NSW Education Standards Authority

2023 HIGHER SCHOOL CERTIFICATE EXAMINATION

Electrotechnology

General Instructions
- Reading time – 5 minutes
- Working time – 2 hours
- Write using black pen
- Calculators approved by NESA may be used
- Write your Centre Number and Student Number at the top of this page and pages 9, 11 and 13

Total marks: 80

Section I – 15 marks (pages 2–5)
- Attempt Questions 1–15
- Allow about 20 minutes for this section

Section II – 35 marks (pages 9–15)
- Attempt Questions 16–20
- Allow about 50 minutes for this section

Section III – 15 marks (page 17)
- Attempt Question 21
- Allow about 25 minutes for this section

Section IV – 15 marks (page 18)
- Attempt Question 22
- Allow about 25 minutes for this section

Section I

15 marks
Attempt Questions 1–15
Allow about 20 minutes for this section

Use the multiple-choice answer sheet for Questions 1–15.

1 Which of the following tools should be used to measure the diameter of a 2.5 mm^2 solid round copper conductor to an accuracy of 0.1 mm?

    A.   Ruler

    B.   Tape measure

    C.   Jenny calipers

    D.   Vernier calipers

2 Which of the following is the most appropriate tool to use when undoing a hexagonal head bolt?

    A.   Pliers

    B.   Spanner

    C.   Multi-grip

    D.   Stock and die

3 Which form should be completed after the final testing of a main switchboard?

    A.   Job safety analysis (JSA)

    B.   Standard operating procedures (SOP)

    C.   Safe work method statement (SWMS)

    D.   Certificate of Compliance Electrical Work (CCEW)

4 What unit of measurement is used in a floor plan?

    A.   Centimetre

    B.   Kilometre

    C.   Metre

    D.   Millimetre

5   Which of the following is a non-renewable energy source?

    A.   Wind

    B.   Biomass

    C.   Natural gas

    D.   Geothermal

6   Which type of drawing shows the layout and location of incoming consumer mains from the point of supply?

    A.   Site plan

    B.   Floor plan

    C.   Specification

    D.   Detail drawing

7   Which of the following would be the most appropriate fixing device for attaching a speaker weighing 3 kg to a hollow plasterboard wall?

    A.   Pop rivet

    B.   Coach bolt

    C.   Toggle bolt

    D.   Wood screw

8   Which equation should be used to calculate power losses in a cable?

    A. $P = IR$

    B. $P = I^2R$

    C. $P = V^2R$

    D. $P = \dfrac{V}{R}$

9   Why would a consumer install battery banks in an existing residential solar system?

    A.   To create a long-term benefit

    B.   To meet legislative requirements

    C.   To meet environmental requirements

    D.   To increase the solar panels' production of electricity

10   Which of the following is required to cut an external thread on a mild steel rod?

    A.   Metric cutter

    B.   Stock and die

    C.   Thread cutter jig

    D.   Tap and thread wrench

11   What is the purpose of a switching chart?

    A.   To develop wiring diagrams

    B.   To identify the links between terminals of switches

    C.   To determine the number of switches in a cable schedule

    D.   To identify the current rating of the various types of switches

12   Which of the following will lower the consumption of electricity in a household?

    A.   Using battery storage

    B.   Conducting an energy audit

    C.   Using green energy sources

    D.   Changing to energy-efficient appliances

13 Which of the following is the correct description of an M12 × 1.5 thread?

    A.   Metric, 12 mm diameter, 1.5 mm pitch

    B.   Metric thread, 12 mm long, 1.5 mm pitch

    C.   Mild steel, 12 mm diameter, 1.5 mm thick

    D.   Mushroom head, 12 mm long, 1.5 mm thick

14 Two resistors, A and B, are connected in series across a 12-volt DC supply.

What would be the voltage drop across resistor B if resistor B has three times the resistance of resistor A?

    A.   3 volts

    B.   6 volts

    C.   9 volts

    D.   12 volts

15 What is the result when a closed circuit occurs in a basic DC single path circuit?

    A.   No current flows.

    B.   The total resistance decreases.

    C.   The voltage across the switch falls to zero.

    D.   The protection device closes the circuit after a short time.

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Electrotechnology

Section II

35 marks
Attempt Questions 16–20
Allow about 50 minutes for this section

Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response.

Show all relevant working in questions involving calculations.

Question 16 (5 marks)

(a) Identify the personal protective equipment (PPE) required when cutting galvanised sheet metal with an angle grinder. **2**

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(b) Compare the methods of using a *pop rivet* and a *nut and bolt* to join sheet metal. **3**

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Question 17 (4 marks)

The resistivity of copper is given as $(\rho) = 1.72 \times 10^{-8}\ \Omega\,\text{m}$ at 20°C.   **4**

Calculate the length of a 4 mm^2 copper conductor needed to equal half the resistance of a 50 m × 1.5 mm^2 copper conductor.

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Section II (continued)

Question 18 (5 marks)

(a) Noise issues can arise during excavation on a worksite.

Identify a verbal method and a non-verbal method to effectively communicate with workers on the worksite.

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(b) Outline the effects of excessive noise on a worker in the electrotechnology industry. In your answer, include both short and long-term effects.

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Question 19 (7 marks)

(a) Outline the benefits of using block diagrams to develop circuit diagrams. **2**

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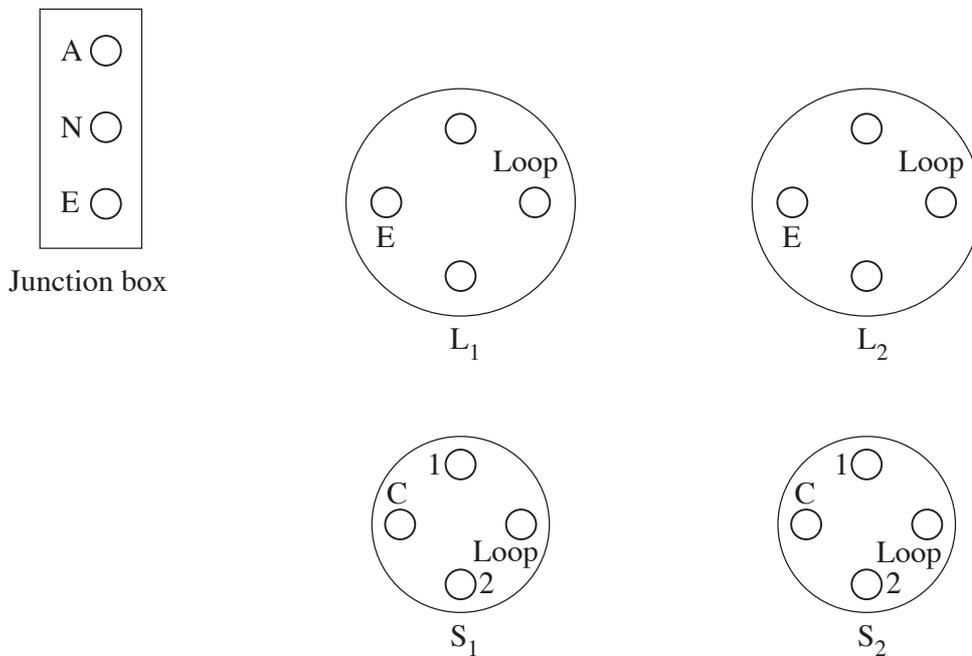..

(b) The circuit diagram shows two lights that are independently switched. **5**
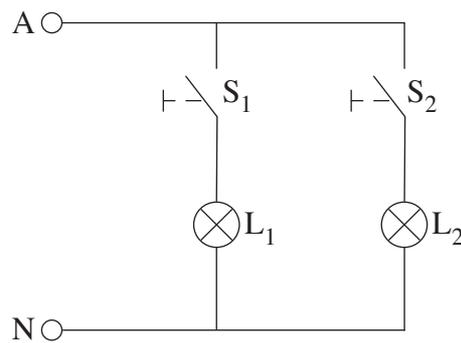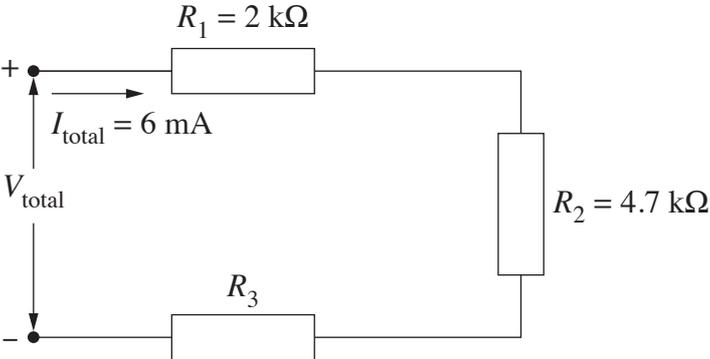

Convert this circuit diagram into a wiring diagram using the 'loop at the light' method. A TPS twin plus earth cable runs from a junction box to the two lighting points and a two core TPS cable runs between the lighting point to the switch.

Question 20 (14 marks)

Refer to the diagram to answer parts (a)–(e).

$R_1 = 2 \text{ k}\Omega$

$I_{total} = 6 \text{ mA}$

V_{total}

$R_2 = 4.7 \text{ k}\Omega$

R_3

(a)   Determine the current flow I_1 through the resistor R_1 AND I_2 through the resistor R_2.

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(b)   Calculate the resistance of R_3 if V_{total} is 50 V.

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Question 20 (continued)

(c) Calculate the voltage drop of resistor R_2 if $I_1 = 4$ mA.   **3**

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(d) Calculate the power dissipated in the circuit if $R_3 = 3$ kΩ and $I_{total} = 6$ mA.   **3**

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(e) Calculate the current flow through the resistor R_2 if the V_{total} is 80 V and R_3 is short-circuited.   **3**

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End of Question 20

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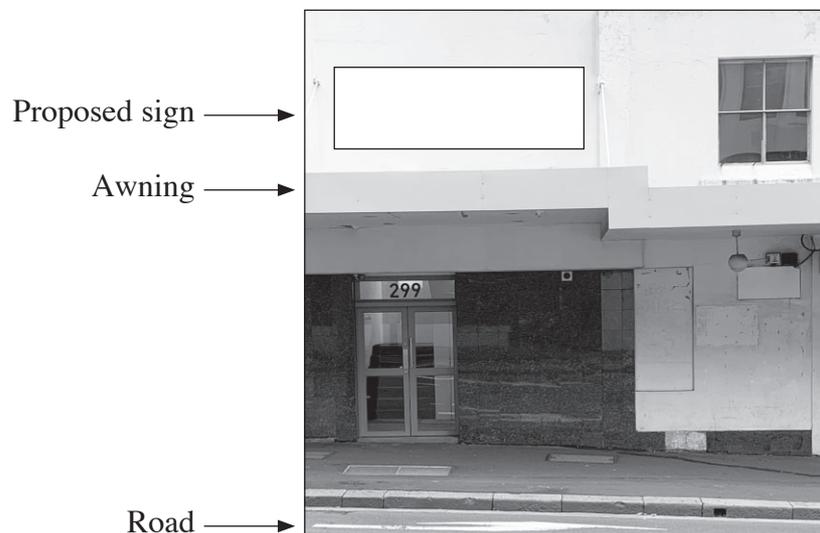# Electrotechnology

Section III

15 marks
Attempt Question 21
Allow about 25 minutes for this section

Answer the question in a writing booklet. Extra writing booklets are available.

Question 21 (15 marks)

The image shows a shop that is to have an LED sign installed above an awning.

- The LED sign is 3000 mm long × 1000 mm high and has to be fixed to a solid double-brick wall.

- The awning is able to support workers and the equipment required.

- The LED sign weighs 30 kg and has a 12 mm waterproof plywood back.

- The electrical feed has already been installed to an isolating switch on the wall.

(a) Describe an appropriate method of fixing the sign to the wall. In your answer, include the tools and materials required. **6**

(b) Describe the information that would be in the Safe Work Method Statement (SWMS) for this project, from the preparation of the site, to the installation and commissioning of the LED sign. **9**

Please turn over

Section IV

15 marks
Attempt Question 22
Allow about 25 minutes for this section

Answer the question in a SEPARATE writing booklet. Extra writing booklets are available.

Your answer will be assessed on how well you:
- demonstrate knowledge and understanding relevant to the question
- communicate ideas and information using relevant workplace examples and industry terminology
- present a logical and cohesive response

Question 22 (15 marks)

Changes in technology create significant challenges for businesses within the electrotechnology industry.

Explain how businesses are addressing these changes while ensuring that they maintain environmentally sustainable practices.

In your answer, refer to materials, processes and/or legislation.

End of paper