3. STANDARDS The purpose of a ‘Standard’ is to set the ________________________ requirements for the design and use of products and provision of services without stifling innovation or placing barriers on trade between enterprises, states or countries. Standards are frequently called up by a _______Government_____________ regulation, and when this occurs they, in fact, become part of the regulation and must be complied with. __________________Penalty____________ apply to those who don’t comply.

4. REASONS FOR THE AS3000
The wiring rules (AS3000) was first published in 1923, and has grown and developed over the last ______70_______ years. There are normally new issues when there is a jump in technology or after an error that results in deaths is found. It is compulsory for electricians to carry out work in accordance with the regulations, standards and codes. There are a number of reasons why all electricians follow the AS3000:
• Legal obligation: fines, loss of licence and ______Penalty______ time (incase of electrical deaths)
• Cost: to re-do or pay any electrician to redo unsafe or unsatisfactory works, loss of business (due to bad name), loss of livelihood (nolicense), increase insurance premiums, and court fees.
  • Personal: __________Injury________ __Properties damage________ of causing death, fire, etc.
  • Advantage of easy determination of appropriate materials, design, estimating, planning and execution.

5. CODES OF PRACTICE
An approved _______ industry code of practice is a practical guide to employers and others who have duties under the OHS Act 2000 and the OHS Regulation 2001 with respect to occupational health, safety and welfare.
These are issued and administered by ______________ authority _______________ and apply the wiring rules to particular industries. Relevant electrical industry codes of practice include:
  • Code of Practice – Low Voltage Electrical Work
  • Code of Practice - Electrical Practice for Construction Work
  • Additional requirement to AS 3000

Ensure the installation conforms to the requirements of the supply authorities’ reticulation system and the supply authority’s equipment.
Generally do not affect sub-circuit cabling, although local authority rules may still apply (service and metering equipment.)

5. SCOPE OF AS/NZS 3000:2007
The scope of the standard is stated in clause 1.1. Open your book to page 21 and copy the clause to your notes.
1.1 SCOPE
This Standard sets out requirements for the design, construction and
verification of electrical installations, including the selection and
installation of electrical equipment forming part of such electrical
installations.
These requirements are intended to protect persons, livestock, and
property from electric shock, fire and physical injury hazards that may
arise from an electrical installation that is used with reasonable care
and with due regard to the intended purpose of the electrical
installation.

7. STRUCTURE OF THE SECTIONS
In simple terms, the AS3000:2007 is, like most
books, broken into chapters. However the chapters are called Sections, and each
section deals with a particular aspect of the electrical industry.
Open to page 9 of the SA3000 and write down the heading of each section of the wiring rules:

Part 1: Scope, application and fundamental principles
SECTION 1 SCOPE, APPLICATION AND FUNDAMENTAL PRINCIPLES

Part 2: Installation practices—Sections 2 to 8
SECTION 2 GENERAL ARRANGEMENT, CONTROL AND PROTECTION

SECTION 3 SELECTION AND INSTALLATION OF WIRING SYSTEMS

SECTION 4 SELECTION AND INSTALLATION OF ELECTRICAL
EQUIPMENT

SECTION 5 EARTHING ARRANGEMENTS AND EARTHING
CONDUCTORS

SECTION 6 DAMP SITUATIONS

SECTION 7 SPECIAL ELECTRICAL INSTALLATIONS

SECTION 8 VERIFICATION

APPENDICES

9. TYPEFACE SYSTEM OF THE AS3000
Since the AS3000 is a Rule book under the law of Australia, it is
written in legal terms in "lawyers speak". Certain words have a specific
legal meaning under the law. No matter what you would like the word to
mean, its legal meaning will be used in practice. The same can be said about the typefaces (bold, normal, italic, etc). Typefaces are how the letters and words are printed on the pages.

P34

10.FINDING THE RIGHT CLAUSE IN THE RULE BOOK

1. Using the contents
Many electricians prefer to use the Index to find the correct clause number and then the necessary information. The contents shows the logical format of the book and can be helpful in increasing your electrical vocabulary. The following steps will assist you in using the contents.

4. Turn to the Index clause and scan the clauses listed until the specific information required is located.

2. Using the index to find a clause
The index can also be used to find the correct Clause related to an installation. The index contains a list of key words in alphabetical order. The following steps will assist you to use the index.

P36 to 38

4. What is a distribution board?
Clauses:____________________________________________________
Answer:____________________________________________________
distribution boards App K3.3, K8.1, K8.2
1.4.46 Distribution board
A switchboard other than a main switchboard.
Distributor, electricity (see Clause 1.4.57 Electricity distributor).
Domestic electrical installation (see Clause 1.4.53 Electrical installation, domestic).

5. What is the general requirement of a main switch?
Clauses:____________________________________________________
Answer:____________________________________________________
main switches 2.3.3
2.3.3 Main switches

* 2.3.3.1 Introduction
The following requirements are intended to provide for the—
(a) efficient and effective isolation of electricity supply from the electrical
installation, or part thereof, by persons, including emergency services personnel, in the event of an emergency arising that requires prompt isolation; and
(b) maintenance of supply to safety services during an emergency that may require, or result in, isolation of supply from other portions of the electrical installation.

6. How should circuit breakers be oriented on a switchboard?

Clause number:_______________________________________________________
Answer:_____________________________________________________________

2.5.3.2 Position of overload protective device—General arrangement
In accordance with Clause 2.5.1.3, a device providing protection against overload shall be installed at the origin of every circuit and at each point where a reduction occurs in the current-carrying capacity of the conductors.

7. What is the definition of a fuse?

Clause number:_______________________________________________________
Answer:_____________________________________________________________

1.4.68 Fuse
A device for protecting a circuit against damage from an excessive current flowing in it by opening the circuit on the melting of the fuseelement by such excessive current. The fuse comprises all the parts that form the protective device.

8. What are the requirements for the location of the earth electrode?

5.3.6.4 Location
Earth electrodes shall be installed in a location that satisfies the following conditions:
(a) The electrode maintains effective contact with moist soil that is not subject to excessive drying out.
NOTE: This condition is deemed to be satisfied by locating the electrode—
(a) external to the building in ground that is exposed to the weather; or
(b) in other locations where the ground remains moist because of soil conditions or covers that reduce loss of moisture.
(b) The electrode is separated from conductive enclosures of other buried services, such as water, gas, telecommunications and flammable liquid, in order to reduce possible electrolytic action affecting the electrode or the other service.
NOTE: Separation distances are specified in Table 3.7.
(c) The main earthing conductor connection to an electrode is accessible, in accordance with Clause 5.5.1.2. The location of the earth electrode shall be identified at the main switchboard.

P37

9. Which section covers testing and verification of electrical installations?

*Clause number:*_________________________________________________________

*Answer:*_____________________________________________________________

verification 1.8, 8.1.2

Section 8

10. When and why would a visual inspection of an electrical installation be carried out prior to completion of the installation?

*Clause number:*_________________________________________________________

*Answer:*_____________________________________________________________

8.2.1 General
A visual inspection shall be made when work on an electrical installation has been completed in order to verify that the work complies with the requirements of this Standard. The visual inspection shall be carried out before, or in association with, testing. The visual inspection should, where practicable, be made before the relevant part of the electrical installation is placed in service. Exception: Where the visual inspection of a part of the electrical installation is not practicable at the completion of the work, e.g. not accessible because of enclosure in the building structure, consideration should be given to inspecting that part during the course of the installation

11. What are the six sub-clause headings from the check list for visual inspections?

*Clause number:*_________________________________________________________

*Answer:*_____________________________________________________________

8.2.2 Checklist
The following items shall be checked, where applicable during the visual inspection, to assess that the relevant requirements of this Standard are satisfied:

(a) General:
   (i) Basic protection (protection against direct contact with live parts), e.g. insulation and enclosure.
   (ii) Fault protection (protection against indirect contact with exposed conductive parts), e.g. by the use of automatic disconnection of supply, double insulation or isolating transformers.
(iii) Protection against hazardous parts, e.g. enclosure, guarding or screening of flammable materials, hot surfaces and parts that may cause physical injury.

(iv) Protection against spread of fire, e.g. penetration of fire barriers.

(v) General condition of the electrical equipment, e.g. signs of damage that could impair safe operation, disconnection of unused electrical equipment.

(b) Consumer mains:

(i) Current-carrying capacity.

(ii) Voltage drop, e.g. size of conductors.

(iii) Underground installation conditions, e.g. enclosure, depth burial, mechanical protection.

(iv) Aerial installation conditions.

(v) Connection of wiring.

(vi) Protection against external influences.

(c) Switchboards:

(i) Location, e.g. access and egress.

(ii) Protective devices, e.g. selection and setting of adjustable protective devices for compliance with overcurrent protection, arc fault protection and discrimination requirements.

(iii) Isolating devices, e.g. main switches.

(iv) Connecting devices, e.g. neutral bars, earth bars and active links.

(v) Connection and fixing of wiring and switchgear.

(vi) Identification and labelling of electrical equipment.

(vii) Protection against external influences.

(d) Wiring systems:

(i) Conductor size, e.g. current-carrying capacity and voltage drop.

(ii) Identification of cable cores.

(iii) Adequate support and fixing.

(iv) Connections and enclosures.

(v) Particular installation conditions, e.g. underground, aerial, safety services.

(vi) Segregation from other services and electrical installations.

(vii) Protection against external influences, e.g. enclosure.

(e) Electrical equipment:

(i) Isolation and switching devices for protection against injury from mechanical movement devices and motors.

(ii) Isolation and switching devices for protection against thermal effects, e.g. motors, room heaters, water heaters.

(iii) Switching devices for particular electrical equipment, e.g. socket outlets, water heaters, etc.

(iv) Particular installation conditions, e.g. locations affected by water, explosive atmospheres, extra-low voltage, high voltage.
(v) Compliance with required Standard.
(vi) Connection, support and fixing.
* (vii) Protection against external influences including ingress of moisture where required by any clause.
* (viii) Suitability for intended voltage, current and frequency.

(f) Earthing:
(i) MEN connection.
(ii) Earth electrode.
(iii) Earthing conductors, e.g. size, identification.
(iv) Equipotential bonding conductors, e.g. size, identification.
(v) Connections, joints and terminations.
(vi) Protection against external influences.
(vii) Connection to earthing arrangements for other systems.
(viii) Creation of earthed situation that may require earthing of additional electrical equipment.

12. What is the minimum insulation resistance allowed between live and earthed parts of an electrical installation?

Clause number:_______________________________________________________
Answer:_____________________________________________________________

8.3.6.3 Results
The insulation resistance between—
(a) the conductors of consumer mains and submains; and
(b) live and earthed parts of an electrical installation, or parts thereof, including consumer mains and submains,
shall be not less than 1 MΩ.

13. What is the definition of

a) Low voltage?_______________________________________________________
b) Extra low voltage?_________________________________________________
c) High voltage?_____________________________________________________

1.4.128 Voltage
Differences of potential normally existing between conductors or between conductors and earth as follows:
(a) Extra-low voltage Not exceeding 50 V a.c. or 120 V ripple-free d.c.
(b) Low voltage Exceeding extra-low voltage, but not exceeding 1000 V a.c. or 1500 V d.c.
(c) High voltage Exceeding low voltage.
14. What is the general requirement for the electrical connection of conductors?

Clause number: __________________________________________________________
Answer: __________________________________________________________________

3. 7 ELECTRICAL CONNECTIONS
3. 7. 1 General
Connections between conductors and between conductors and other electrical equipment shall provide electrical continuity, an appropriate level of insulation and adequate mechanical strength. The method of joining or connecting cables shall be suitable for the application and ensure that the conductivity of the joint or connection is not less than that of the conductor. All cables and conductors shall be installed so that there is no undue mechanical stress on any connection.

15. What is an Exposed conductive part?

Clause number: __________________________________________________________
Answer: __________________________________________________________________

1. 4. 62 Exposed conductive part
A conductive part of electrical equipment that—
(a) can be touched with the standard test finger as specified in AS/NZS 3100; and
(b) is not a live part but can become live if basic insulation fails.

5. 5. 3. 5 Unprotected consumer mains
Exposed conductive parts associated with consumer mains not provided with short-circuit protection on the supply side shall be earthed by a conductor or by direct connection to an earth bar such that either has a current-carrying capacity not less than that of the main neutral conductor.

16. Are isolating switches required for an electric motor supply circuit?

Clause number: __________________________________________________________
Answer: __________________________________________________________________

Yes
4. 13. 1. 1 Switching devices
Every motor shall be provided with a switching device capable of performing all of the following functions:
(a) Starting and stopping the motor.
(b) Emergency stopping, in accordance with Clause 2. 3. 5.
(c) Isolating the motor for mechanical maintenance, in accordance with Clause 2. 3. 6.
17. How is a damp situation defined?

Clause number: _______________________________________________________
Answer: _______________________________________________________________

6.1 GENERAL
6.1.1 Application
This Section specifies the minimum requirements for the selection and installation of electrical equipment in locations subject to the effects of water or high humidity (damp situations).

18. How must an “Edison Screw” lamp holder be connected to the supply?

Clause number: _______________________________________________________
Answer: _______________________________________________________________

4.5.1.2 Edison screw lampholders
Every low voltage Edison screw lampholder shall be connected to the supply so that, where a neutral conductor is required, it is connected to the outer contact.

Circuit/ Practical
The difference present between Active and Earth terminals of the single phase AC circuit is usually 240V (the 'nominal' voltage in AS/NZS3000.2007 for Australia is 230/400 V +10% to -4% 1:6.2 (a)(ii)). A normal circuit like a 24V 16A socket outlet (power point) is connected with a three wire system (Active, Neutral and Earth).

A domestic circuit consist of:

<table>
<thead>
<tr>
<th>Item / part</th>
<th>Complete Installation</th>
<th>Final Circuit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply</td>
<td>Active conductors (A &amp; N)</td>
<td>Point X(A) &amp; Y(N)</td>
</tr>
<tr>
<td>Protective device</td>
<td>Service Fuse</td>
<td>Circuit breaker</td>
</tr>
<tr>
<td>Control device</td>
<td>Main isolating switch</td>
<td>Functioning Switch</td>
</tr>
</tbody>
</table>

Although figure 1.2 is more complex than figure 1.1, the various parts are the same. The differences are important:

a) The connection between the Neutral link (NL) and the Earth link (EL) is the way of providing every installation with thousands of connections. In case of any fault current. By using the MEL connection system, a fault current (in your house) can also travel to earth through the neutral conductor & main earth the adjacent properties. By having many parallel pathways to earth, the overall resistance is greatly reduced to the fault current flowing. Thus keeping touch voltages as low as possible so the protective devices can open circuit, and reducing the operating time for the protective devices.

b) The installation and the Oven circuit have a protection device and control.

13. PROTECTION DEVICES

Protection Devices are designed to create an open circuit, automatically if excessive current flows. Fuses and Circuit breakers are designed to protect the circuit (cable/conductor).

a) Fuses - Re- drawable (known as wired or an equivalent)
   - Totally enclosed (known as HRC - High Capacity)

b) Circuit Breaker - Thermal
   - Magnetic
   - Thermal/Magnetic

b) Residual Current Devices - Technology only developed since 1990 - Protects life by detecting the current (from the active or neutral), which may be passing through the body to earth.

Semi enclosed / Rupturing, Flow
1. Name one device that can be used for the automatic disconnection of supply for the protection against indirect contact. 

   ________________ AS/NZS 3000 Rule No: ________________

2.4.2 Protection by automatic disconnection of supply
Protection by means of automatic disconnection of supply is intended to limit the prospective touch voltage arising between simultaneously accessible conductive parts in the event of a fault between a live part and exposed conductive parts or a protective earthing conductor. This protection shall be achieved by—
(a) provision of a system of earthing in which exposed conductive parts are connected to a protective earthing conductor, in accordance with Section 5; and
(b) disconnection of the fault by an overcurrent protective device or an RCD.

2.4.3 Types of devices
A device used for protection by automatic disconnection of supply shall not be capable of automatically re-closing. The following types of devices may be employed to provide automatic disconnection of supply:
(a) Enclosed fuse-links complying with the appropriate part(s) of the IEC 60269 series.
(b) Miniature overcurrent circuit-breakers complying with AS/NZS 60898
series or AS/NZS 3111.
(c) Moulded-case circuit-breakers complying with AS/NZS IEC 60947.2.
(d) Fixed setting RCDs complying with AS/NZS 3190, AS/NZS 61008.1 or AS/NZS 61009.1.
(e) Other devices, with no automatic reclose function, having characteristics similar to any of the devices listed in Items (a) to (d). Semi-enclosed rewireable fuses shall not be used.

2. What is the maximum permissible percentage voltage drop allowed?

______________________________ AS/NZS 3000 Rule No: ______________

3.6.2 Value
The cross-sectional area of every current-carrying conductor shall be such that the voltage drop between the point of supply for the low voltage electrical installation and any point in that electrical installation does not exceed 5% of the nominal voltage at the point of supply.

3. How can access to live parts of a switchboard be protected against direct contact?

1) ___________________ 2) ___________________ 3) ___________________
4) ___________________ AS/NZS 3000 Rule No: ______________

1.4.38 Contact, direct
Contact with a conductor or conductive part that is live in normal Service

1.5.4.2 Methods of protection
Basic protection shall be provided by one or any combination of the following methods:
(a) Insulation, in accordance with Clause 1.5.4.3.
(b) Barriers or enclosures, in accordance with Clause 1.5.4.4.
(c) Obstacles, in accordance with Clause 1.5.4.5.
(d) Placing out of reach, in accordance with Clause 1.5.4.6.
RCDs are not recognized as a sole means of basic protection against contact with live parts but may be used to augment one of the above methods.

4. What is the recommended colour for an active conductor?

______________________________ AS/NZS 3000 Rule No: ______________

3.8.3.3 Active and neutral conductors
An active or neutral conductor need not be coloured in accordance with the colours specified in Table 3.4 where—
(a) insulated conductors within a multi-core cable, provided they are not yellow, have each core clearly identifiable by means of numbering.
lettering or equivalent means;

* (b) conductors of flexible cords and flexible cables, provided they are not yellow, are identified by alternative colours in accordance with Clause 3.8.3.4; or

(c) the neutral conductor of an insulated aerial conductor is identified by multiple longitudinal ribs around the circumference and length that clearly distinguish it from the other conductors.
5. How close to a cooking appliance should a functional switch be installed?

AS/NZS 3000 Rule No: ____________________

4.7 COOKING APPLIANCES

4.7.1 Switching device

The switch shall not be mounted on the cooking appliance.

NOTE: The switch should be mounted within 2 m of the cooking appliance.

The switch shall not be mounted in such a position that the user must reach across the open cooking surface to operate it.

6. Is it necessary to provide an earthing conductor at each lighting point?

AS/NZS 3000 Rule No: ____________________

5.4.3 Lighting points

A protective earthing conductor, connected to a terminal or suitably insulated and enclosed, shall be provided at every lighting point, including transformers supplying ELV lighting systems.

7. How shall main switches be identified on a switchboard?

AS/NZS 3000 Rule No: ____________________

2.3.3.5 Identification
Main switches shall be identified as follows:
(a) Each main switch shall be marked ‘MAIN SWITCH’ and shall be readily distinguishable from other switchgear by means of grouping, contrasting colouring or other suitable means to provide for prompt operation in an emergency.
(b) Where there is more than one main switch, each main switch shall be marked to indicate the electrical installation or portion of the electrical installation it controls.
(c) Where the opening of a main switch brings into operation or isolates an alternative supply, a notice shall be provided to indicate the position of the main switch controlling the alternative supply.

8. What is the operating temperature of V 75 thermoplastic cables for normal use?

______________________________ AS/NZS 3000 Rule No: ______________

3.4.2 Operating temperature limits
The operating temperatures of conductors shall not exceed the limits given in Table 3.2.
Polymeric cables with normal use temperatures below 75°C (see Notes to Table 3.2) are deemed not suitable for Australian or New Zealand conditions.

![Image of Table 3.2]

<table>
<thead>
<tr>
<th>Type of cable insulation(a)</th>
<th>Operating temperature of conductor, °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polymeric</td>
<td></td>
</tr>
<tr>
<td>V/75</td>
<td>75, 75, 90, 90, 90</td>
</tr>
<tr>
<td>PE/5-90, PE/90, PE/90</td>
<td></td>
</tr>
<tr>
<td>PVC/5-90, PVC/90</td>
<td></td>
</tr>
<tr>
<td>PEX/5-90, PEX/90</td>
<td></td>
</tr>
<tr>
<td>X/90</td>
<td>90, 90, 90, 90, 90</td>
</tr>
<tr>
<td>X/110, X/110</td>
<td></td>
</tr>
<tr>
<td>LLOPE</td>
<td>70, 70, 90, 90</td>
</tr>
</tbody>
</table>

75 Deg C

9. Is it permissible to join aerial cable by soldering if subject to tension?

______________________________ AS/NZS 3000 Rule No: ______________

3.7.2.9 Aerial conductors
3.7.2.9.1 Joints and connections
The following limitations and additional requirements apply to joints and connections in aerial conductors:
(a) Connections or joints in aerial conductors in tension shall be made without soldering.
(b) Connections to aerial conductors shall be reliable and adequately protected against the effects of movement, exposure to direct sunlight and entry of moisture, and shall be as short as practicable.
(c) Where conductors of dissimilar metals are joined, means shall be taken to prevent galvanic action by the use of appropriate connecting devices.

10. What are the percentages of green and yellow in an earth conductor?

______________________________ AS/NZS 3000 Rule No: ______________

70%

11. What is the rating of an RCD used to protect a socket outlet in residential installations?

________________________ AS/NZS 3000 Rule No: ______________

2.6.3.2.2 Domestic and residential installations—Australia only
Additional protection by RCDs with a maximum rated residual current of 30 mA shall be provided for all final subcircuits in domestic and residential electrical installations.
Where protection of final subcircuits is required, RCDs shall be installed at the switchboard at which the final subcircuit originates. These installations include but are not limited to—
(a) individual domestic electrical installations;
(b) residential areas of electrical installations;
(c) multiple residential electrical installations that are provided for common use; or
(d) external lighting installations in common areas of multiple residential electrical installations.

Exception: RCD protection need not apply to repairs undertaken in accordance with Clause 2.6.3.2.6.

P58

**Job Specifications.**

*These questions will help you revise what you have learnt in Section.*

1. Briefly describe the purpose of job specifications?__________________________________________________________
______________________________________________________________________
______________________________________________________________________
______________________________________________________________________

Job specifications relate to the work we do. As electricians, someone makes a decision on what work they want, we send them a quote, and if successful, go and do the job. This someone is usually the customer however larger jobs including government tenders use different engineering departments, quantity surveyors, estimators and other very specific people to assist in preparing tenders and Job specifications. As subcontractors, we have to quote on the electrical aspects of the tender to win the job. The purpose of using job specifications in addition to drawings, diagrams, codes and standards is to ensure we give the customer what they have asked for.

2. List 4 people who may have an interest in Job Specifications?__________________________________________________________
______________________________________________________________________
______________________________________________________________________

Designers, clients, certifying authorities, estimators, tenderers, contractors and sub-contractors, contract administrators, legal representatives, project managers, construction managers and facilities managers all have an interest in the specifications.

3. List the 4 types of job specification clauses and give examples of each.

1st Clause:________________________________________
Description:_________________________________________________
______________________________________________________________________

2nd Clause:________________________________________
Description:_________________________________________________
______________________________________________________________________

3rd Clause:________________________________________
Description:_________________________________________________
______________________________________________________________________
TYPES OF SPECIFICATION CLAUSES

Descriptive – describes in detail the material, workmanship and installation required to be used by the contractor or tradesperson. For example; Piping – 3mm diameter beads with core.

Reference – to a published document, with which process and products must comply. It is incorporated by a reference to the title or other identification of the document which may be a standard or a manufacture’s manual. For example; Grading – DD to AS/NZS2269.0, Bond type A.

Performance – specifies an item in a construction project by prescribing a desired end result and the criteria by which the result will be judged for its acceptability. For example; Pole Taper – maximum 1 in 120.

Direct/Proprietary – specification clauses nominate an item in a construction project by reference to a proprietary trade name. For example; Coating Systems – apply Dulux paints coating systems to the Exterior painting schedule and the Interior painting schedule.

Floor plan, Skeleton diagram, Circuit diagram, Installation diagram, Switch schedule, Lamp schedule.
In order to avoid congestion and possible confusion by superimposing electrical symbols over building fittings, a separate electrical floor plan is usually prepared.

Other drawings, for example planters, will often be supplied with a separate drawing as well.

List 2 advantages of knowing exactly where sinks, tubs and vanities are to be installed:

1. 

2. 

Elevation

Drawings of the various sides of a building viewed at right angles (usually only four views). The views are mostly named in relation to their geographic orientation, e.g., North Elevation. They show:

- Overall shape of the dwelling

Detail drawings

These are larger scale drawings, used to clearly show details of specific areas of construction where greater detail needs to be shown, for example the footings and installation of electrical accessories.

Answer the following:
The kitchen detail drawing above, assists us to determine the location and placement of how many electrical accessories/items?
Answer the following:
The sketch detail drawing above assists us to determine the location and placement of how many electrical accessories/items?

What height is the single power point on the splashback installed?

The sketch detail indicates that the splashback wall will have what type of finish?

3. ARCHITECTURAL CONVENTIONS

Certain conventions (symbols) are used to illustrate the constructional features on a floor plan. For example:

**6.980mm, 560mm**

Ex. 100x 50 framing
4.5 hardiflex lining
P66

Note: Care should be taken when scaling from a plan. The plan may have been reduced or enlarged thus giving a false measurement when transferring it to the actual job.

**Student exercise 1**

The lines shown in the table represent dimensions from a drawing. For each line, measure the length in millimetres between the dimensioning symbols then determine the actual size of the dimensions.

<table>
<thead>
<tr>
<th>No.</th>
<th>Dimensioned line</th>
<th>Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>1:50</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>1:100</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Student exercise 2**

Determine the scale size of the dimension given in the table for the scale specified.

<table>
<thead>
<tr>
<th>No.</th>
<th>Length dimension</th>
<th>Scale</th>
<th>Scale size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10500</td>
<td>1:100</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>890</td>
<td>1:10</td>
<td></td>
</tr>
</tbody>
</table>

Measure the length of the line by ruler then multiply with the scale.
Do the scaled lengths

Student exercise 2

Determine the scale size of the dimension given in the table for the scale specified.

<table>
<thead>
<tr>
<th>No.</th>
<th>Length dimension</th>
<th>Scale</th>
<th>Scale size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10500</td>
<td>1:100</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>890</td>
<td>1:10</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>12000</td>
<td>1:800</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>2480</td>
<td>1:20</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>1300</td>
<td>1:50</td>
<td></td>
</tr>
</tbody>
</table>

\[ \frac{1}{10500} / \frac{1}{100} = 105 \text{mm} \]

Do 2, 3, 4, 5

Student exercise 3

On the grid below, draw a line, to scaled length, for each of your results from student exercise 2.

5. ELECTRICAL SERVICES

In order to satisfactorily carry out the installation of the electrical services for a building, an electrician will be required to read and interpret the site plans. Provide information for the position of:

- Service point (point of attachment)
Refer the following table

From the floor plan above (scale 1:100) determine the location of the first 10 power outlets shown numbered. List and record in Table 1 on the following page the following information for each outlet:

<table>
<thead>
<tr>
<th>LIGHTING</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Incandescent 1 Luminaire - general symbol or luminaire outlet</td>
<td></td>
</tr>
<tr>
<td>2 Luminaire fixed to a wall</td>
<td></td>
</tr>
<tr>
<td>3 Number &amp; power of lamps in a group may be specified</td>
<td>3 x 15&quot;</td>
</tr>
<tr>
<td>4 Spot light</td>
<td></td>
</tr>
<tr>
<td>5 Flood light</td>
<td></td>
</tr>
<tr>
<td>6 Signal Light</td>
<td></td>
</tr>
<tr>
<td>Fluorescent 7 Tubular Fluorescent Luminaire - one Lamp</td>
<td></td>
</tr>
<tr>
<td>8 Tubular Fluorescent Luminaire - two Lamps</td>
<td></td>
</tr>
<tr>
<td>9 Discharge Lamp - general symbol</td>
<td></td>
</tr>
<tr>
<td>SWITCHBOARD</td>
<td></td>
</tr>
<tr>
<td>10 General symbol - within the symbol the type of switchboard should be nominated. MB = Main Switch Board</td>
<td></td>
</tr>
<tr>
<td>11 General symbol - within the symbol is placed the accepted abbreviation for the appliance: HSW = Hot water system</td>
<td></td>
</tr>
<tr>
<td>APPLIANCE</td>
<td></td>
</tr>
<tr>
<td>12 Air Conditioner (an example of Number 11)</td>
<td>AC</td>
</tr>
</tbody>
</table>
Student exercise 4
From the floor plan above (scale 1:100) determine the location of the first 10 power outlets shown numbered. List and record in table 1 on the following page the following information for each outlet:

---

**Table 1 – Socket outlet details**

<table>
<thead>
<tr>
<th>Outlet no.</th>
<th>Outlet details</th>
<th>Room in which outlet is located</th>
<th>Location details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**Table 2 – Light point details**

<table>
<thead>
<tr>
<th>Point no.</th>
<th>Switching details</th>
<th>Room in which point is located</th>
<th>Location details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Student exercise 8

From the same floor plan (scale 1:100) determine the location of the hot water service, 3 exhaust fans, 2 heaters, cook top and the wall oven. List and record in table 3 below the required information for each point:

- Point type (e.g. HWS)
- Room in which the point is located (e.g. lounge, kitchen, bedroom 1 etc)
- Location details (e.g. south wall)

<table>
<thead>
<tr>
<th>Point type</th>
<th>Room in which point is located</th>
<th>Location details</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Student exercise 7

Step 1 - Freestyle drawing

At the end of this section you should create a drawing using pen and ink. Then, draft a freehand sketch of the floor plan below.

Be sure to make the plan as big as possible as you will be using it in future exercises.
Step 2 - Lighting Points and Switching Locations

1. On the floor plan that you have just drawn, show the locations of all lighting points and switching positions as detailed in the lighting schedule below.
2. When locating symbols make the centre line of the symbol correspond to the centre line of the lighting point.
3. Show switching positions for all lighting points, taking into account the type of switching required according to the schedule and the practical situation for switches.

<table>
<thead>
<tr>
<th>Room</th>
<th>No. of Points</th>
<th>Switching</th>
<th>Location Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Porch</td>
<td>2</td>
<td>one-way</td>
<td>two-way west \begin{center}truss each side of door\end{center}</td>
</tr>
<tr>
<td>Living</td>
<td>1</td>
<td>two-way</td>
<td>living centre</td>
</tr>
<tr>
<td>Dining</td>
<td>1</td>
<td>one-way</td>
<td>dining centre</td>
</tr>
<tr>
<td>Kitchen</td>
<td>1</td>
<td>one-way</td>
<td>kitchen centre</td>
</tr>
<tr>
<td>Family</td>
<td>1</td>
<td>two-way</td>
<td>family centre</td>
</tr>
<tr>
<td>Toilet</td>
<td>1</td>
<td>one-way</td>
<td>toilet centre</td>
</tr>
<tr>
<td>W/n</td>
<td>1</td>
<td>one-way</td>
<td>W/n centre</td>
</tr>
<tr>
<td>W/n</td>
<td>1</td>
<td>one-way</td>
<td>W/n centre</td>
</tr>
<tr>
<td>W/n</td>
<td>1</td>
<td>one-way</td>
<td>W/n centre</td>
</tr>
<tr>
<td>W/n</td>
<td>1</td>
<td>one-way</td>
<td>W/n centre</td>
</tr>
</tbody>
</table>

Step 3 - Power Outlets

1. On your floor plan draw the locations of all power outlets as detailed in the electrical schedule below.
2. When locating symbols make the centre line of the symbol correspond to the centre line of the outlet.
3. Use a small circle to distinctly separate single and double 10A outlets and 15A outlets, by the use of appropriate symbols.

<table>
<thead>
<tr>
<th>Room</th>
<th>No. of Outlets</th>
<th>Type</th>
<th>Location Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kitchen</td>
<td>1</td>
<td>single 10A</td>
<td>southern wall 300mm from SE corner</td>
</tr>
<tr>
<td>Living</td>
<td>1</td>
<td>single 10A</td>
<td>southern wall 300mm from SE corner</td>
</tr>
<tr>
<td>Bedroom</td>
<td>1</td>
<td>single 10A</td>
<td>southern wall 300mm from SE corner</td>
</tr>
<tr>
<td>Bathroom</td>
<td>1</td>
<td>single 10A</td>
<td>southern wall 300mm from SE corner</td>
</tr>
<tr>
<td>Bedroom 2</td>
<td>1</td>
<td>single 10A</td>
<td>southern wall 300mm from SE corner</td>
</tr>
<tr>
<td>Kitchen</td>
<td>1</td>
<td>single 10A</td>
<td>southern wall 300mm from SE corner</td>
</tr>
<tr>
<td>Living</td>
<td>1</td>
<td>single 10A</td>
<td>southern wall 300mm from SE corner</td>
</tr>
</tbody>
</table>

Step 4 - Appliances

1. On the floor plan provided in Fig 2 draw the locations of the following appliances:
   a) range - located in kitchen on the northern wall in the NW corner
   b) hot water service - located in kitchen under sink
   c) door bell - located in family room, operated by an illuminated pushbutton
P80+81  Practical Task together with G106

1. JOB SPECIFICATION - Earthling Terminations

   1. Cut 50 mm of each of the 10 sq mm earth conductors:
      - 2.5 sq mm
      - 4 sq mm
      - 6 sq mm
      - 10 sq mm

   2. Use a knife to remove the insulation from one end of each cable 2.5, 4, 6, 10 sq mm.

   3. Fit a copper lug to the end of the 4, 6 and 10 sq mm cable.

   4. Fit a flare to the end of the 2.5 sq mm cable.

   5. Strip the other end of the 2.5, 4, and 6 sq mm cable ready to solder (approx. 15 mm).

   6. Strip square 55 mm down the center of the 10 sq mm cable.

   7. Wrap the 2.5, 4, and 6 sq mm cable around for 15 sq mm cable.

   8. Have your teacher check your work

   9. Use the torch to heat the cable to gather.
Architectural Drawings.

These questions will help you revise what you have learnt in Section.

1. Briefly describe the difference between a site plan and a floor plan.

---

**THE SITE PLAN**

The site plan shows the outline of the building lot and the position (orientation) of the building on the lot.

The external walls are shown in heavy outline with the eaves marked with a dashed line.

Typically shows details such as:

- Scale of the plan
- Surveyors datum location
- Northerly direction (orientation)
- Land contours
- Street name
- Lot number and the numbers of adjacent lots in order to clearly identify the correct site on which to construct the building.
- Deposited plan (DP) number.
- Exterior building dimensions and distances from the property lines.
- Site coverage of building(s).
- Location and dimensions of any easements.

**The Floor Plan**

This is a drawing of the house, viewed from above, with the roof, ceiling and part of the walls removed. It shows the outline and shape of the building and the position of all the internal walls.
Floor plans are the most useful drawing to an electrician, and a detailed floor plan will generally show:

- All dimensions
- Type of wall construction and thickness
- Position of windows, doors and archways.
- Width of openings
- Position of electrical accessories, appliances and other equipment
- Position of kitchen, laundry and bathroom fittings.
- Location of eaves, steps and downpipes

Any existing buildings on the site.

2. Briefly describe the function of a detailed drawing. Relate the answer to the installation of electrical services.

**Detail drawings**

These are larger scale drawings, used to clearly show details of specific areas of construction where greater detail needs to be shown, for example the footings and installation of electrical accessories.

3. Draw a diagram showing the method used on a floor plan to show one light point controlled by three switches.

Refer

4. Indicate the actual lengths of the following drawing dimensions at the scale specified. Include the correct unit of measurement in your answer (m, mm etc)
a. Line length 75mm – scale 1:100
b. Line length 68mm – scale 1:200
c. Line length 32mm – scale 1:50
d. Line length 4.5mm – scale 1:10
e. Line length 115mm – scale 1:100

Do yourself

Refer P69

Use the symbols shown in P69, and draw below:

**LIGHTING**

<table>
<thead>
<tr>
<th>Incandescent</th>
<th>1. Luminaires - general symbols or luminaires outlet</th>
<th>○</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2. Luminaires fixed to a wall</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td>3. Number &amp; power of lamps in a group may be specified</td>
<td>3 x 15</td>
</tr>
<tr>
<td></td>
<td>4. Spot light</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td>5. Flood light</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td>6. Signal light</td>
<td>○</td>
</tr>
</tbody>
</table>

| Fluorescent | 7. Tubular Fluorescent Luminaires - one Lamp | ○ |
|            | 8. Tubular Fluorescent Luminaires - five Lamp | ○ |
|            | 9. Discharge Lamps - general symbol | ○ |

| SWITCHBOARD | 10. General symbol - within the symbol the type of switchboard should be indicated. MCB = Main Switch Board |

| APPLIANCE | 11. General symbol - within the symbol is placed the accepted abbreviation for the appliance. HSW = Hot water system |

EF = Exhaust fan |
<table>
<thead>
<tr>
<th>No.</th>
<th>Diagram</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td><img src="image1.png" alt="Diagram" /></td>
<td>Tubular Fluorescent Luminaire Two Lamp</td>
</tr>
<tr>
<td>9</td>
<td><img src="image2.png" alt="Diagram" /></td>
<td>Discharge Lamp - general symbol</td>
</tr>
<tr>
<td>10</td>
<td><img src="image3.png" alt="Diagram" /></td>
<td>General symbol - within the symbol the type of switchboard should be nominated. MCB = Main Switch Board MCB = Major Board</td>
</tr>
<tr>
<td>11</td>
<td><img src="image4.png" alt="Diagram" /></td>
<td>Appliance - general symbol - within the symbol is placed the accepted abbreviation for the appliance. HGS = Hot water system SF = Extract fan</td>
</tr>
<tr>
<td>12</td>
<td><img src="image5.png" alt="Diagram" /></td>
<td>Air Conditioner (an example of Number 11)</td>
</tr>
<tr>
<td>13</td>
<td><img src="image6.png" alt="Diagram" /></td>
<td>Electric Heater</td>
</tr>
<tr>
<td>14</td>
<td><img src="image7.png" alt="Diagram" /></td>
<td>Switch - single pole (one-way) switch</td>
</tr>
<tr>
<td>15</td>
<td><img src="image8.png" alt="Diagram" /></td>
<td>Single pole pull switch</td>
</tr>
<tr>
<td>16</td>
<td><img src="image9.png" alt="Diagram" /></td>
<td>Two-way switch</td>
</tr>
</tbody>
</table>

**Note:**
The switches shown are drawn in ANSI/IES conventions.
7. Explain why the “point of entry” is not shown on the floor plan of a domestic installation.

Because floor plan is to show the electrical layout of each floor rather than supply entry from main power line.

8. Briefly explain the meaning of the term “standard drawing”.

a drawing or illustration that is accurate and comprehensive enough to be used in different projects with little or no change.

9. Name five parts of an electrical installation that may have their location(or route) determined from the site plan.

1. Equipments
2. Light points
3. Outlets
4. Switch
5. Relevant actuation

Equipsments, light points, outlets, switch, relevant actuation, layout of conduit.

10. Who has the responsibility of determining the cable routes for the various
various circuits of a domestic installation?

Installing Electrician

Refer

Manually operated switch
Fuse

Circuit breaker Single pole symbol
The location of all appliances and accessories, which form part of the electrical installation, are shown with the use of symbols on the floor plan. The symbols used are specified in AS 1102, and are listed below.

<table>
<thead>
<tr>
<th>LIGHTING</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Incandescent</td>
<td>General</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Luminaries</td>
<td></td>
</tr>
<tr>
<td>Luminaires</td>
<td></td>
</tr>
<tr>
<td>Luminaires</td>
<td></td>
</tr>
<tr>
<td>Light</td>
<td></td>
</tr>
<tr>
<td>Floodlight</td>
<td></td>
</tr>
<tr>
<td>Spot light</td>
<td></td>
</tr>
<tr>
<td>Signal light</td>
<td></td>
</tr>
<tr>
<td>Fluorescent</td>
<td></td>
</tr>
<tr>
<td>Tube fluorescent lamp</td>
<td></td>
</tr>
<tr>
<td>Tube fluorescent lamp</td>
<td></td>
</tr>
<tr>
<td>Discharge lamp</td>
<td></td>
</tr>
<tr>
<td>General purpose</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SWITCHBOARD</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>General symbol</td>
<td></td>
</tr>
<tr>
<td>符号</td>
<td></td>
</tr>
<tr>
<td>General symbol</td>
<td></td>
</tr>
<tr>
<td>符号</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>APPLIANCE</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat</td>
<td></td>
</tr>
<tr>
<td>Cool</td>
<td></td>
</tr>
<tr>
<td>Air conditioner</td>
<td></td>
</tr>
<tr>
<td>General</td>
<td></td>
</tr>
<tr>
<td>Appliances</td>
<td></td>
</tr>
</tbody>
</table>
Fig. 7 Circuit diagram - Light Circuit

Fig. 8: Wiring diagram - Light Circuit
Class Exercise

PROCEDURE 1 – Single lamp controlled by a single switch

1. For circuit diagram 1 shown, neatly sketch the layout of wiring diagram 1 for the circuit.

2. Connect the circuit according to the wiring diagram.
PROCEDURE 1 – Single lamp controlled by a single switch

1. For circuit diagram 1 shown, neatly sketch the layout of wiring diagram 1 for the circuit.

   ![Circuit diagram 1]

   Circuit diagram 1

   AC supply

   Lamp panel

   Fuse

   Switch panel

2. Connect the circuit according to the wiring diagram.

PROCEDURE 2 – Single lamp controlled by parallel connected switches

1. For circuit diagram 2 shown, neatly sketch the layout of wiring diagram 2 for the circuit.

   ![Circuit diagram 2]

   Circuit diagram 2

   AC supply

   Lamp panel

   Switch panel

Class Exercise
1. For circuit diagram 3 shown, neatly sketch the layout of wiring diagram 3 for the circuit.

```
      A
    /   \
   /     \
  S1----C
    \   / \\
     \ /  \\
      C---N

Circuit diagram 3
```

- AC supply
- S1
- L1
- L2
- Fuse

```
      A
    /   \
   /     \
Lamp panel
    \   / \\
     \ /  \\
      C---N

```

Class Exercise

1. For circuit diagram 4 shown, neatly sketch the layout of wiring diagram 4 for the circuit.

```
      A
    /   \
   /     \
  S1----C
    \   / \\
     \ /  \\
      C---N

Circuit diagram 4
```

- AC supply
- S1
- S2
- L1
- L2
- Fuse

```
      A
    /   \
   /     \
Fuses
    \   / \\
     \ /  \\
      C---N

```

Class Exercise
Class Exercise

1. AS/NZS 3000:2007 provides a table of electrical symbols as used in the standard. Find and neatly sketch the electrical symbols for the following devices and write down their reference number to AS 1102.

Refer the given sheet
2. The best type of electrical diagram to use when fault finding electrical equipment is a/an:
   a) circuit diagram;
   b) wiring diagram;
   c) block diagram;
   d) architectural diagram.
3. What are the five different types of diagrams used in the electrical industry?
   a) _________________________
   b) _________________________
   c) _________________________
   d) _________________________
   e) _________________________
   a) circuit diagram;
   b) wiring diagram;
   c) block diagram;
   d) skeleton diagram
   e) schematic diagram

4. What is another name for a circuit diagram?
   Connection diagram

5. Draw the symbol for a connection of 2 wires to a terminal as used in a wiring diagram.

   Wire 1   Wire 2

6. Convert the circuit diagram in below into a wiring diagram
1. INTRODUCTION

The circuit diagram is a detailed diagram intended to describe the interconnections of every component in the circuit and can also be used to assist with fault finding. Circuit diagrams are sometimes referred to as schematic diagrams. Circuit diagrams can be very complex and for a piece of equipment may in fact contain several circuits. All circuit diagrams contain symbols representing components, or lines of equipment, interconnected by lines representing conductors.

2. CIRCUIT DIAGRAM CONVENTIONS

Power/Flow and Operational Sequence

The figures below show the two accepted methods of aligning or arranging diagrams to show energy flow and operational sequence. Although both are acceptable, the most common arrangement for circuit diagrams is in the vertical orientation.

- Vertical Orientation
- Horizontal Orientation

Symbol Relationships

Circuit diagrams are most commonly drawn as detailed representation where component parts of an electrical circuit are shown in detail. This method of presentation is known as a schematic diagram. The symbols used to represent the electrical components are based on standardization. The example shown is the control panel of a motor circuit from the previous section. It can be seen that all the contacts are in a line on the left side of the circuit. The contacts are shown as closed in series with the operator's switch. Contacts L1 and L2 are being used to start the operation and control the timing of the opening of contacts A and B respectively.

Conductors crossing and joining

This is an area where the equipment may need to be identified for maintenance or repair. The preferred methods for drawing conductors crossing and joining are shown below.
Operation/ power flow/ control

Conductors crossing and joining:
This is an area where problems may occur in the incorrect connection of equipment, or confusion about the operation of a circuit. In order to overcome or minimize these problems, the preferred methods for drawing conductors crossing and joining are shown below:

Conductor crossing not permitted

Reference condition of a circuit:
Because the state or condition of circuit components vary during the normal operation of the circuit or equipment, that is, what's the condition of the circuit when the circuit is turned on? This, in turn, signifies the need to determine the sequence of operation when power is applied.

Class Exercise

Student Exercise 1:
The drawing below is to be drawn on a letter-sized sheet using standard symbols to the recommended scales for an A4 sheet.
**4. CIRCUIT SYMBOLS**

Student Exercise 2: Using a pencil, draw what you think may be the Australian standard symbols for each description given in Table 1 below. You may refer to your textbook.

<table>
<thead>
<tr>
<th>Description</th>
<th>Your drawing</th>
<th>Correct drawing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manually operated switch – Normally Open</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manually operated switch – N/C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuse</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lamp – Illuminating</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lamp – signal or Indicating</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single Pole, Double Throw (SPDT) – Changeover switch</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time delay Contacts (switch – instant on, delay off)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Circuit Breaker – single pole</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Double Pole Switch – switch both active and neutral (avoid as construction sites for safety)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Triple Pole Switch – 3 phase switch</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single Pole, Multi Position – selector switch</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Push Button Switch – single pole, non latching (NO)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Push Button Switch – single pole, non latching (NC)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Class Exercise**

Student Exercise 3: The following diagram of figure 2 is a sketch of a circuit containing a single pole double throw switch (such as a STAB type 705). Complete the circuit using the diagram and your electrically rewiring, fill in the following table.

![Diagram](image)

**Table 1**

<table>
<thead>
<tr>
<th>Phase</th>
<th>Symbol 1</th>
<th>Symbol 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The procedure can be used for all arbitrary accessories and devices. Only experience with a given accessory eliminates the need to determine terminal connections. The procedure may also be used for accessories other than switches, as it provides a useful means of identifying terminal allocation.

Single-way switching – single lighting point

Single-way switching provides simple ON/OFF control of one or more lighting points from a single switch.
Student Exercise 3:

The following diagram of figure 2 is that of a circuit containing a single-pole double-throw switch (such as a HPM type 770) controlling a lamp. Using the diagram and your electrically reasoning, fill in the switching table.

![Diagram of a single-pole double-throw switch](image)

<table>
<thead>
<tr>
<th>Terminals</th>
<th>Toggle Up</th>
<th>Toggle Down</th>
</tr>
</thead>
<tbody>
<tr>
<td>C - 1</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>C - 2</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>C - L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 - 2</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>1 - L</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>2 - L</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

This procedure can be used for all unfamiliar accessories and devices. Only experience with a given accessory eliminates the need to determine terminal connections. This procedure may also be used for accessories other than switches, as it provides a useful means of identifying terminal allocation.
Two-way switching - single lighting point

It is often necessary to control a lighting point from either of two positions e.g. for lighting in a or . In these situations the lighting point must be capable of being switched ON or OFF from either of the two control positions. Switches S1 and S2 in figure 5 are SPDT type switches. The switching chart for a SPDT switch is shown on the previous page (table 2).

Fig 5: Two-way switching single lighting point

NOTE: with a two-way switching circuit, it is possible that the light can be turned on by moving the toggle up, depending on the position of the other switch. That is, neither switch has a true OFF position. A typical light switch such as a Clipsal 39 series or a HPM 770 series may be used as either a single or two-way switch.

Student Exercise 4:
Refer to figure 5 and complete table 3.

<table>
<thead>
<tr>
<th>Switch configuration</th>
<th>LP1 condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switches S1 and S2 both toggled down (as drawn)</td>
<td>X</td>
</tr>
<tr>
<td>Switch S1 toggled up only</td>
<td></td>
</tr>
<tr>
<td>Switch S2 toggled up only</td>
<td>X</td>
</tr>
<tr>
<td>Switches S1 and S2 both toggled up</td>
<td>X</td>
</tr>
</tbody>
</table>
These questions will help you revise what you have learnt in Section. In the following statements, circle the letter that best answers the question.

1. Circuit diagrams are intended to describe:
   (a) The operation of some components in a circuit
   (b) The operation of switch contacts in a circuit
   (c) The operation of all components in a circuit
   (d) The physical layout of components in a circuit

2. Circuit diagrams are sometimes referred to as:
   (a) schematic diagrams
   (b) block diagrams
   (c) wiring diagrams
   (d) component diagrams

3. Circuit diagrams are always drawn in the electrically:
   (a) cold condition
   (b) shutdown condition
   (c) reset condition
   (d) all of the above

4. SPST is an abbreviation for:
   (a) single plate/single throw
   (b) switch plate/single throw
   (c) single pole/switch toggle
   (d) single pole/single throw

5. An instrument suitable for testing circuit continuity would be a:
(a) voltmeter
(b) ohmmeter
(c) wattmeter
(d) none of the above
6. What is the minimum number of switches to be wired for an intermediate switch setup:

(a) 1
(b) 2
(c) 3
(d) 4
7. A triple pole switch is a switch which:

(a) opens or closes three contacts simultaneously with one toggle action
(b) opens or closes one single contact with three toggle actions
(c) has three switch mechanisms mounted on one plate
(d) opens or closes three contacts with a triple action
**Section B** - Blank spaces in the following statements represent omissions. Write the appropriate information.

1. All circuit diagrams contain _____ symbol_______ that represent components or items of equipment.

2. The most common arrangement for circuit diagrams is _____ equipment______ representation.

3. Circuit diagrams are commonly drawn as _______ left to right______ _____________ where component parts of an item are drawn remote from each other.

4. When freehand sketching, it is important to maintain the same _____ sketch_______ for all symbols for the same type of device.

5. Switching charts provide a useful means of identifying _____ switch__________ allocation.

6. Intermediate switching allows on/off control from any of ____3______ or more switching positions.
Damp proof course/ Ant cap

Student exercise 1: Complete the following:
What is the purpose of a 'drip loop'?
When terminating, an excess of cable should be pushed back into the cavity so that a loop of cable is formed which is lower than the point of termination.

List 2 possible consequences of not properly forming a 'drip loop'
It will provide a moisture path from the external wall to the internal/ Cable will be wet by touching with wall.

Damp course
Minimum

Student exercise 2:
Refer to AS/NZS 3000:2007 Clause 3.9.4, and answer the following:
(a) TPS cable requires further mechanical protection if installed within __________mm of an external or internal surface.
(b) List 1 protection method (including the clause number) that could be used if a cable were to be installed in a location deemed to 'require additional protection'.

3.3.2.6 Mechanical damage
Wiring systems shall be selected and installed so as to minimize the risk of mechanical damage.
Protection against mechanical damage shall be provided by one or any combination of the following:
(a) Mechanical characteristics of the wiring system.
(b) Location selected.
(c) Provision of additional local or general mechanical protection.
NOTE: Guide to adequacy and WS classification is provided in Appendix H.

3.9.3.3 Wiring systems likely to be disturbed
3.9.3.3.1 Location
Wiring systems installed in the following locations are deemed likely to be disturbed:
(a) On the surface of a wall or on the underside of a ceiling or roof.
(b) In a space between a floor and the ground to which a person may gain entry.
(c) In parts of a ceiling space where access is greater than 0.6 m in height.
(d) Within 2.0 m of any access to any space to which a person may gain
entry.
(e) Below raised floors.

3.9.4.2 Wiring systems near building surfaces

* Wiring systems that are fixed in position by fasteners, or held in position by thermal insulation, or by passing through an opening in a structural member, shall be protected by one of the methods outlined in Clause 3.9.4.4 if they are concealed within 50 mm from the surface of a wall, floor, ceiling or roof.

Exception: This requirement need not apply to wiring systems that can move freely to a point not less than 50 mm from the surface in the event of a nail or screw penetrating the cavity at the location of the wiring system.
Inter-trade Relationships in the Building Sequence
The electrician must be familiar with the construction sequence and the structural details so that the wiring can be hidden as much as possible. Also, an appreciation of the role and timing of other tradespersons on the job can improve communication and co-operation. This is important to be able to determine when it is appropriate to install________________, fit________________ and_________________.

Under floor cable/ slab wiring, fit out, rough in

EXERCISE 3

Student exercise 3: Name the parts indicated by the arrows on the diagram

Student exercise 4: Name the parts indicated by the arrows on the diagram
Cavity Brick Wall Construction
Cavity or double brick construction has two brick walls separated by a cavity of approximately 50 mm and the two walls are held together with wall ties of either steel strip or wire embedded in the mortar joints.

The inner skin of the brickwork is structural i.e., the load-bearing part, while the outer skin provides protection from the weather as well as being designed for visual effect.

The function of the wall cavity is to:
- Provide a moisture barrier from the outside wall to the inside wall (most masonry is porous)
- Provide air circulation to assist in drying out any moisture that has penetrated the external wall
- Provide thermal and acoustic insulation

Timber or Metal Frame Construction
Timber frame construction employs a single timber frame, which forms the internal and external walls. That is there is no cavity. The internal wall is clad with normal internal cladding (Gyprock etc) and the outside of the frame must be covered with one of various types of waterproof cladding. Some types of cladding include:

- Weatherboards (timber)
- Brick tile sheets
- Treated metal (aluminium or steel)
- Fibre cement (sheets or planks)
- Plywood
- Hardboard
- PVC (sheeting or planks)
EXERCISE 4+5

Student exercise 4:
Name the parts indicated by the arrows on the diagram.

Student exercise 5:
Name the parts indicated by the arrows on the diagram.

Refer for 4

masonry:
Eaves — The lower part of the roof that overhangs the wall.
Footing — The construction whereby the weight of the structure is transferred from the base structure to the foundation.
Gable — The triangular end of a house formed at the end of a pitched roof, from the eaves line to the apex.
Hip roof — A roof which is roughly pyramidal in shape, with surfaces sloping upwards from all the eaves.
Joists, floor — Timber members spanning between walls or other supports, to which the ceiling is attached.
Joists, ceiling — Timber members spanning between walls or other supports.
Lintel — A horizontal load-bearing member spanning an opening.
Nogging — A horizontal piece of timber providing a stiffener between studs in wall frames.
Par caps (Anti caps) — A membrane (usually galvanised steel) to prevent dampness and deter insect attack of sub-floor timber.
Purlins — Longitudinal roof timber giving intermediate support for rafters.
Rafter — In roof construction, a timber framing member providing the principle support for the roofing material.
Sarking — A covering of waterproof building paper or boarding fixed on the top of the rafters beneath the external roof covering.
Skillion or lean-to roof — A roof sloping in one direction only with the rafters pitching or leaning against a wall.
The cavity can be used as a route for electrical wiring and similar precautions to double brick construction need to be taken.

**Floors**

1. Timber floor boards or compressed sheets (tongue and groove) are the most common type of flooring. The floor is constructed so that the external and internal plans support bearers. Floor joints are nailed to the bearers and the flooring is nailed to the joists.

2. Concrete (Raft) slab – screeded for a smooth surface.

**Walls**

The two main types of walls are:

1. **Load-bearing walls**
   - Load-bearing walls transfer loads to the foundations. That is, they support the weight of the roof etc.
   - External wall framing and some internal walls are load-bearing.

2. **Non load-bearing walls**
   - Non load-bearing walls are usually called partition walls and do not carry any of the roof loads.
   - They divide the space into living areas – i.e. rooms.

Both types of walls, load or non load-bearing, could be constructed from timber, masonry or steel.
The ceiling is supported by ceiling joists, trimmers and hanging beams.

Trussed roofs
This is a pre-fabricated form of roofing framework.
A trussed roof is a structural load-bearing frame comprising a number of equally spaced trusses which span across the building and are supported on the outside wall. When fixed in position, the trusses are designed to support the roof and ceiling loads.

P141 to 144 Practical Task

1. Strip the end of the cable and fold the conductor over:
   - 1 sq mm
   - 2.5 sq mm
   - 4 sq mm
   - 6 sq mm
   - Have the cables checked by the Teacher

2. TERMINATING TWIN DOUBLE INSULATED CABLE
   Cut 300 mm of each conductor
   Strip the end of the cable and fold the conductor over:
   - 1 sq mm
   - 2.5 sq mm
   - 4 sq mm
   - Have the cables checked by the Teacher

3. TERMINATING TWIN AND EARTH DOUBLE INSULATED CABLE
   Cut 300 mm of each conductor
   Strip the end of the cable and fold the conductor over:
   - 1 sq mm
1. 1.5 SQMM TWINS AND EARTH CABLE
   1. Cut cable to size and push clips on the cable to the board
   2. Fix junction box to the board and connect the junction box
   3. Connect the lighting point
   4. Strip the end of the supply cable – 7mm single insulated. Loos exposed, twist copper.

   Have your teacher check your work
   
   5. Add another light point to the wiring point.

   Have your teacher check your work

6. Re-arrange the circuit and add a junction box and 3嘉兴 silver box.
Building Construction.

These questions will help you revise what you have learnt in Section. In the following statements, circle the letter that best answers the question.

1) Name the six main parts of a structure.

a) ___________________  b) ___________________  c) ___________________

b) ___________________  e) ___________________  f) ___________________

2) State two reasons why a concrete slab footing is sometimes used in preference to piers.

a) ________________________________________________

b) __________________________________________________________

Concrete slab footings – act as the support for the structure as well as being the floor.

3) Define the following terms used in timber floor construction:

a) Floor joists: ________________________________________________________

Define joist: any of the small timbers or metal beams ranged parallel from wall to wall in a structure to support a floor or ceiling.
b) Bearers: __________________________________________________________

Bearers are the timber or steel that attaches directly to the stumps in the ground, that supports the deck of flooring structure. Joists are the timbers that then attach across the top of the bearers, after which the timber or particle board floor is then attached.

c) Pier: ____________________________________________________________

1. a platform on pillars

d) Floorboard: _______________________________________________________

long plank making up part of a wooden floor in a building.

4) Define the following terms used in framed wall construction:
a) Studs: ___________________________________________________________

large-headed piece of metal that pierces and projects from a surface, especially for decoration

b) Top plate: ________________________________________________________

A Top Plate is the continuous timber beam on top of the walls that supports the roof structure by carrying the vertical forces from the rafters to the wall studs

c) Bottom plate: ____________________________________________________
A **Bottom Plate** is the piece of timber which sits on the floor and forms the **bottom** of the wall, carrying the stud loads to the floor joists.

**d) Noggings:**

- a horizontal piece of wood fixed to a framework to strengthen it.

**e) Braces:**

What is a brace in construction?

In **construction**, cross **bracing** is a system utilized to reinforce building structures in which diagonal supports intersect. **Cross bracing** can increase a building’s capability to withstand seismic activity. **Bracing** is important in earthquake resistant buildings because it helps keep a structure standing.
5) Define the following terms used in brick wall construction: a) Single brick wall:

What is a single brick wall?
A leaf is as thick as the width of one **brick**, but a **wall** is said to be one **brick** thick if it as wide as the length of a **brick**. Accordingly, a **single-leaf wall** is a half **brick** thickness; a **wall** with the simplest possible masonry transverse bond is said to be one **brick** thick, and so on

b) Course:

What is a course in masonry?
A **course** is a layer of the same unit running horizontally in a wall. It can also be defined as a continuous row of any **masonry** unit such as bricks, concrete **masonry** units (CMU), stone, shingles, tiles, etc. ... If a **course** is the horizontal arrangement then a wythe is the vertical section of a wall

c) Feature wall:
What is feature wall?
**Feature walls** are most often used when the rest of the room is decorated with a fairly neutral colour. You pick a **wall** in the room and paint it a different colour, or **wallpaper** it with a bold pattern, creating a **feature**. A **feature wall** can also be used to create a more defined space in an open-plan area
d) Rendered wall:

What does render a wall mean?
Cement rendering is the application of a premixed layer of sand and cement to brick, cement, stone, or mud brick. It is often textured, colored, or painted after application. It is generally used on exterior walls but can be used to feature an interior wall.

6) What is the average width of the cavity between the brick wall and the framed wall in brick veneer construction?

Cavity width
General: Provide minimum cavity widths in conformance with the following:
- Masonry walls: 50 mm.
- Masonry veneer walls: 40 mm between the masonry leaf and the loadbearing frame and 25 mm minimum between the masonry leaf and sheet bracing.

7) What purpose does the cavity serve in a double brick wall?

Cavity walls consist of two "skins" separated by a hollow space (cavity). The skins are commonly masonry, such as brick or concrete block. Masonry is an absorbent material, and therefore will slowly draw rainwater or even humidity into the wall, as well as from the inside of the house as from outside. Advantages of Cavity Walls. Following are the advantages of cavity wall when compared to solid walls. Cavity walls give better thermal insulation than solid walls. It is because of the space provided between two leaves of cavity walls is full of air and reduces heat transmission into the building from outside.

8) Name three common types of roof covering.

a) Asphalt Roofing. Asphalt roofing is the most common form of roof covering in the United States. ...
b) Clay Tile Roofing. Clay tile roofing is one of the oldest forms of roofing. ...
c) Flat Roof Covering Options. ...
   • Metal Roofing. ...
   • PVC Flat Roofing. ...
   • Rubber Roofing. ...
   • Shingle Roofing. ...
   • Slate Roofing.
9) In what circumstances are trussed roofs used?
Planar truss. ... Planar trusses are typically used in parallel to form roofs and bridges. The depth of a truss, or the height between the upper and lower chords, is what makes it an efficient structural form. A solid girder or beam of equal strength would have substantial weight and material cost as compared to a truss.

10) List four materials used to clad the external walls of a house built using timber frame construction.

a) ______________________  b) ______________________

c) ______________________  d) ______________________

Materials. Cladding can be made of any of a wide range of materials including wood, metal, brick, vinyl, and composite materials that can include aluminium, wood, blends of cement and recycled polystyrene, wheat/rice straw fibres. Materials used for cladding affect vulnerability to fire.

11) In relation to the installation of wiring, describe the meaning of the following terms:

c) First fixing or rough in: _____________________________________________________

d) Second fixing or fit out: ___________________________________________________

First fix comprises all the work needed to take a building from foundation to putting plaster on the internal walls. This includes constructing walls, floors and ceilings, and inserting cables for electrical supply and pipes for water supply.

Second fix comprises all the work after the plastering of a finished house. Electrical fixtures are connected to the cables, sinks and baths connected to the pipes, and doors fitted into doorframes. ... Some construction companies specialise in first fix work or second fix work, but most do both.

12) When installing wiring in the cavity of a cavity wall, explain why it is important that the cables don’t touch both the internal and external walls.

To prevent the external dampness to be transferred to cable

13) The following is a list of constructional stages of a timber framed cottage. Write these in the correct sequence.

Base cladding finishing floor roof walls footings interior lining painting setting out tiling

a) ______________________  b) ______________________  c) ______________________

d) ______________________  e) ______________________  f) ______________________

g) ______________________  h) ______________________  i) ______________________
j) __________________________ k) ______________________
Various trades in construction need to be planned and scheduled so that the various trades interact smoothly. The diagram outlines the following steps:

- **Bricklayer**
  - Lock-up stage
- **Tiler**
  - Interior lining
  - Tiling ( Contact)
- **Painter**
  - Painting
- **Electrician**
  - Under-floor cables or in-duct wiring
- **Plumber**
  - Rough-in
- **Finishing**
- **Rough Structure**
  - Setting out
  - Foundations
  - Base
  - Floor
  - Walls
  - Roof
  - Cladding

These trades need to be coordinated and scheduled to ensure a smooth and efficient construction process.
Switch 1 - Panel 1
1. Using a suitable testing device, check for continuity between each terminal combination for each position of the switch toggle.
2. Number the switch terminals on the diagram according to your results.
3. Draw in the table below, the switching chart for the switch on the panel stated. Remember to take into account the:
   a. Number of terminals
   b. Number of switch positions
4. Indicate the closed terminal connections with a cross in the appropriate box.
5. Draw the Australian standard symbol for the switch next to the table.

<table>
<thead>
<tr>
<th>Terminals</th>
<th>Toggle Up</th>
<th>Toggle Down</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Switch 1 - Panel 2
1. Using a suitable testing device, check for continuity between each terminal combination for each position of the switch toggle.
2. Number the switch terminals on the diagram according to your results.
3. Draw in the table below, the switching chart for the switch on the panel stated. Remember to take into account the:
   a. Number of terminals
   b. Number of switch positions
4. Indicate the closed terminal connections with a cross in the appropriate box.
5. Draw the Australian standard symbol for the switch next to the table.

<table>
<thead>
<tr>
<th>Terminals</th>
<th>PB In</th>
<th>PB Out</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>