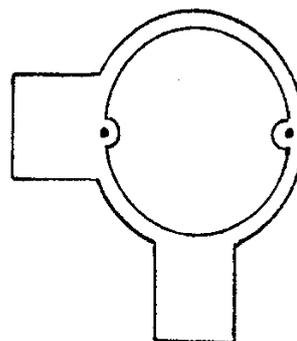
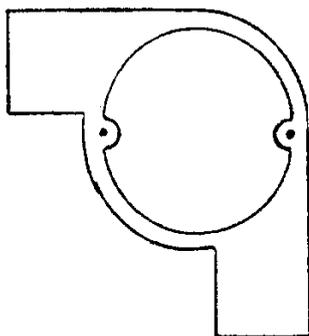
## **Conduit Boxes**



**TANGENT      STRAIGHT THROUGH BOXES      STANDARD**

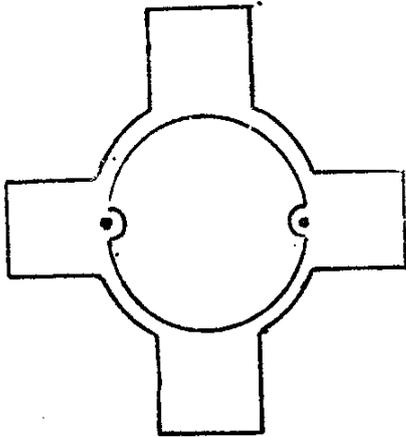


**TANGENT      'T' BOXES      STANDARD**

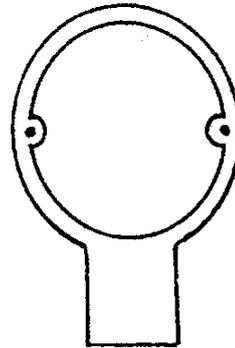


**TANGENT      ANGLE BOXES      STANDARD**

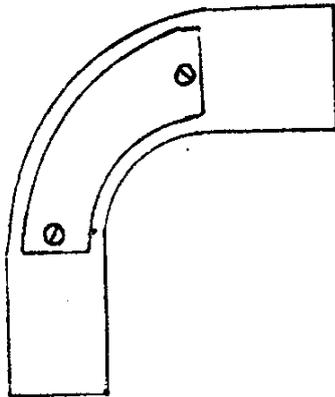
## ***Conduit Boxes***



**4 WAY BOX**

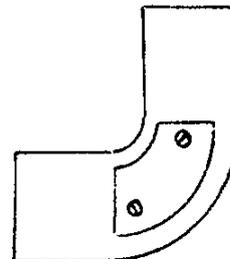


**TERMINATION BOX**



**INSPECTION BEND**

**INSPECTION ELBOW**



# CIRCUIT WIRING

## *PVC Singles*

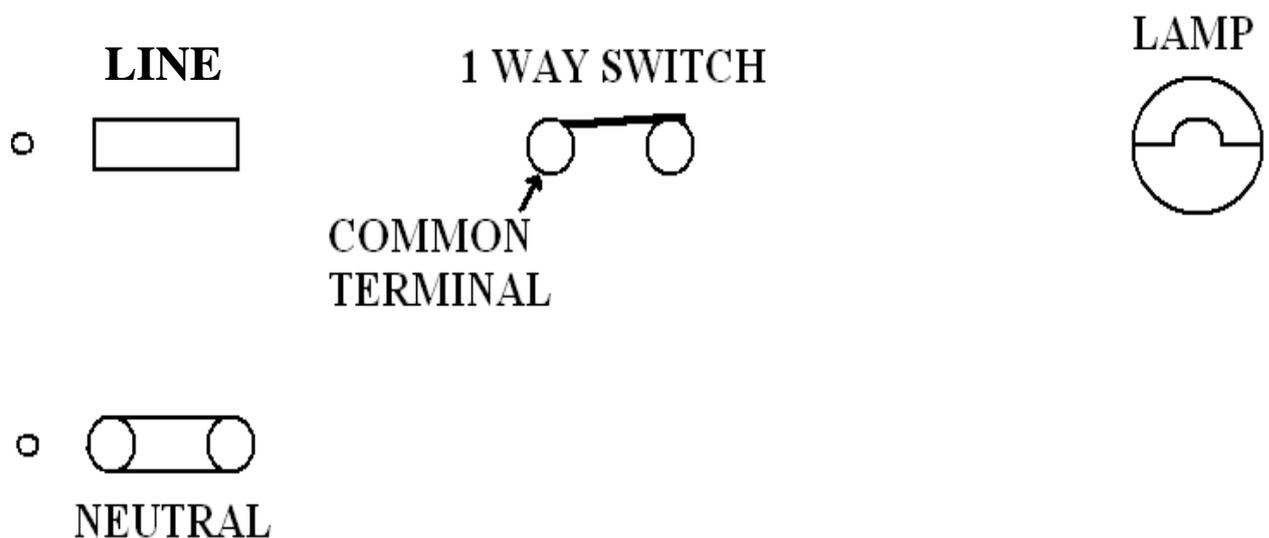
Where circuits are to be wired in PVC or metal conduit or trunking single cables are used. These cables are single PVC insulated with the conduit or trunking providing the mechanical protection. The copper conductors are stranded for greater flexibility when installing them. The cables are coloured to distinguish them i.e. brown line, blue neutral and green and yellow cpc. **When wiring lighting circuits in conduit 1.5mm<sup>2</sup> singles are used** and not 1.0mm<sup>2</sup>. In this system the line conductor is taken from the consumer unit to the first switch then the feed is **LOOPED** to each switch in turn. The switch wire goes from each switch to its light to turn it on. From the consumer unit the neutral and cpc conductors are looped into each lighting point. Below shows how the line conductor is looped between switches in a lighting circuit in conduit.

## ***Circuit Diagrams***

A circuit diagram uses symbols to represent all circuit components and shows how they are connected. It should be as clear as possible and follow a logical progression from **supply** to **output**. The diagram does not represent physical symbol or circuit size and normally only show live conductors (line and neutral).

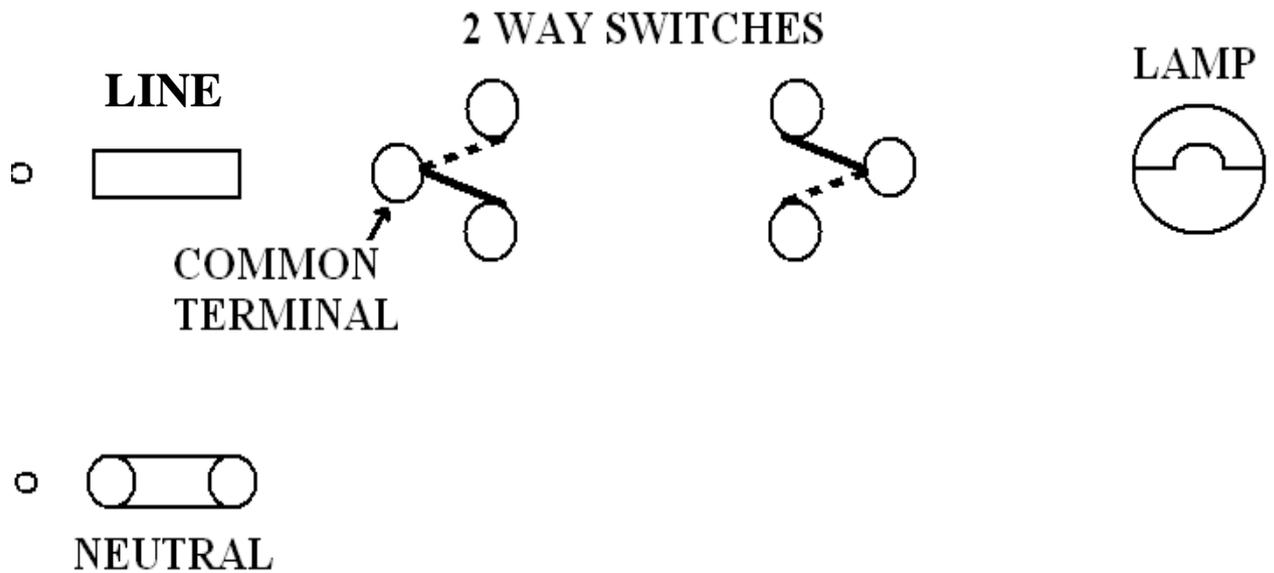
### ***One Way Switching***

In order to light a lamp both line and neutral conductors must be present at the lamp. To have control over the lamp the line conductor must be passed through a switch. The neutral conductor is supplied from either the consumer unit or other lamp in circuit whichever is closest.



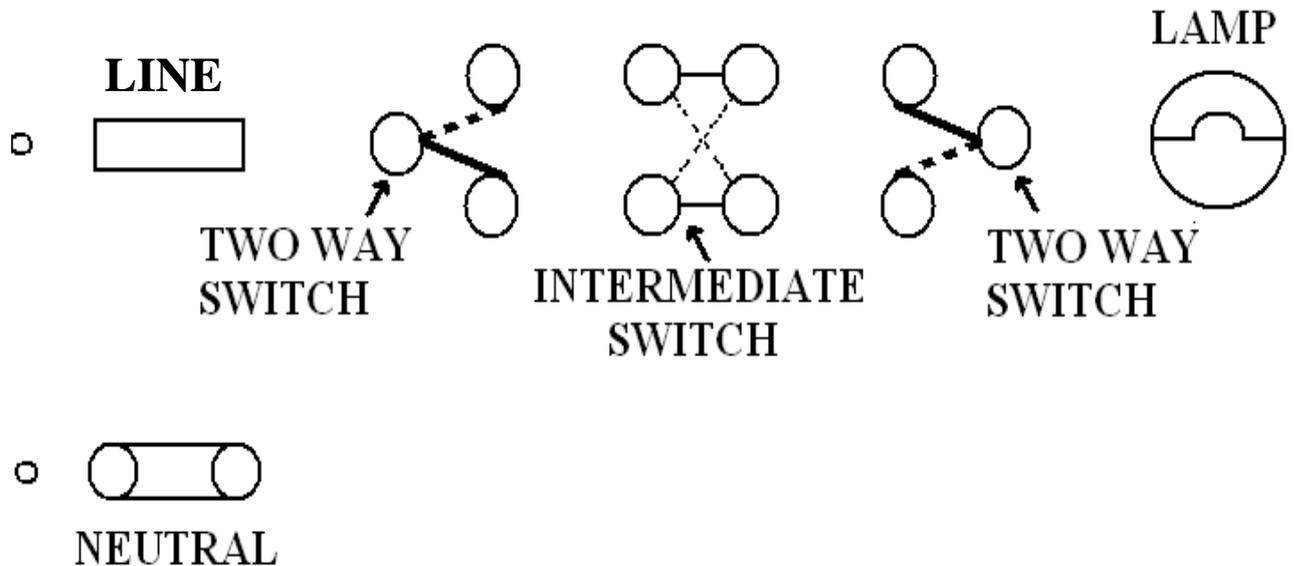
## ***Two Way Switching Standard Circuit***

Circuits wired in **CONDUIT** or in some older properties the switching is wired as shown below with all line conductors in brown.



## ***Two Way and Intermediate Switching Standard Circuit***

In circuits which require 3 or more switches to control the lights **as many intermediate switches can be fitted as needed**, again this method is commonly used when wiring in **CONDUIT**.



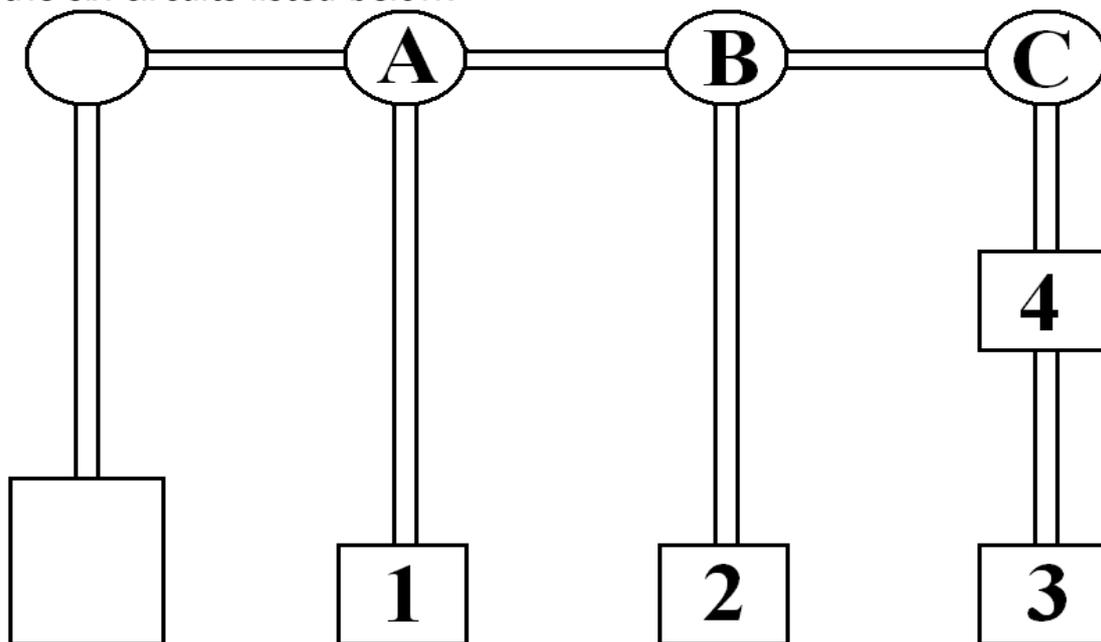
## Exercise No. 7 a (part 1)

### PVC Wiring 1 (Simple Lighting Circuits)

Student Name ..... Start Date .....

#### Instruction to Trainee

Install 1.5 mm<sup>2</sup> PVC singles into pre - tubed work boards. Using the loop - in method commonly used in conduit installations, wire the six circuits listed below.



Conduit Loop-In Method

Stage 1 : Wire in 1.5mm<sup>2</sup> PVC singles light 'A' controlled from switch '1'

Stage 2 : Add light 'B' controlled from switch '2'

Stage 3 : Then add light 'C' controlled from switches '3'

Stage 4 : Wire light 'A' and 'B' controlled from switch '1'

Stage 5 : Wire light 'A' and 'B' controlled from switches '1' and '3'

Stage 6 : Wire light 'A' controlled from switches '1', '2' and '3'

Exercise No. 7 a (part 1)

PVC Wiring 1 (Simple Lighting Circuits)

**Test Results Stage '1'**

Circuit description	Fuse size and type	Cable size mm <sup>2</sup>		Ring Final Circuit Continuity Ω			Continuity Ω R1+R2	Insulation resistance M Ω			Polarity ✓
		Live	CPC	r1	rn	r2		L/N	L/E	N/E	

Continuity of protective bonding conductor \_\_\_\_\_

Exercise No. 7 a (part 1)

PVC Wiring 1 (Simple Lighting Circuits)

**Test Results Stage '2'**

Circuit description	Fuse size and type	Cable size mm <sup>2</sup>		Ring Final Circuit Continuity Ω			Continuity Ω R1+R2	Insulation resistance M Ω			Polarity ✓
		Live	CPC	r1	rn	r2		L/N	L/E	N/E	

Continuity of protective bonding conductor \_\_\_\_\_

Exercise No. 7 a (part 1)

PVC Wiring 1 (Simple Lighting Circuits)

**Test Results Stage '3'**

Circuit description	Fuse size and type	Cable size mm <sup>2</sup>		Ring Final Circuit Continuity Ω			Continuity Ω R1+R2	Insulation resistance M Ω			Polarity ✓
		Live	CPC	r1	rn	r2		L/N	L/E	N/E	

Continuity of protective bonding conductor \_\_\_\_\_

Exercise No. 7 a (part 1)

PVC Wiring 1 (Simple Lighting Circuits)

**Test Results Stage '4'**

Circuit description	Fuse size and type	Cable size mm <sup>2</sup>		Ring Final Circuit Continuity Ω			Continuity Ω R1+R2	Insulation resistance M Ω			Polarity ✓
		Live	CPC	r1	rn	r2		L/N	L/E	N/E	

Continuity of protective bonding conductor \_\_\_\_\_

Exercise No. 7 a (part 1)

PVC Wiring 1 (Simple Lighting Circuits)

**Test Results Stage '5'**

Circuit description	Fuse size and type	Cable size mm <sup>2</sup>		Ring Final Circuit Continuity Ω			Continuity Ω R1+R2	Insulation resistance M Ω			Polarity ✓
		Live	CPC	r1	rn	r2		L/N	L/E	N/E	

Continuity of protective bonding conductor \_\_\_\_\_

Exercise No. 7 a (part 1)

PVC Wiring 1 (Simple Lighting Circuits)

**Test Results Stage '6'**

Circuit description	Fuse size and type	Cable size mm <sup>2</sup>		Ring Final Circuit Continuity Ω			Continuity Ω R1+R2	Insulation resistance M Ω			Polarity ✓
		Live	CPC	r1	rn	r2		L/N	L/E	N/E	

Continuity of protective bonding conductor \_\_\_\_\_

## Exercise No. 7 a (part 1)

### PVC Wiring 1 (Simple Lighting Circuits)

Marking criteria	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6
Job carried out in a safe manner						
All accessories undamaged and assembled						
Acceptable insulation removed						
Correct termination of conductors						
Acceptable amount of spare at termination						
Termination's tight						
Termination's doubled over						
Circuit functional						
Correct torque settings						
Worked safely						
Work area tidy						

#### **Assessor Feedback and Learner Response**

Assessor ..... Date.....

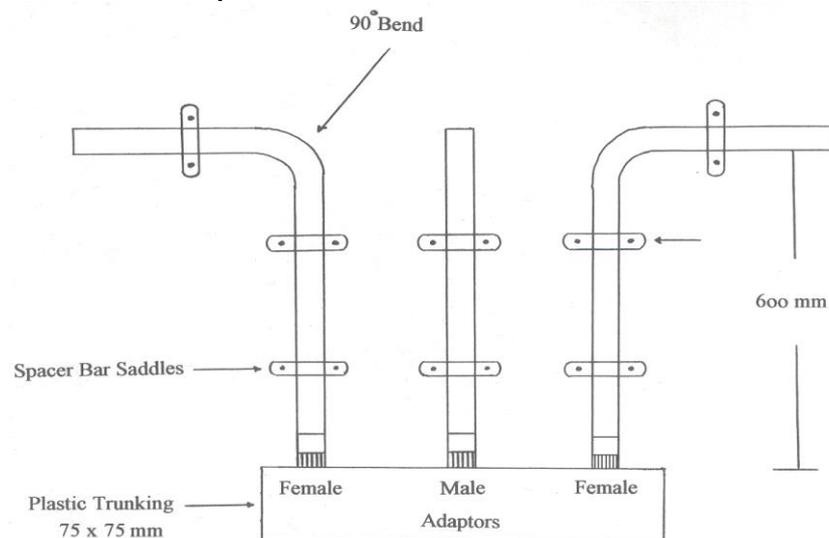
## Exercise No. 12 a

### Plastic Conduit (Basic Technique)

Student Name ..... Start Date .....

#### Instruction to Trainee

On a surface identified by your instructor, fit a pre-cut 75mm by 75mm length of PVC trunking. Fix, terminate and bend black PVC conduit as shown below. Bends should be smooth and spacer bar saddles at the same position on each conduit.



Marking Criteria	Completed
Job carried out in a safe manner	
Conduit cut to length	
Conduit ends cut square	
All burrs removed	
Conduit saddles secure	
<b>Correctly fabricated 90° bends PASS or FAIL</b>	
Correct dimensions	
Worked safely	
Work area tidy	
<b>Assessor Feedback and Learner Response</b>	

Assessor ..... Date .....

### Material Requisition

Name: ..... Job No: Ex N° 12a ..... Date or Time Required: .....

Quantity Required	Description
	<b>20 mm Black High Impact Heavy Gauge PVC Conduit</b>
	<b>20 mm Black PVC Spacer Bar Saddles</b>
	<b>75 x 75 mm Grey PVC Trunking</b>
	<b>20 mm Black PVC Male Adaptors</b>
	<b>20 mm Black PVC Female Adaptors</b>
	<b>3/4" N°8 Pozi Counter Sunk Screws</b>
	<b>3/4" N°8 Pozi Round Headed Screws</b>

## PVC CONDUIT

PVC conduit is supplied in **3-metre** lengths.

The 4 common sizes of conduit are **16mm**, **20mm**, **25mm**, and **32mm** the same as metal conduit.

The common type of PVC conduit is **high impact**.

PVC conduit can be supplied in 2 colours **black** and **white**.

PVC conduit must be installed in ambient temperatures of above **0°C**.

After bending PVC conduit the spring is easier to withdraw if it is twisted in an **anti-clockwise** direction.

PVC conduit is fixed into accessories by means of an **adhesive**, care must be taken not to over apply because this can cause a **barrier** which in turn can cause problems when wiring the final circuits.

As with any adhesive care must be first taken to first **read** the **label** and then follow the **instructions**.

PVC conduit expands with increased temperature and precautions must be taken to prevent bowing. Usually bends and sets that are close together take up any movement but in longer runs an **expansion coupler** must be fitted. This coupler is **fixed** at one end and the other end is **free** to slide in and out during expansion. A good guide is one expansion coupler per six metres in a straight run.

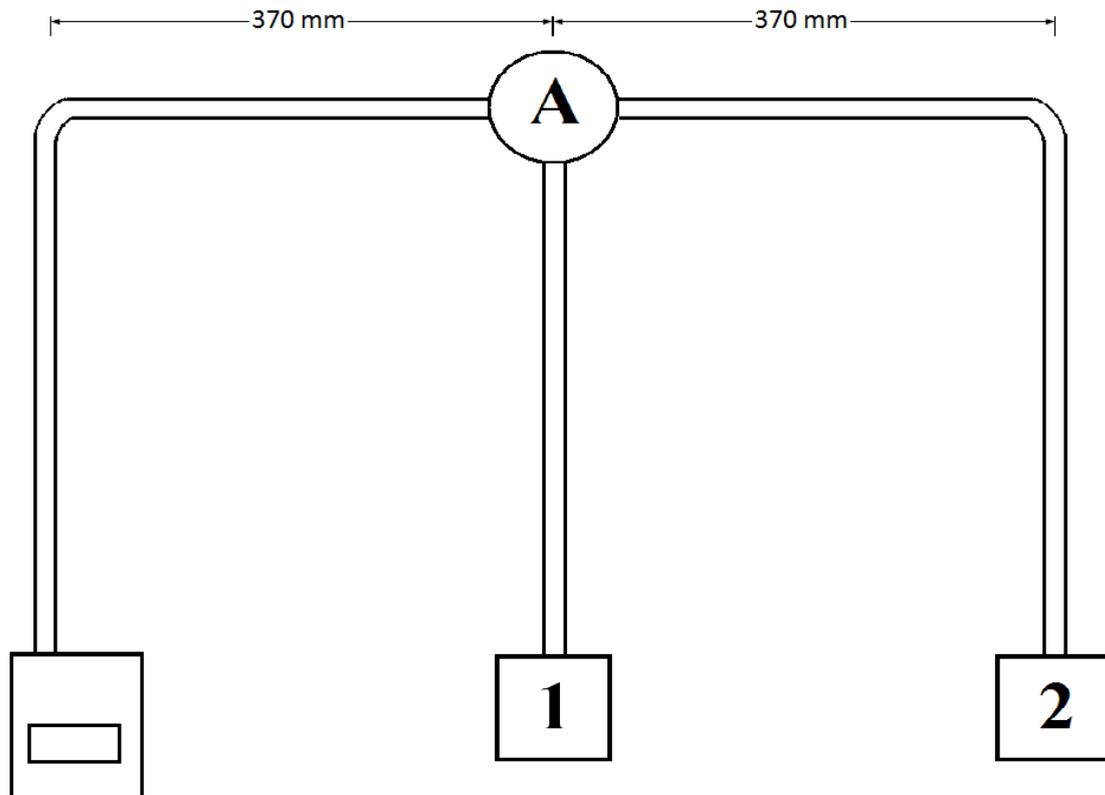
Exercise No. 12 b

Plastic Conduit (Lights Circuit 2 Way Switching)

Student Name ..... Start Date .....

Instruction to Trainee

On a surface identified by your instructor, produce in 20mm black PVC conduit the circuit shown below and wire as one light controlled by 2 way switching circuit. All 90° bends should be smooth.



**Circuit must be tested**

### Material Requisition

Name: ..... Job No: Ex N° 12b..... Date or Time Required: .....

Quantity Required	Description
	<b>20 mm Black High Impact Heavy Gauge PVC Conduit</b>
	<b>20 mm Black PVC Spacer Bar Saddles</b>
	<b>20 mm Black PVC Tee Box</b>
	<b>2 Way Metal Clad Consumer Unit With A 63 Amp 30 mA Main RCD Switch</b>
	<b>20 mm Black PVC Female Adaptors</b>
	<b>Brown 1.5 mm<sup>2</sup> Single Thermoplastic (PVC) Stranded Cable</b>
	<b>Blue 1.5 mm<sup>2</sup> Single Thermoplastic (PVC) Stranded Cable</b>
	<b>Green and Yellow 1.5 mm<sup>2</sup> Single Thermoplastic (PVC) Stranded Cable</b>
	<b>MK Logic Plus Surface Metal Clad 1 Gang Light Switch Box</b>
	<b>¾" N°8 Pozi Round Headed Screws</b>
	<b>¾" N°8 Pozi Counter Sunk Screws</b>

### Material Requisition

Name: ..... Job No: Ex N° 12b..... Date or Time Required: .....

Quantity Required	Description
	<b>BS EN 60898 6 Amp Type b Circuit Breaker</b>
	<b>Straight Skirt Batten Lamp Holders</b>
	<b>MK Logic Grid Plus One Gang Two Way 10 Amp Switches</b>
	<b>MK Logic Grid Plus One Gang Mounting Frame</b>
	<b>MK Logic Grid Plus One Gang Metal Front Plate</b>
	<b>Consumers Unit Blank</b>
	<b>60 Watt Bayonet Cap Lamp</b>
	<b>M4 16 mm Brass Screws</b>
	<b>Wiska Gland 10mm<sup>2</sup>/10mm<sup>2</sup>/10mm<sup>2</sup></b>

Exercise No. 12 b

Plastic Conduit (Lights Circuit 2 Way Switching)

**Test Results**

Circuit description	Fuse size and type	Cable size mm <sup>2</sup>		Ring Final Circuit Continuity Ω			Continuity Ω R1+R2	Insulation resistance M Ω			Polarity ✓
		Live	CPC	r1	rn	r2		L/N	L/E	N/E	

Exercise No. 12 b **Extension Task**

Plastic Conduit (Lights Circuit 2 Way and Intermediate Switching)

**Test Results**

Circuit description	Fuse size and type	Cable size mm <sup>2</sup>		Ring Final Circuit Continuity Ω			Continuity Ω R1+R2	Insulation resistance M Ω			Polarity ✓
		Live	CPC	r1	rn	r2		L/N	L/E	N/E	

Exercise No. 12 b

Plastic Conduit (Lights Circuit 2 Way Switching)

<b>Marking Criteria</b>	<b>Peer Marked</b>	<b>Completed</b>
Job carried out in a safe manner		
Conduit cut to length		
Conduit ends cut square		
All burrs removed		
<b>Correctly fabricated 90° bends PASS or FAIL</b>		
All accessories undamaged and assembled		
Correct and tight termination of conductors		
Acceptable amount of spare at termination		
Conduit termination's tight		
Termination's doubled over		
Correct dimensions		
Circuit functional		
Circuit test results completed		
Schedule of inspection completed		
Material requisition completed		
Correct torque settings		
Worked safely		
Work area tidy		
<b>Assessor Feedback and Learner Response</b>		

Assessor ..... Date .....

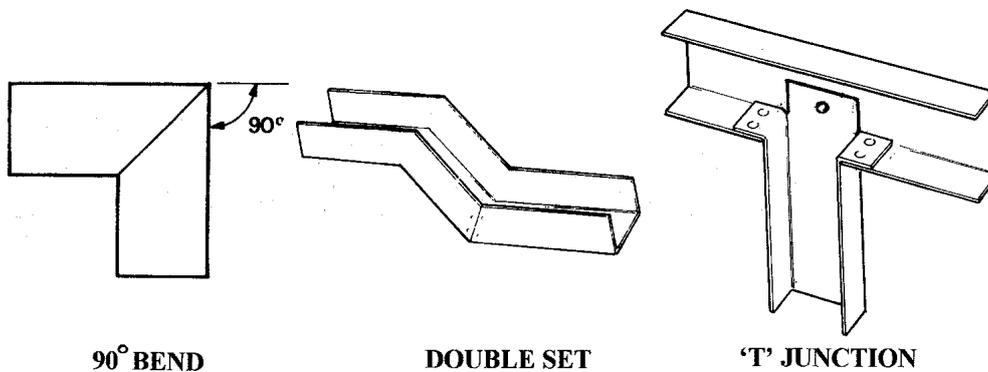
Exercise No. 13 a

Steel Trunking (Basic Techniques)

Student Name ..... Start Date .....

Instruction to Trainee

Cut a piece of 50 mm by 50 mm steel trunking, 300 mm long. Ends should be square, burr free, lid fitted and end caps. Next fabricate a 90 degree angle, double set and a tee junction to the same criteria.



Marking Criteria	Straight	90° bend	Double set	Tee Junction
Job carried out in a safe manner				
Trunking cut to length				
Trunking ends cut square				
All burrs removed				
Correct fabrication				
Lid fitted				
End caps fitted				
Secure nuts and bolts				
Worked safely				
Work area tidy				

**Assessor Feedback and Learner Response**

Assessor ..... Date .....

## Exercise No. 13 b Parts 1 and 2

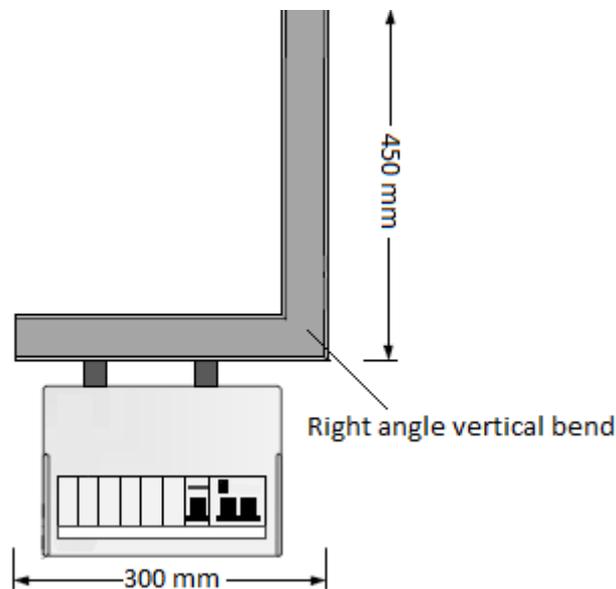
### Steel Trunking Socket Circuit

Student Name ..... Start Date .....

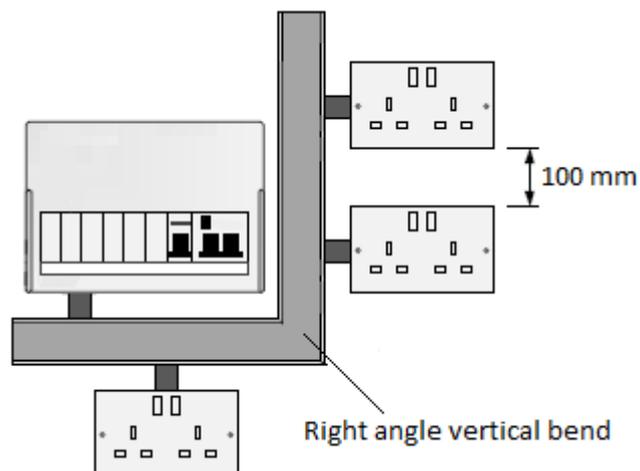
#### Instruction to Trainee

Cut and fabricate a piece of 50 mm by 50 mm steel trunking to the dimension shown below. Ends should be square, burr free, lid fitted and end caps.

#### Part 1



#### Part 2



### Material Requisition

Name: ..... Job No: Ex N° 13b..... Date or Time Required: .....

Quantity Required	Description
	<b>50 x 50mm Galvanised Steel Trunking</b>
	<b>50 x 50mm Galvanised Steel End Caps</b>
	<b>50 x 50mm Turnbuckle Clips</b>
	<b>13 Amp BS 1363 Metal Clad Switched Twin Socket Outlets (Includes Box)</b>
	<b>20mm Galvanised Steel Couplers</b>
	<b>20mm Brass Male Bushed</b>
	<b>Brown 2.5 mm<sup>2</sup> Single Thermoplastic (PVC) Stranded Cable</b>
	<b>Blue 2.5 mm<sup>2</sup> Single Thermoplastic (PVC) Stranded Cable</b>
	<b>Green and Yellow 2.5 mm<sup>2</sup> Single Thermoplastic (PVC) Stranded Cable</b>
	<b>2 Way Metal Clad Consumer Unit With A 63 Amp 30 mA Main RCD Switch</b>
	<b>Consumer Unit Blanks and Blind Gromets As Required</b>

### Material Requisition

Name: ..... Job No: Ex N° 13b ..... Date or Time Required: .....

Quantity Required	Description
	<b>BS EN 60898 20 Amp Type b Circuit Breaker</b>
	<b>BS EN 60898 32 Amp Type b Circuit Breaker</b>
	<b>Brown 10mm<sup>2</sup> Double Insulated Thermoplastic (PVC) Meter Tails</b>
	<b>Blue 10mm<sup>2</sup> Double Insulated Thermoplastic (PVC) Meter Tails</b>
	<b>Green/Yellow 10mm<sup>2</sup> Single Insulated Thermoplastic (PVC) Stranded Cable</b>
	<b>Wiska Gland 10mm<sup>2</sup>/10mm<sup>2</sup>/10mm<sup>2</sup> Tails</b>
	<b>3.5mm Box Screws (If Not Supplied With Sockets)</b>

## Exercise No. 13 b Parts 1 and 2

### Steel Trunking Socket Circuit

<b>Marking Criteria</b>	<b>Peer Marked</b>	<b>Completed</b>
Job carried out in a safe manner		
Trunking cut to length		
Trunking ends cut square		
All burrs removed		
All accessories undamaged and assembled		
Correct and tight termination of conductors		
Acceptable amount of spare at termination		
Termination's doubled over		
Trunking end caps tight		
Trunking earthed		
Correct dimensions		
Circuit functional		
Circuit test results completed		
Schedule of inspection completed		
Material requisition completed		
Correct torque settings		
Worked safely		
Work area tidy		
<b>Assessor Feedback and Learner Response</b>		

Assessor ..... Date .....

## Exercise No. 14 a

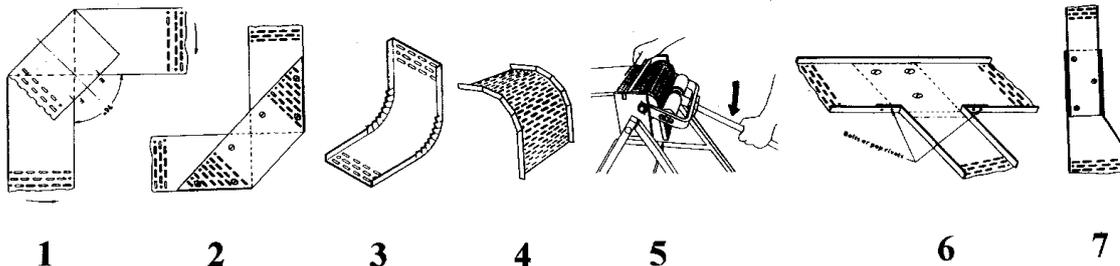
### Cable Tray (Basic Techniques)

Student Name ..... Start Date .....

#### Instruction to Trainee

Cut, bend and fabricate as identified by your instructor, **3 out of 7** of the following 100 mm wide cable tray exercises listed below.

1. Flat 90 degree bend using 1 piece
2. Flat 90 degree bend using 3 pieces
3. 90 degree inside bend using a crimping tool
4. 90 degree outside bend using a saw
5. 90 degree outside bend using bending machine
6. Equal tee
7. Reduction 100 mm down to 50 mm



<b>Marking Criteria</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
Job carried out in a safe manner							
Tray cut to length							
Tray ends cut square							
All burrs removed							
Correct fabrication							
Secure nuts and bolts							
Work area tidy							
<b>Assessor Feedback and Learner Response</b>							

Assessor ..... Date .....

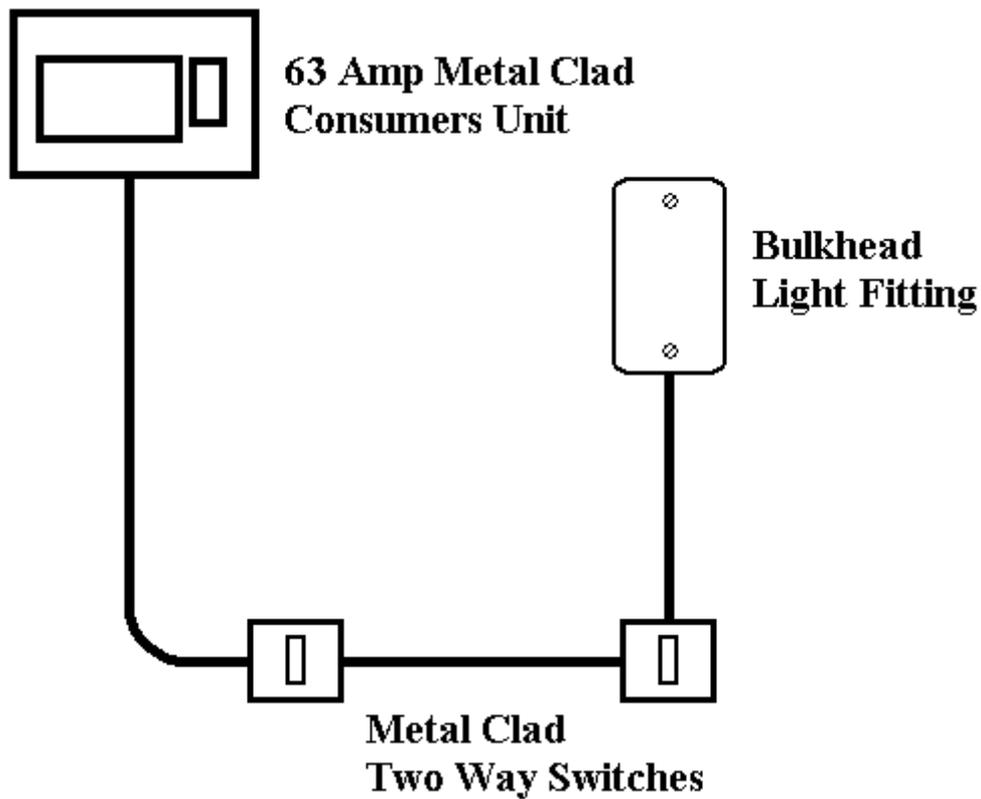
Exercise No. 15 a

Fire Tough (Fire Resistant Cable)

Student Name ..... Start Date .....

Instruction to Trainee

On a surface identified by your instructor, produce in 2 core and 3 core and cpc fire tough the lighting circuit below. Cables should be clipped using 7 mm round red clips and with a smooth bend.







## Exercise No. 15 a

### Fire Tough (Fire Resistant Cable)

### Test Results

Circuit description	Fuse size and type	Cable size mm <sup>2</sup>		Continuity Ω			Insulation resistance M Ω	Polarity ✓
		Live	CPC	R1+R2	R2	Ring		

Marking Criteria	Completed
Job carried out in a safe manner	
All accessories undamaged and assembled	
Acceptable insulation removed	
Correct termination of conductors	
Acceptable amount of spare at termination	
Termination's tight	
Termination's doubled over	
Cables clipped straight and flat	
Acceptable clipped distance	
Acceptable bending radius	
Switch termination identified	
Circuit functional	
Circuit test results completed	
Wiring diagrams produced	
Correct torque settings	
Worked safely	
Work area tidy	
<b>Assessor Feedback and Learner Response</b>	

Assessor ..... Date.....

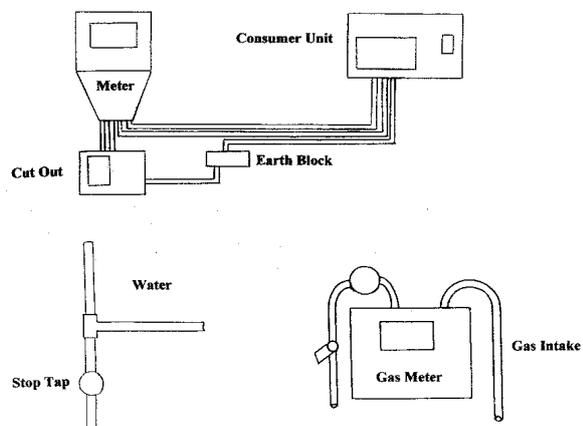
## Exercise No. 16a

### Protective Bonding Conductor

Student Name..... Start Date.....

#### Instruction to Trainee

Install 10mm<sup>2</sup> single earth bonding conductor to main 'gas' and 'water' services. Prepare services before fixing bonding clamps to give the best possible electrical connection. Clip bonding conductor using 6mm white round clips. Loop between 'gas' and 'water' services without breaking the conductor to insure continuity. When install test the circuit and record the test results.



Test result  
.....ohms

Marking Criteria	Completed
Job carried out in a safe manner	
Acceptable insulation removed	
Correct termination of conductors	
Cables clipped straight and flat	
Acceptable clipping distance	
Bonding surface cleaned	
Bonding clamp positioned correctly	
Bonding clamp securely fitted	
Bond not broken	
Circuit test results completed	
Worked safely	
Work area tidy	
<b>Assessor Feedback and Learner Response</b>	

Assessor ..... Date .....

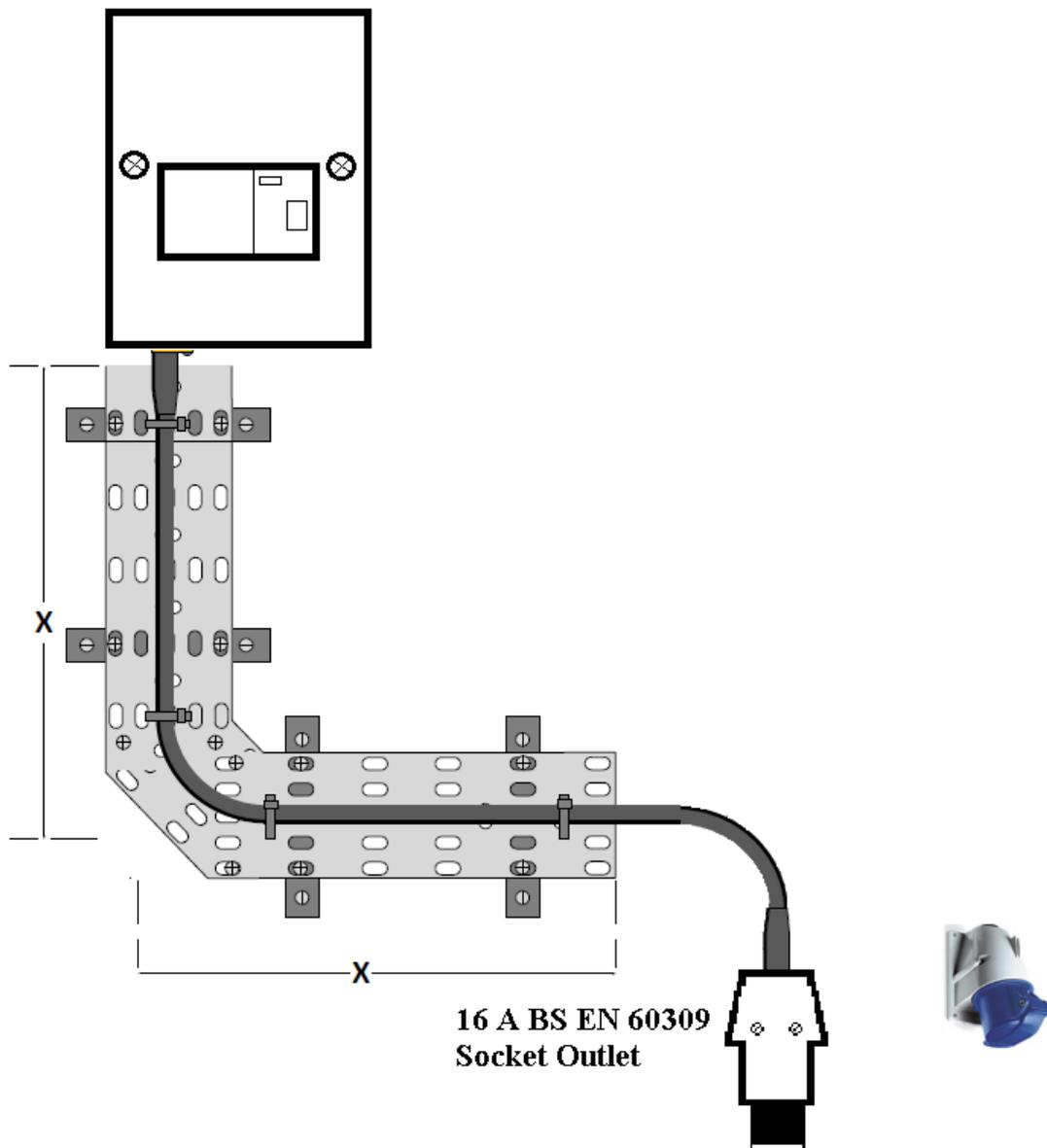
Exercise No. 17a

'SY' Cable (Clipping) (USE TRAY FROM SWA JOB)

Student Name ..... Start Date.....

Instruction to Trainee

On a wooden surfaces fix one 63 amp metal clad consumer unit and one 16 amp BE EN 60309 socket outlet. Wire between with three core SY flex fixed on 100mm cable tray.



16 A BS EN 60309  
Socket Outlet

**Dimensions may alter**

### Material Requisition

Name: ..... Job No: Ex N° 17a ..... Date or Time Required: .....

Quantity Required	Description
	<b>SY Gland Kit</b>
	<b>1.5mm<sup>2</sup> SY 3 Core PVC Cable</b>
	<b>2 Way Metal Clad Consumer Unit With A 63 Amp 30 mA Main RCD Switch</b>
	<b>Metal Clad Double Pole Switch</b>
	<b>N°6 Cable Cleats</b>
	<b>1½" N°8 Slotted Black Round Headed Screws</b>
	<b>¾" N°8 Pozi Round Headed Screws</b>

## Exercise No. 17a

### 'SY' Cable (Clipping)

### Test Results

Circuit description	Fuse size and type	Cable size mm <sup>2</sup>		Continuity Ω			Insulation resistance M Ω	Polarity ✓
		Live	CPC	R1+R2	R2	Ring		

Marking Criteria	Peer Marked	Completed
Job carried out in a safe manner		
Cable stripped to a suitable length		
Undamaged cable sheath		
Squarely cut braiding		
<b>Correctly fitted gland and tight PASS or FAIL</b>		
Termination's tight		
Termination's doubled over		
Cables clipped straight and flat		
Acceptable clipping distance		
Cable run vertically		
Correct dimensions		
Circuit test results completed		
Correct torque settings		
Worked safely		
Work area tidy		
<b>Assessor Feedback and Learner Response</b>		

Assessor ..... Date .....

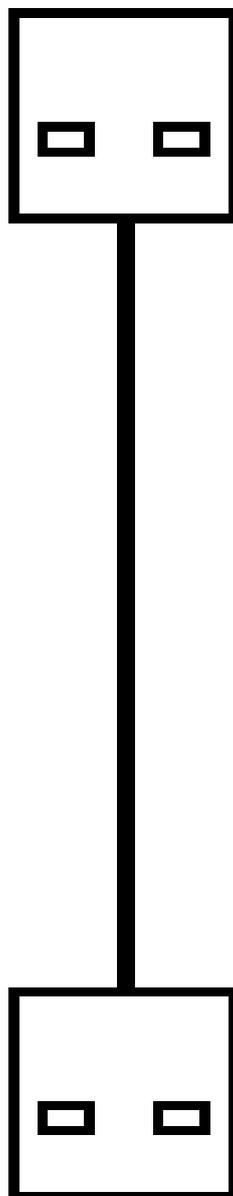
Exercise No. 18a

Cat 5 Data Cable (Clipping)

Student Name..... Start Date.....

Instruction to Trainee

On surfaces identified by your instructor, fix two surface PVC boxes and wire between them in Cat 5 (8 core) data cable ensure cable is straight and flat.





## Exercise No. 18a

### 'Cat 5' Cable (Clipping)

<b>Marking Criteria</b>	<b>Peer Marked</b>	<b>Completed</b>
Job carried out in a safe manner		
Cable stripped to a suitable length		
Undamaged cable sheath		
Termination's within connections		
Termination's have continuity		
Correct polarity of all 8 conductors		
Cables clipped straight and flat		
Acceptable clipping distance		
Cable run vertically		
Correct dimensions		
Circuit test completed		
Correct torque settings		
Worked safely		
Work area tidy		
<b>Assessor Feedback and Learner Response</b>		

Assessor ..... Date

.....

## TOOLS

Tape Measure (5m Steel)  
Posidrive Screwdriver  
Junior Hacksaw  
Bradawl  
Terminal Screwdriver  
Cross Pein Hammer  
2.5lb Lump Hammer  
Bolster Chisel  
Stripping Knife  
Pliers  
Side Cutters  
Medium Flat Tip Screwdriver  
Hacksaw min 24TPI  
Engineers File  
45x45x100mm Wooden Block  
Set HSS Drill Bits (sizes 3mm, 6mm, 10mm)  
Engineers Vice  
Centre Punch  
Electric/Cordless Drill (with 110v Transformer & extension cable & safety sign) (or spare battery and charger if cordless)  
Large Flat Tip Screwdriver  
Conduit Bending Machine with 20mm former.  
Reamer/Round File  
20mm Stocks and die  
Cutting compound  
20/25 Bush Spanner  
20/25 Internal Bush Spanner  
Adjustable grips (water pump pliers)  
Conduit Bending Machine (20mm Former)  
20mm Conduit Bending Spring  
Conduit Warming Cloth  
5.5mm Masonry Drill Bit

Draw Through Tape  
Ratchet Crimping Tool Large and Small  
Combination Wire Stripper  
20mm Hole Saw and Mandrill  
Scriber  
Combination Square (set square)  
Adjustable Spanner  
Open Ended Spanners for SWA Gland 20/22 or 21/23  
Long Spirit Level and Short Spirit Level  
20mm Spade Bit  
Mitre Block  
Noga Burr Removal Tool  
RJ45 Crimp Tool  
CAT5 RJ45 Punch Down Impact Network Tool  
Hawk  
Tin Snips  
Trowel (Float)  
Pad Saw  
Emery cloth for removing galvanised finish from trunking  
Wooden Step Ladder or Platform  
Pencil  
PVC Insulation Tape  
Torque Screwdriver  
Pot Wrench  
Joy Stripper  
MICC Crimping Tool

### **Test Equipment**

Insulation Resistance Tester Set To 500V/1000M $\Omega$   
Low Reading Ohm Meter 0-10 $\Omega$  (Continuity Tester)  
1 Set of Test Leads, Crocodile Clips and a Link  
Test socket adaptor  
Plug in Socket Tester  
Voltage indicator **to GS 38** and Proving Unit (if require to prove safe isolation)

**PPE:**

Goggles, Ear Defenders, Hardhat, Steel Toed Footwear,  
Dust Mask, Overalls, Barrier Cream if required.