2019 HSC Electrotechnology Marking Guidelines

Section I

Multiple-choice Answer Key

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

Section II

Question 16 (a)

Criteria	Marks
• Demonstrates an understanding of the difference between TPS and TPI cable	2
• Demonstrates an understanding of either TPS or TPI cable	1

Sample answer:

TPS refers to a cable composed of individually insulated wires surrounded by an outer plastic cover, whereas TPI is an individual wire with one insulating layer.

Question 16 (b)

Criteria	Marks
• Outlines the process of preparing a cable for termination • At least one safety consideration included	3
• Provides some relevant steps for preparing a cable for termination • At least one safety consideration included	2
• Provides some relevant information	1

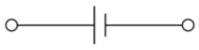
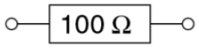
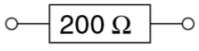
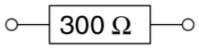
Sample answer:

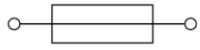
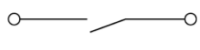
Ensure the cable is isolated from supply. Remove outer sheathing to expose active, neutral & earth to approximately 100 mm. Strip the end of each wire to 25–30 mm. Twist the strands and fold back so that the end of the bare wires don’t touch or project past the insulation of the wire. Only bare wire should be in contact with the screw of the terminal and not extend past the terminal.

Question 17 (a)

Criteria	Marks
• Demonstrates a comprehensive understanding of circuit components and their correct placement • Creates a functioning circuit with a total resistance of 150 Ω • Correctly positions all components	3
• Demonstrates a sound understanding of circuit components and their correct placement • Creates a circuit with a total resistance of 150 Ω • Correctly positions a majority of components	2
• Demonstrates a basic understanding of circuit components and their correct placement • Correctly positions one component	1

Sample answer:

Component	*Position*
	*A*
	*D* or *E*
	*D* or *E*
	*F*

Component	*Position*
	*G*
	*B*
	*C*

Note: Candidates may provide an alternative arrangement for the resistors, however must also provide a resistance value for the lamp.

Question 17 (b)

Criteria	Marks
• Demonstrates a comprehensive understanding of effective fault finding • Uses an appropriate process to test each component	3
• Demonstrates a sound understanding of effective fault finding • Uses an appropriate process to test most components OR can list what needs to be tested	2
• Demonstrates a basic understanding of effective fault finding • Considers the need for testing of components	1

Sample answer:

Initially use a voltmeter to ensure the power supply is operational and delivering the correct voltage required.

Isolate the circuit from the supply and use a continuity tester to ensure that the fuse has not open circuited, the switch functions correctly, all connecting wires are intact and that the integrity of the circuit is not compromised.

Finally, use an ohmmeter to check each individual resistor and the lamp. The continuity tester may also be used to test the lamp.

Voltmeter is also accepted for fault finding before and after each component with respect to polarity.

Question 18 (a)

Criteria	Marks
• Demonstrates a thorough understanding of the functioning of switching in a lighting circuit • Shows the effect each switch has on the others in the given circuit	3
• Demonstrates a sound understanding of the functioning of switching in a lighting circuit • Describes the function of each switch in the given circuit	2
• Demonstrates a basic understanding of the functioning of switching in a lighting circuit • Identifies ONE switching function in the given circuit	1

Sample answer:

S_1 is a master switch that controls the whole circuit. S_2 and S_3 will not function if S_1 is open. S_2 and S_3 act as two way switching where either switch can turn the light on or off when S_1 is closed.

Question 18 (b)

Criteria	Marks
• Demonstrates an extensive understanding of the isolation procedure for a lighting circuit	4
• Demonstrates a sound understanding of the isolation procedure for a lighting circuit	2–3
• Demonstrates a basic understanding of the isolation procedure for a lighting circuit	1

Sample answer:

- Identify the circuit to be isolated at the appropriate MSB or DB
- Notify any person affected by isolation of the circuit
- Test the test equipment on a known source, eg voltmeter, test lamps
- De-energise the lighting circuit by turning off circuit breaker, RCD, RCBO or remove HRC fuse
- Lock out and danger tag the circuit isolator to ensure personal safety
- Test that the circuit is de-energised
- Re-test the test equipment on a known source to ensure correct operation
- The lighting circuit is now considered safe for work to be carried out.

Question 19

Criteria	Marks
• Provides an extensive explanation of the first-aid procedure to treat a victim of low-voltage electric shock • Uses correct industry terminology	4
• Provides a sound explanation of the first-aid procedure to treat a victim of low-voltage electric shock • Uses industry terminology	2–3
• Provides a basic explanation of the first-aid procedure to treat a victim of low-voltage electric shock • Uses non industry specific terminology	1

Sample answer:

Check the victim is isolated from the source of electricity to ensure you are in no danger of harm while treating the victim. If possible isolate the electrical source otherwise use a non-conductive instrument, eg plastic hook, dry and clean wooden pole, to remove victim from source.

D – awareness of danger to self and others
R – response from patient
S – send for a health professional
A – check airway for blockages
B – check if patient is breathing
C – If not breathing, perform cardiopulmonary resuscitation (CPR)
D – use a defibrillator if appropriate or available

Electric current can damage vital organs so the victim must be referred to hospital for ongoing monitoring and treatment.

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 OR correct answer using incorrect units	2
• Provides correct formulae OR correct substitution of values	1

Sample answer:

$R_T = [(R_1 + R_2)^{-1} + (R_3 + R_4)^{-1}]^{-1} + R_5 = [(40 + 80)^{-1} + (30 + 60)^{-1}]^{-1} + 20 = 71.43\Omega$

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 OR correct answer using incorrect units	2
• Provides correct formulae OR correct substitution of values	1

Sample answer:

$I_1 (R_1 + R_2) = I_2 (R_3 + R_4)$

$I_2 = I_1 (R_1 + R_2) / (R_3 + R_4) = 0.72 \times (40 + 80) / (30 + 60) = 0.96A$

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 OR correct answer using incorrect units	2
• Provides correct formulae OR correct substitution of values	1

Sample answer:

$I_T = I_1 + I_2 = 0.72 + 0.96 = 1.68A$

$P = I^2R = 1.68^2 \times 20 = 56.45\ W$

Question 20 (d)

Criteria	Marks
• Provides correct formulae AND correct substitution of values OR provides a correct answer using correct units	2
• Provides correct formulae OR correct substitution of values	1

Sample answer:

$\tau = RC = 2.5\ M\Omega \times 0.1\ \mu F = 0.25\ S$

Question 20 (e)

Criteria	Marks
• Provides correct formulae AND correct substitution of values OR provides a correct answer using correct units	2
• Provides correct formulae OR correct substitution of values	1

Sample answer:

Time $= 5\tau = 5 \times 0.25 = 1.25\ S$

NOTE: substituting an incorrect value from Question 19 (d) but using correct methodology allows full marks.

Section III

Question 21

Criteria	Marks
• Demonstrates an extensive understanding of WHS inductions and policies using a range of examples • Provides a logical and clear response that shows how worker safety can be improved by effective WHS and other policies • Uses correct industry terminology	13–15
• Demonstrates a thorough understanding of WHS inductions and/or policies using a range of examples • Provides a logical and clear response that shows how worker safety can be improved by effective WHS and other policies • Uses correct industry terminology	10–12
• Demonstrates a sound understanding of WHS inductions and/or policies using some examples • Provides a logical response that shows how worker safety can be improved by effective WHS and other policies • Uses relevant industry terminology	7–9
• Demonstrates some understanding of WHS inductions and/or policies using an example • Provides a response that shows how worker safety can be improved by effective WHS and other policies • Uses some industry terminology	4–6
• Demonstrates a basic understanding of WHS inductions and/or policies • Provides a response that shows how safety can improve a work site • Uses non industry specific terminology	1–3

Answers could include:

WHS inductions:

- Types of inductions
  - General
  - Site/section/department specific
  - White card
  - Safety.
- Reasons for WHS induction
  - Improve worker safety
  - Reduce LTI (lost time injury)
  - Reduce cost to company/employer.
- Time taken for WHS induction is less than any LTI therefore is time/cost effective

- Cost of WHS inductions is less than:
  - payout of workers compensation
  - increased insurance costs
  - loss of work time
  - repair and loss of equipment and materials.

Workplace policies:

- Depends on site eg noisy environment requires hearing protection policy, dusty environment may require PPE for vision and breathing
- WHS induction policy can reduce LTI
- Isolation policy can reduce exposure to serious injury
- Bullying policy can lead to improved worker satisfaction
- Inclusive workplace policies
  - Gender, culture, religion, ethnicity etc
- Improvement in productivity
  - Happier workers
  - Better understanding of work practices and site procedures
  - Reduced costs in legal issues and insurances
  - Decrease in staff turnover
  - Improvement in teamwork and reduction in lost time during mediation as a result of conflict
  - Creation of a collegial work relationship
  - Improvement in standard of work and a reduction in remediation work needed.

While inductions and policies may take time to deliver, implement, maintain and review, ultimately this is beneficial as workers are able to remain fit and healthy thus leading to better standard of living and allowing companies to re-invest in their workplace.

Section IV

Question 22 (a)

Criteria	Marks
• Demonstrates a sound understanding of the term ‘carbon footprint’	2
• Demonstrates a basic understanding of the term ‘carbon footprint’	1

Sample answer:

Carbon footprint refers to the amount of CO_2, CO and green house gases released into the atmosphere by a product or item over its entire lifetime, ie energy used to construct the item during the lifetime and disposal of the product.

Question 22 (b)

Criteria	Marks
• Demonstrates an extensive understanding of the process of carrying out an energy audit • Considers a range of areas that use energy in the proposal • Uses industry standard terminology	4
• Demonstrates a sound understanding of the process of carrying out an energy audit • Considers some areas that use energy in the proposal	2–3
• Demonstrates a limited understanding of the process of carrying out an energy audit • Considers one area of energy use in the proposal	1

Answers could include:

The energy audit needs to consider all facets of the operation of the resort.

When measuring the usage of electricity, the monitoring needs to be done over a range of times to consider peak periods of use. This could be done by installing energy audit instruments in individual circuits or on pieces of equipment.

For example:
- lighting circuits
- air conditioning/heating/climate control
- kitchen areas for stoves, refrigeration
- laundry for washers and dryers
- pumps to move water and waste water around the resort.

Other areas that use energy such as transport, waste disposal would need to be analysed.

The amount of fuel used by the diesel generator would be an important part as this is the area to be reduced.

This could all then be collated to determine areas that would give the best outcomes with a change during refurbishment.

Question 22 (c)

Criteria	Marks
• Demonstrates an extensive understanding of the energy requirements of equipment and processes throughout the resort • Considers the effect of refurbishment choices on energy consumption and generation • Uses industry standard terminology	9
• Demonstrates a thorough understanding of the energy requirements of equipment and processes throughout the resort • Considers the effect of a range of options on energy consumption AND/OR generation • Uses industry standard terminology	7–8
• Demonstrates a sound understanding of the energy requirements of equipment AND/OR processes throughout the resort • Considers a range of options to reduce energy consumption • Uses some industry standard terminology	5–6
• Demonstrates a basic understanding of the energy requirements of equipment AND/OR processes throughout the resort • Identifies a range of options to reduce energy consumption	3–4
• Demonstrates a limited understanding of the energy requirements of equipment or processes throughout the resort	1–2

Answers could include:

The following areas of consideration should be related back to the effect of reducing demand on the diesel generator.

- Electrical energy generation:
  - Installation of solar panels
  - Installation of wind turbines
  - Other appropriate energy generation
    - Water turbine off water supply
    - Incineration of waste for power or water heating
    - Methane from sewerage/food waste
  - Installation of battery storage
- Reduction of energy consumption
  - Lighting
    - LED
    - Timers
    - Sensors
  - Energy efficient pumps, air-conditioning
  - Insulation of buildings
  - Water heating methods
- Work practices
  - Reduce, reuse, recycle
    - Food

    - Housekeeping eg laundry
  - Education and training on sustainability practices
  - Planning/timing of work tasks and resort operations
- Designing/planning of the resort refurbishment structure and grounds
  - Energy efficient building practices
    - Passive heating and cooling
    - Layout of buildings, ie consider efficient movement of people and equipment
    - Watering of gardens, eg type of plants and method of irrigation, eg less watering = less pump use.

2019 HSC Electrotechnology
Mapping Grid

Section I

Question	Marks	HSC content – focus area	Employability skills (Please put an X where appropriate)							
			Communication	Teamwork	Problem-solving	Initiative and enterprise	Planning and organising	Self-management	Learning	Technology
1	1	Direct current circuits — measuring and testing – page 42	X		X				X	
2	1	Safety — risk management – page 54	X		X					
3	1	Direct current circuits — electrical concepts (basic) – page 37	X		X				X	
4	1	Drawings, diagrams and compliance — relationship to building construction work – page 49	X				X			X
5	1	Working in the industry — energy sector worker – page 68		X		X				
6	1	Working in the industry — working with others – page 69	X	X		X		X		
7	1	Components, tools and equipment — fixing, securing and mounting accessories – page 32			X				X	
8	1	Components, tools and equipment — hand and power tools – page 30							X	X
9	1	Working in the industry — working with others – page 69	X	X		X				
10	1	Safety — safe work practices and procedures – page 55–56			X					X
11	1	Working in the industry — employment – page 67	X				X		X	
12	1	Working in the industry — energy sector worker – page 68	X		X				X	
13	1	Working in the industry — anti-discrimination – page 70	X	X				X		
14	1	Components, tools and equipment — hand and power tools – page 30			X		X			X
15	1	Direct current circuits — energy and power – page 38			X				X	X

Section II

Question	Marks	Unit of competency / Element of competency	Employability skills (Please put an X where appropriate)							
			Communication	Teamwork	Problem-solving	Initiative and enterprise	Planning and organising	Self-management	Learning	Technology
16 (a)	2	Drawings, diagrams and compliance — compliance – page 49–50	X						X	X
16 (b)	3	Components, tools and equipment — hand and power tools – page 31			X		X		X	
17 (a)	3	Drawings, diagrams and compliance — electrical drawings and diagrams – page 48–49			X		X		X	
17 (b)	3	Direct current circuits — problem-solving – pages 44–45 Working in the industry — energy sector worker – page 68			X				X	X
18 (a)	3	Drawings, diagrams and compliance — electrical drawings and diagrams – page 48–49	X		X				X	X
18 (b)	4	Working in the industry — energy sector worker – page 68	X	X	X		X			X
19	4	Safety — incidents, accidents and emergencies – page 56–57	X	X		X		X		
20 (a)	3	Direct current circuits — series/parallel circuits – page 40	X		X				X	X
20 (b)	3	Direct current circuits — series/parallel circuits – page 40	X		X				X	X
20 (c)	3	Direct current circuits — series/parallel circuits – page 40	X		X				X	X
20 (d)	2	Direct current circuits — capacitance – page 44	X		X				X	X
20 (e)	2	Direct current circuits — capacitance – page 44	X		X				X	X

Section III

Question	Marks	Unit of competency / Element of competency	Employability skills (Please put an X where appropriate)							
			Communication	Teamwork	Problem-solving	Initiative and enterprise	Planning and organising	Self-management	Learning	Technology
21	15	Safety — safe work practices and procedures – page 55 Components, tools and equipment — hand and power tools – page 30 Working in the industry — working with others – page 69	X	X	X		X	X		

Section IV

Question	Marks	Unit of competency / Element of competency	Employability skills (Please put an X where appropriate)							
			Communication	Teamwork	Problem-solving	Initiative and enterprise	Planning and organising	Self-management	Learning	Technology
22 (a)	2	Sustainability — environment – issues and sustainability – page 60	X						X	X
22 (b)	4	Sustainability — energy sector workplace – page 61			X		X			X
22 (c)	9	Sustainability — energy sector workplace – page 61–62 Working in the industry — energy sector worker – page 67–68 Sustainability — environment – issues and sustainability – page 60 Sustainability — sustainable energy – page 60–61	X	X		X	X			X