

# 2022 HSC Electrotechnology Marking Guidelines

## Section I

### Multiple-choice Answer Key

| Question | Answer |
|----------|--------|
| 1        | C      |
| 2        | C      |
| 3        | A      |
| 4        | B      |
| 5        | A      |
| 6        | B      |
| 7        | C      |
| 8        | C      |
| 9        | A      |
| 10       | D      |
| 11       | A      |
| 12       | C / D  |
| 13       | C      |
| 14       | D      |
| 15       | B      |

## Section II

### Question 16 (a)

| Criteria  | Marks |
|---|-------|
| <ul style="list-style-type: none"> <li>Identifies correctly ONE appropriate function for X and Y on the tool shown</li> </ul> | 2     |
| <ul style="list-style-type: none"> <li>Identifies correctly ONE appropriate function for X or Y on the tool shown</li> </ul>  | 1     |

**Sample answer:**

X is to cut copper wire

Y is to crimp lugs

### Question 16 (b)

| Criteria  | Marks |
|---|-------|
| <ul style="list-style-type: none"> <li>Completes the table with the correct descriptions and uses</li> </ul>            | 3     |
| <ul style="list-style-type: none"> <li>Completes part of the table with the correct descriptions and uses</li> </ul> OR | 2     |
| <ul style="list-style-type: none"> <li>Completes the table with correct descriptions OR uses</li> </ul>                 |       |
| <ul style="list-style-type: none"> <li>Provides some relevant information</li> </ul>                                    | 1     |

**Sample answer:**

|   |
|---|
| <i>Name and example of use</i>  |
| Thermoplastic-sheathed cable (TPS)<br>It is used for low voltage circuit    |
| Coaxial cable<br>It is used for connecting TV aerials and the internet      |
| Figure 8 cable single insulated<br>It is used for audio speakers and alarms |

### Question 17 (a)

| Criteria   | Marks |
|--|-------|
| <ul style="list-style-type: none"> <li>Demonstrates a sound understanding of factors that need to be considered when planning cable routes during construction of a metal frame house</li> </ul> | 2     |
| <ul style="list-style-type: none"> <li>Provides some relevant information</li> </ul>   | 1     |

**Sample answer:**

The length of the runs needs to be considered to make sure that there are no sharp edges that could damage the cable or 'pinch points' where the cable could get caught. There should also be access to the cable for fixing off.

### Question 17 (b)

| Criteria   | Marks |
|--|-------|
| <ul style="list-style-type: none"> <li>Demonstrates a sound understanding of the features of an abrasive disc required to cut the metal frame</li> </ul> | 2     |
| <ul style="list-style-type: none"> <li>Provides some relevant information</li> </ul>   | 1     |

**Sample answer:**

The diameter, hole diameter, thickness of the disc and material of the disc must be suitable for cutting metal.

### Question 17 (c)

| Criteria   | Marks |
|--|-------|
| <ul style="list-style-type: none"> <li>Demonstrates a sound understanding of the safety checks when using a battery-powered angle grinder</li> </ul>       | 3     |
| <ul style="list-style-type: none"> <li>Demonstrates some understanding of the safety checks required when using a battery-powered angle grinder</li> </ul> | 2     |
| <ul style="list-style-type: none"> <li>Provides some relevant information</li> </ul>   | 1     |

**Sample answer:**

Make sure the disc has no cracks or chips. Check that the disc is done up tightly on the grinder arbor. Check that it has the correct disc and the guard is on the grinder.

### Question 18 (a)

| Criteria   | Marks |
|--|-------|
| <ul style="list-style-type: none"> <li>Two or more errors identified in the diagram</li> </ul> | 2     |
| <ul style="list-style-type: none"> <li>One error identified in the diagram</li> </ul>          | 1     |

**Sample answer:**

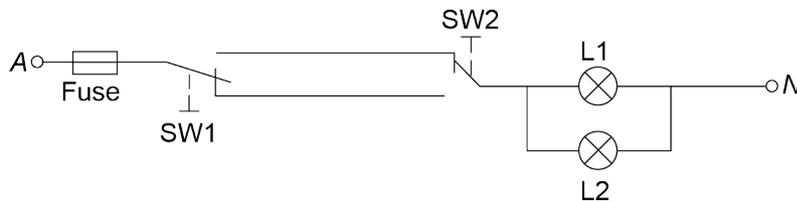
Two lamps are connected in series, should be in parallel.

The switch is connected to the neutral conductor, should be connected to the active conductor.

### Question 18 (b)

| Criteria  | Marks |
|---|-------|
| • Produces a correct fully functional circuit diagram               | 4     |
| • Produces a circuit diagram containing minor errors                | 2–3   |
| • Produces a circuit diagram that contains only some basic features | 1     |

**Sample answer:**



### Question 19

| Criteria   | Marks |
|--|-------|
| • Provides a detailed explanation of how a worker who suffers from an electric shock while working on a switchboard should be safely moved | 4     |
| • Provides some explanation of how a worker who suffers from an electric shock while working on a switchboard should be safely moved       | 2–3   |
| • Provides some relevant information   | 1     |

**Sample answer:**

First check whether any danger is present before reaching out to the victim, eg wet floor, loose cable, exposed electrical conductor or metal objects. Secondly, try to isolate power from switchboards or at isolation switches.

Using a non-conductive stick or using a crook, remove electrical conductor or metal objects from victim. Move the victim to a dry safe place away from other dangers if possible.

Do not move or drag the victim if the victim has a suspected neck or back injury.

### Question 20 (a)

| Criteria  | Marks |
|---|-------|
| • Provides correct formulae and correct substitution of values or provides a correct answer using correct units | 3     |
| • Provides correct formulae and correct substitution of values with some errors                                 | 2     |
| • Provides correct formula or correct substitution of values  | 1     |

**Sample answer:**

$$R_T = R_1 + ((R_2 + R_3)^{-1} + R_4^{-1})^{-1} = 10 + ((15 + 33)^{-1} + 47^{-1})^{-1} = 33.747 \Omega$$

### Question 20 (b)

| Criteria  | Marks |
|---|-------|
| • Provides correct formulae and correct substitution of values or provides a correct answer using correct units | 3     |
| • Provides correct formulae and correct substitution of values with some errors                                 | 2     |
| • Provides correct formula or correct substitution of values  | 1     |

**Sample answer:**

$$I = \frac{V}{(R_1 + R_2 + R_3)} = \frac{48}{(10 + 15 + 33)} = 0.8276 \text{ A}$$

### Question 20 (c)

| Criteria  | Marks |
|---|-------|
| • Provides correct formulae and correct substitution of values or provides a correct answer using correct units | 3     |
| • Provides correct formulae and correct substitution of values with some errors                                 | 2     |
| • Provides correct formula or correct substitution of values  | 1     |

**Sample answer:**

$$V_1 = \frac{V_T R_1}{(R_1 + R_2)} = \frac{48 \times 10}{(10 + 47)} = 8.421 \text{ V}$$

### Question 20 (d)

| Criteria   | Marks |
|--|-------|
| • Provides correct formulae and correct substitution of values or provides a correct answer using correct units                    | 4     |
| • Provides correct formulae and correct substitution of values with some errors or provides a correct answer using incorrect units | 2–3   |
| • Provides correct formula or correct substitution of values   | 1     |

**Sample answer:**

$$I = \frac{V}{(R_1 + R_2)} = \frac{48}{(10 + 47)} = 0.842 \text{ A}$$

$$P_1 = I^2 \times R_4 = 0.842^2 \times 47 = 33.32 \text{ W}$$

## Section III

### Question 21

| Criteria  | Marks |
|---|-------|
| <ul style="list-style-type: none"> <li>Provides a comprehensive explanation of how a company can achieve a carbon neutral workplace and meet government regulations with reference to energy audits</li> <li>Communicates ideas and information using relevant workplace examples and industry terminology</li> <li>Presents a logical and cohesive response</li> </ul> | 13–15 |
| <ul style="list-style-type: none"> <li>Provides a detailed explanation of how a company can achieve a carbon neutral workplace and meet government regulations with reference to energy audits</li> <li>Communicates some ideas and information using workplace examples and industry terminology</li> <li>Presents a logical response</li> </ul>                       | 10–12 |
| <ul style="list-style-type: none"> <li>Provides a sound explanation of how a company can achieve a carbon neutral workplace and/or meet government regulations with reference to energy audits</li> <li>Uses some relevant workplace examples and industry terminology</li> <li>Presents a mostly logical response</li> </ul>   | 7–9   |
| <ul style="list-style-type: none"> <li>Provides some basic information about how a company can achieve a carbon neutral workplace and/or meet government regulations with reference to energy audits</li> <li>Uses limited example(s) and/or industry terminology</li> </ul>  | 4–6   |
| <ul style="list-style-type: none"> <li>Provides some relevant information</li> </ul>  | 1–3   |

**Answers could include:**

Heating/cooling, ventilation and lights

- Replacement of old, inefficient boilers, chillers, pumps and motors
- Improved insulation (ie replacing old hot water pipe insulation, and roof/cavity insulation)
- Improved lighting controls, including motion or lux sensors in suitable places
- Decreasing the number of light fittings as well as ensuring all incandescent and halogen bulbs are transferred to LEDs
- Designing to maximise the effect of solar light and heat
- Thermal properties of roofing, walls and floor materials

Appliances/machinery

- Efficient electric motors (DC, variable speed etc)

Electronics

- Heat recovery such as from IT communications rooms

Materials

- Efficient design usage to reduce waste

#### Generation

- Solar photovoltaics which reduce grid electricity consumption as well as peak demand
- Wind power
- Steam generation from burning waste/byproducts from production eg sawdust or methane

#### Storage

- Battery storage of electricity
- Thermal heat storage – hot water or rock heat walls to store heat in buildings

#### Government regulators and Acts that may be referenced in answer

- NSW Environment Protection Agency (EPA)
- NSW Department of Environment and Climate Change
- Clean Energy Regulator (Cth)
- Department of Climate Change and Energy Efficiency (Cth)
- Local council
- *Protection of the Environment Operations Act 1997* (NSW) (as amended)
- *Clean Energy Act 2011* (Cth) (as amended)

## Section IV

### Question 22 (a)

| Criteria   | Marks |
|--|-------|
| <ul style="list-style-type: none"> <li>Provides a comprehensive description of the documentation and preparation required prior to commencing practical work</li> <li>Uses correct industry terminology</li> </ul> | 6     |
| <ul style="list-style-type: none"> <li>Provides a sound description of the documentation and preparation required prior to commencing practical work</li> <li>Uses correct industry terminology</li> </ul>         | 4–5   |
| <ul style="list-style-type: none"> <li>Provides some description of the documentation and/or preparation required prior to commencing practical work</li> <li>Uses some correct industry terminology</li> </ul>    | 2–3   |
| <ul style="list-style-type: none"> <li>Provides some relevant information</li> </ul>   | 1     |

**Answers could include:**

- Develop a working plan
- Conduct site survey
- Develop a risk assessment – isolate general public from site
- Contact building manager regarding access and start/finish times
- Obtain the site, floor and service plans
- Confirm the exact location of the power outlet on the floor plan
- Survey the existing services located near the proposed working area
- Develop Safe Work Method Statement (SWMS)
- Organise the tools and equipment and PPE for the work
- Order the materials and consumables, eg cables; conduits; recessed socket outlets; diamond cutters; drill bits
- Conduct site induction
- Conduct tool box talk
- Sign off safe work method statement.

## Question 22 (b)

| Criteria  | Marks |
|---|-------|
| <ul style="list-style-type: none"> <li>• Demonstrates a comprehensive understanding of the procedure to install, test and commission the recessed power outlet as shown in the picture</li> <li>• Uses correct industry terminology</li> </ul>        | 9     |
| <ul style="list-style-type: none"> <li>• Demonstrates a thorough understanding of the procedures to install, and test or commission the recessed power outlet as shown in the picture</li> <li>• Uses correct industry terminology</li> </ul>         | 7–8   |
| <ul style="list-style-type: none"> <li>• Demonstrates a sound understanding of the procedures to install and/or test and/or commission the recessed power outlet as shown in the picture</li> <li>• Uses some correct industry terminology</li> </ul> | 5–6   |
| <ul style="list-style-type: none"> <li>• Demonstrates a basic understanding of the procedures to install and/or commission the recessed power outlet as shown in the picture</li> </ul>   | 3–4   |
| <ul style="list-style-type: none"> <li>• Provides some relevant information</li> </ul>  | 1–2   |

### **Answers could include:**

- Mark out the cable route on the floor
- Double check the existing service works not near the proposed cutting of the concrete floor
- Use a wall/floor chaser to cut the concrete floor and chisel out the waste
- Use a diamond concrete saw to cut the concrete floor and make a recessed space to fit the recessed socket outlet
- Isolate, lock out and tag the appropriate power circuit in the switchboard
- Rough in wiring
- Terminate cables for the new recessed power outlet
- Fit the conduit to the groove and connect to the recessed socket outlet
- Test the cable and socket outlets
- Test the cable for earth conduct or continuity protection
- Test insulation resistance between live conductors and protective earths
- Test correct polarity and circuit connection
- Test RCBO when power is available
- Commission the socket outlets
- Clean up the site and hand over to the building manager
- Complete the Certificate of Compliance and give it to the customer.

# 2022 HSC Electrotechnology Mapping Grid

## Section I

| Question | Marks | HSC content – focus area   | Employability skills<br>(Please put an X where appropriate) |          |                 |                           |                         |                 |          |            |
|----------|-------|--|---|----------|-----------------|---------------------------|-------------------------|-----------------|----------|------------|
|          |       |  | Communication   | Teamwork | Problem-solving | Initiative and enterprise | Planning and organising | Self-management | Learning | Technology |
| 1        | 1     | Safety — safe work practices and procedures – page 55                                    | X   |          | X               |                           |                         |                 |          |            |
| 2        | 1     | Components, tools and equipment — hand and power tools – page 30                         |   |          | X               |                           |                         |                 |          | X          |
| 3        | 1     | Working in the industry — careers and training – page 66                                 |   |          | X               |                           | X                       |                 | X        |            |
| 4        | 1     | Components, tools and equipment — mechanical/engineering drawings and sketches – page 29 |   |          |                 | X                         | X                       |                 |          | X          |
| 5        | 1     | Drawings, diagrams and compliance — architectural drawing – page 48                      | X   |          |                 |                           | X                       |                 |          |            |
| 6        | 1     | Components, tools and equipment — hand and power tools – page 30                         |   |          | X               |                           |                         |                 |          | X          |
| 7        | 1     | Safety — incidents, accidents and emergencies – page 56                                  | X   |          |                 |                           | X                       |                 | X        |            |
| 8        | 1     | Drawings, diagrams and compliance — relationship to building construction work – page 49 | X   |          | X               |                           |                         |                 |          |            |
| 9        | 1     | Components, tools and equipment — hand and power tools – page 31                         |   |          |                 |                           | X                       |                 |          | X          |
| 10       | 1     | Drawings, diagrams and compliance — electrical drawing and diagrams – page 48 and 49     | X   |          |                 |                           | X                       |                 |          |            |
| 11       | 1     | Direct current circuits — measuring and testing – page 42                                |   |          | X               |                           |                         |                 | X        | X          |
| 12       | 1     | Components, tools and equipment — hand and power tools – page 30                         |   |          | X               | X                         |                         |                 |          | X          |
| 13       | 1     | Direct current circuits — capacitance – page 44  |   |          |                 |                           |                         |                 | X        | X          |
| 14       | 1     | Safety — safe work practices and procedures – page 56                                    | X   |          |                 |                           | X                       |                 |          |            |
| 15       | 1     | Direct current circuits — series/parallel circuits – page 40                             |   |          | X               |                           |                         |                 |          | X          |

**Section II**

| Question | Marks | HSC content – focus area  | Employability skills<br>(Please put an X where appropriate) |          |                 |                           |                         |                 |          |            |
|----------|-------|---|---|----------|-----------------|---------------------------|-------------------------|-----------------|----------|------------|
|          |       |   | Communication   | Teamwork | Problem-solving | Initiative and enterprise | Planning and organising | Self-management | Learning | Technology |
| 16 (a)   | 2     | Components, tools and equipment — hand and power tools – page 30                          |   |          | X               |                           | X                       |                 |          | X          |
| 16 (b)   | 3     | Drawings, diagrams and compliance — electrical drawings and diagrams – page 49            | X   |          |                 |                           |                         |                 |          |            |
| 17 (a)   | 2     | Drawings, diagrams and compliance — relationships to building construction work – page 49 |   |          | X               |                           | X                       |                 |          |            |
| 17 (b)   | 2     | Components, tools and equipment — hand and power tools – page 30                          | X   |          |                 | X                         | X                       |                 |          | X          |
| 17 (c)   | 3     | Safety — safe work practices and procedures – page 55                                     |   |          | X               |                           |                         |                 | X        |            |
| 18 (a)   | 2     | Drawings, diagrams and compliance — electrical drawings and diagrams – page 49            |   |          | X               |                           | X                       |                 |          |            |
| 18 (b)   | 4     | Drawings, diagrams and compliance — electrical drawings and diagrams – page 49            |   |          | X               |                           |                         |                 |          |            |
| 19       | 4     | Safety — incidents, accidents, emergencies – page 57                                      |   |          |                 |                           | X                       |                 | X        |            |
| 20 (a)   | 3     | Direct current circuits — series/parallel circuits – page 40                              | X   |          | X               |                           |                         |                 |          |            |
| 20 (b)   | 3     | Direct current circuits — series circuits – page 39                                       |   |          | X               |                           | X                       |                 |          |            |
| 20 (c)   | 3     | Direct current circuits — series circuits – page 39                                       | X   |          |                 |                           |                         |                 |          |            |
| 20 (d)   | 4     | Direct current circuits — series circuits – page 39                                       | X   |          | X               |                           | X                       |                 |          |            |

**Section III**

| Question | Marks | Unit of competency / Element of competency   | Employability skills<br>(Please put an X where appropriate) |          |                 |                           |                         |                 |          |            |
|----------|-------|--|---|----------|-----------------|---------------------------|-------------------------|-----------------|----------|------------|
|          |       |  | Communication   | Teamwork | Problem-solving | Initiative and enterprise | Planning and organising | Self-management | Learning | Technology |
| 21       | 15    | Sustainability — compliance – page 61<br>Working in the industry — energy sector workers – page 68 | X   |          | X               | X                         |                         |                 | X        | X          |

**Section IV**

| Question | Marks | Unit of competency / Element of competency                | Employability skills<br>(Please put an X where appropriate) |          |                 |                           |                         |                 |          |            |
|----------|-------|---|---|----------|-----------------|---------------------------|-------------------------|-----------------|----------|------------|
|          |       |   | Communication   | Teamwork | Problem-solving | Initiative and enterprise | Planning and organising | Self-management | Learning | Technology |
| 22 (a)   | 6     | Safety — safe work practices and procedures – page 55     | X   |          | X               |                           | X                       |                 | X        |            |
| 22 (b)   | 9     | Working in the industry — energy sector workers – page 68 | X   | X        | X               |                           |                         | X               |          | X          |