

**8202-30 Level 3 Advanced Technical Certificate in Electrical Installation**  
 8202-531 Level 3 Electrical Installation – Theory Exam

June 2022 Mark Scheme

<b>1</b>	
List <b>three</b> technical specifications relating to the selection of a wall mounted light switch when recording on a materials list.	AO1 (3 marks)
LO (unit title): 301 Planning and overseeing work activities.	Test spec: 8202.301.03.02
<p>Answers          Any three (<b>1 mark each</b>);</p> <ul style="list-style-type: none"> <li>• Gangs or number of switches incorporated</li> <li>• Ways or switching operation</li> <li>• Function</li> <li>• Finish or colour or material</li> <li>• Type (e.g. grid, plate, surface, flush etc)</li> </ul> <p>Any other suitable answer but do not allow duplicate marks where same feature is given more than one name.</p>	

<b>2</b>	
State the <b>two</b> types of losses associated with a transformer core.	AO1 (2 marks)
LO (unit title): 302 Principles of electrical science.	Test spec: 8202.302.01.04
<p>Answers          The two acceptable (<b>1 mark each</b>);</p> <ul style="list-style-type: none"> <li>• Iron</li> <li>• Copper</li> </ul> <p>Will accept eddy current loss <b>or</b> hysteresis as alternatives to iron loss but no other answers are acceptable. If eddy current loss or hysteresis is given with iron loss, 1 mark only.          Will also accept heat loss as an alternative to copper loss. Question does state 'the two', so <b>mark first two if more given.</b></p>	

**3**

State **two** types of single-phase AC motor.

AO1  
(2 marks)

LO (unit title): 302 Principles of electrical science.

Test spec: 8202.302.03.02

Answers

Any two from **(1 mark each)**;

- Capacitor start
- Split phase
- Universal
- Induction

Accept induction and split-phase or capacitor start separate answers for 1 mark each even though each are induction motors. Accept squirrel cage as alternative to induction or wound for universal.

**4**

State **two** types of fuse commonly found in electrical installations protecting circuits.

AO1  
(2 marks)

LO (unit title): 302 Principles of electrical science.

Test spec: 8202.302.03.04

Answers

Any two from **(1 mark each)**;

- HRC or HBC
- Cartridge
- Semi-enclosed or rewirable
- Plug fuse

Accept BS numbers as alternative answers. Do not accept duplicates e.g., BS88-3 and Cartridge; or BS88-3 (or BS88) and BS1361, as separate answers. Mark first two only and these must be fuses for the marks.

**5**

List **three** protective conductors commonly installed in electrical installations as given in BS 7671.

AO1  
(3 marks)

LO (unit title): 303 Electrical design and installation practices and procedures.

Test spec: 8202.303.02.01

Answers

Any three from **(1 mark each)**;

- Earthing conductor
- Main protective bonding conductor
- cpc
- Supplementary equipotential bonding conductor
- High integrity protective conductor
- Protective bonding conductor

Accept variations that are fully understandable and cannot be misunderstood. Do not accept functional earth as this is not protective.

**6**

List the first **three** tests carried out on a newly installed radial lighting circuit.

AO1  
(3 marks)

LO (unit title): 304 Principles of inspection, testing and commissioning electrical systems.

Test spec: 8202.304.02.01

Answers

Acceptable answers are **(1 mark each)**;

- Continuity (or continuity of conductors)
- Insulation resistance
- Polarity

No other answers acceptable - order not important. Do not accept continuity of bonding etc or ring final.

**7**

List **three** documents that would assist in fault diagnosis which are to be kept by the client.

AO1  
(3 marks)

LO (unit title): 306 Electrical system fault diagnosis and rectification.

Test spec: 8202.306.02.01

Answers

Any three (**1 mark each**);

- Electrical installation certificates
- Periodic reports or electrical installation condition reports
- Operation manuals or manufacturers data
- Fault reports
- Planned maintenance schedules

Exact wording not essential and other similar or separate documents allowed such as schedule of test results but no duplications such as inspection schedule for periodic and inspection schedule for certificate.

If electrical installation certificate (or EICR) is given and schedules as alternatives, one mark only as these form one document.

**8**

List **three** factors that affect the decision between repairing or replacing a faulty item of equipment.

AO1  
(3 marks)

LO (unit title): 306 Electrical system fault diagnosis and rectification.

Test spec: 8202.306.05.01

Answers

Any three (**1 mark each**);

- Cost
- Availability
- Downtime
- Legal responsibility
- Safety responsibility
- Accessibility
- Frequency of use

Other suitable but do not accept duplications such as cost to repair, cost to replace as this would attract one mark only or how badly it is damaged (simple language for quantifying) for 1 mark.

**9**

State the **two** methods of providing Basic Protection within a dwelling in accordance with BS 7671.

AO1  
(2 marks)

LO (unit title): 307 Requirements for electrical installations.

Test spec: 8202.307.02.01

Answers

Any two from **(1 mark each)**;

- Insulation
- Barriers or enclosures
- SELV

Barriers and enclosures only count as one mark and must be given in full for the one mark. If barriers and enclosures are given as two separate items, one mark only. Obstacles or placing out of reach not acceptable for a dwelling. (restrict to first two answers but take care to keep barriers and enclosures as one answer. Eg. barriers, enclosures is 1 mark only but could be presented as two answers.

**10**

List **three** labels, as given in BS 7671, that would be located on the installation consumer unit at the origin of an electrical installation.

AO1  
(3 marks)

LO (unit title): 307 Requirements for electrical installations.

Test spec: 8202.307.03.01

Answers

Any three **(1 mark each)**;

- Periodic test notice
- RCD test notice
- Alternative supplies
- Voltage label
- Mixed wiring colours

Other suitable notices or labels. Accept circuit chart even though this is not a label. Do not accept bonding label as this would not be on the consumer unit. Do not accept sections/parts of a circuit chart. Do not apply first three rule as many could be complex descriptions.

11

A 20 kVA transformer has a turns ratio of 8:3 and an input voltage of 400 V single-phase.  
Determine the output current.

AO2  
(3 marks)

LO (unit title): 302 Principles of electrical science

Test spec: 8202.302.01.05

Answers

$$\frac{20000}{400} = 50A \text{ input (1)}$$

$$\frac{8}{3} = \frac{I}{50} \text{ so } \frac{50 \times 8}{3} \text{ (1)} = 133.33 A \text{ (1)}$$

12

Determine, for the circuit shown in figure 1, the circuit

- a) supply current ( $I_s$ )
- b) power factor

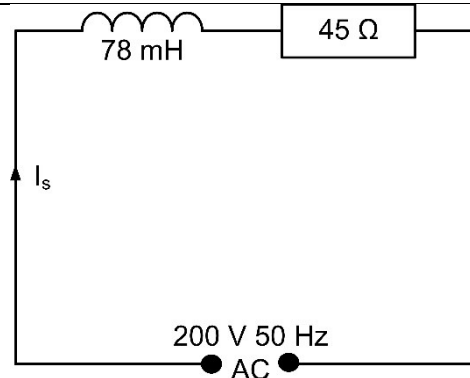


Figure 1

AO2  
(4 marks)  
(1 mark)  
5 total

LO (unit title): 302 Principles of electrical science

Test spec: 8202.302.02.02 & 03

Answers

$$2\pi \times 50 \times 78 \times 10^{-3} = 24.5 \Omega \text{ (2)}$$

$$\sqrt{45^2 + 24.5^2} = 51.23 \Omega \text{ (1)}$$

$$\frac{200}{51.23} = 3.9 A \text{ (1)}$$

$$\frac{45}{51.23} = 0.88 \text{ (1)}$$

Allow 1 mark only for recalling basic formula (with or without figures).

If formula is incorrect in stage 1 or 2, marks for answers should not be given or carried over. If correct formula used but wrong answer, carry over value.

Accept values without units of measure if values are correct.

**13**

A three-phase installation had the following load characteristics.

L1 = 45 A

L2 = 72 A

L3 = 66 A

AO2  
(4 marks)

Determine the resulting neutral current.

LO (unit title): 302 Principles of electrical science

Test spec: 8202.302.02.04

Answers

Answers may use calculation or graphical means to calculate current.

$$N = \sqrt{45^2 + 72^2 + 66^2 - (45 \times 72) - (45 \times 66) - (72 \times 66)} = 24.55 \text{ A}$$

Award marks for the following levels of accuracy;

- (accurate) 23.5 A to 25.5 A (4)
- (fairly accurate) 21 to 23.5 A or 25.5 to 28 A (3)
- Correct calculation or graphics with values but incorrect answer (2)
- Vague attempt at recalling graphic or calculation (formula must be some way to being correct) (1)

**14**

Determine the illuminance level on a surface 3 m directly below a lamp having a luminous intensity of 800 candela.

AO2  
(3 marks)

LO (unit title): 302 Principles of electrical science

Test spec: 8202.302.04.01

Answers

$$\frac{800}{3^2} (1) = 88.9 (1) \text{ lux}(1)$$

**15**

Explain the difference between an earth fault and a short circuit including if circuit breakers or RCDs operate under each condition.

AO2  
(4 marks)

LO (unit title): 303 Electrical design and installation practices and procedures

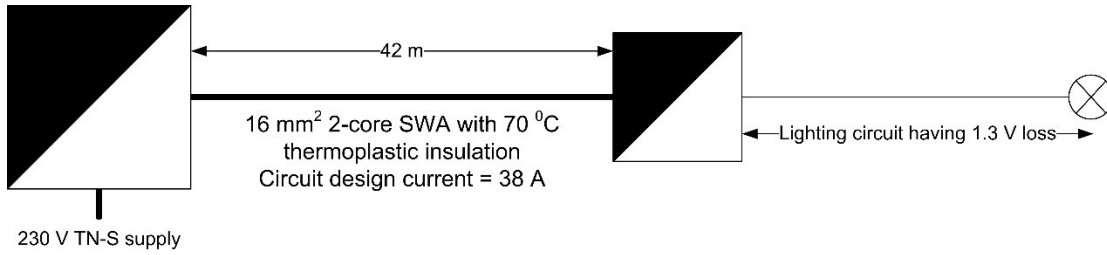
Test spec: 8202.303.03.01

Answers

Explanation to include the following points for **1 mark each**;

- Earth fault is low impedance path between live (or line) and earth
- Short is low impedance path between live conductors
- If impedance between line and earth is low enough, circuit breaker will operate for both
- RCDs will not detect short circuits

16



AO2  
(2 marks)

Figure 2

Determine the overall voltage drop across the distribution and final circuit shown in figure 2.

LO (unit title): 303 Electrical design and installation practices and procedures

Test spec: 8202.303.04.01-02

Answers

$$\frac{2.8 \times 42 \times 38}{1000} = 4.46 V(1)$$
$$4.46 + 1.3 = 5.7 V(1)$$

Answers within 1 V +/- acceptable.

If incorrect VD in stage 1, carry this over for marks in stage 2 but formula in stage 1 must be correct.

17

A continuity of ring-final circuit test is being undertaken during an initial verification. During step 1, the following measurements were made

- $r_1 - 0.8 \Omega$
- $r_n - 0.8 \Omega$
- $r_2 - 1.34 \Omega$

Explain the relationship between these results and the expected results when line and neutral are cross connected and tested at each socket-outlet.

AO2  
(3 marks)

LO (unit title): 304 Principles of inspection, testing and commissioning electrical systems

Test spec: 8202.304.02.04

Answers

The results indicate a reduced size cpc in the circuit and Line and N are the same **csa** (1 for some of this relationship).

$$\frac{0.8 + 0.8}{4} (1) = 0.4 \Omega (1)$$

0.4  $\Omega$  expected at each socket-outlet between line and neutral.



18

Explain why the earthing conductor must be disconnected from the installation main earthing terminal whilst undertaking a test to obtain a value of  $Z_e$ .

AO2  
(3 marks)

LO (unit title): 304 Principles of inspection, testing and commissioning electrical systems

Test spec: 8202.304.03.02

Answers

Answers to cover the following points (1 mark each);

- remove parallel paths
- through other services or metallic parts (answer must indicate a path)
- ensure only electrical earth is providing low impedance

Similar descriptions may be given but marked on strength of description.

19

Figure 3 shows the intended location of a new socket-outlet within a room, as requested by the client. The cable used to supply the socket-outlet is to be concealed in the plastered wall to a depth of 35 mm and run from point A in the ceiling void above.

Describe how to run the cable from point A to the socket in compliance with BS 7671, including any further protection required.

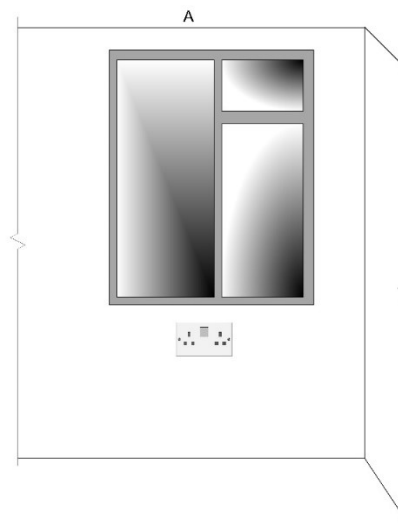


Figure 3

AO2  
(7 marks)

LO (unit title): 307 Requirements for electrical installations

Test spec: 8202.307.03.01

Answers

Suitable answer to include detail of;

- cable run above window within 150 mm of ceiling (or above ceiling) (2 marks if both options explored)
- cable to be run within 150 mm (1) of corner of the walls(1)
- cable to be run directly horizontal to socket-outlet (1)
- cable/circuit to be protected by 30 mA RCD (1) known as Additional Protection (1)
- Identifying that the cable is **less than 50 mm** so requires measures of some type

Alternatively, description may take route to the left of the window but description must include earthed metallic covering for duration of route up to the socket (to enable earthing).

Accept diagrams as an alternative answer but must include dimensions for the marks.

Figure 4 shows the complete earth fault loop path and supply network for a radial power circuit in an electrical installation.

(15 marks)

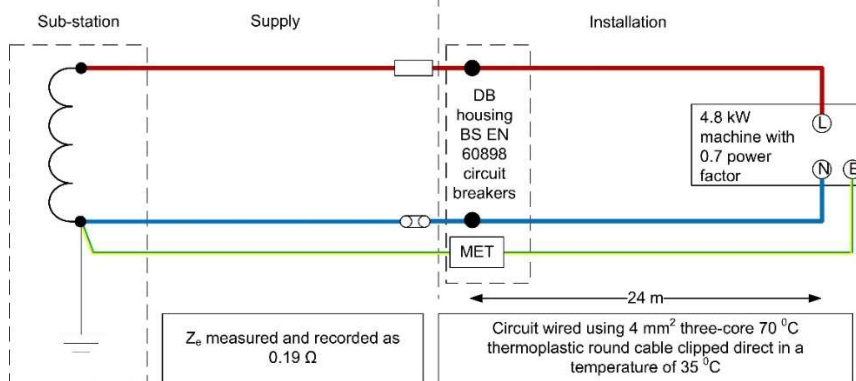


Figure 4

Evaluate the 230 V single-phase circuit for compliance with BS 7671 in terms of current capacity, voltage drop and disconnection under earth fault conditions.

**LO (unit title): 307 Requirements for electrical installations**

**AO4 (see below for test spec references)**

**Band 1 (1-5 marks)**

Poor coverage of the question with no or basic calculations undertaken but may have recalled some points in the process by showing basic formula required. Very few points considered with little relevance or sequence. Limited use of reference materials and little or no evidence that the relevant information can be used in the calculations. No conclusions drawn.

**Access to higher marks**

Very few calculations undertaken with few correctly identified stages in the process. Demonstrated limited ability in researching values such as tabulated values, installation methods, voltage drop tolerances and some rating factors or data from BS 7671.

**Band 2 (6 – 10 marks)**

Some coverage of the question shown with limited calculations or near full coverage with in-accurate calculations. Logical sequence followed, linking stages but with some inaccuracies. Appropriate considerations made through-out the process.

**Access to higher marks**

Most stages of the process considered with more accuracy in calculations and relevance in researched data. Logical sequence

**Indicative Content**

**Design current**

$$\frac{4800}{230 \times 0.7} = 29.81 \text{ A}$$

Protective device therefore **32 A** (consider reasoning of device type, C type more suitable for machine).

**Suitable live conductors**

Live conductor  $I_t$  from table 4D2A = 36 A

Applicable rating factor = 0.94

$I_z = 36 \times 0.94 = 33.84 \text{ A}$  which is greater than 32 A therefore suitable.

**Voltage drop**

Table 4D2B mV/A/m = 11 so

$$\frac{11 \times 24 \times 29.81}{1000} = 7.86 \text{ V}$$

As 7.86 is less than 5% of 230 V (11.5 V) this is suitable.

**Earth fault loop impedance**

Table I1 of OSG 4/4 = 9.22 mΩ/m

Table I3 factor = 1.2

$$R_1 + R_2 = \frac{9.22 \times 1.2 \times 24}{1000} = 0.27 \text{ Ω}$$

followed with most stages linked. General analysis is appropriate with some accurate references to permitted materials. Some conclusions drawn at relevant points.

**Band 3 (11 – 15 marks)**

These candidates will be able to follow all design requirements but with minor errors. Candidates will give some consideration to the location when specifying an installation method. The application of correct parameters for calculating  $Z_s$  and fault current or maximum  $Z_s$  in accordance with BS 7671.

***Access to higher marks***

These candidates will be able to determine all design requirements but with very few errors. They will make justified choices for the circuit breaker type as well as reason all aspects of the circuit design. They will also make comparisons and evaluations, justifying choice.

$$Z_s = 0.19 + 0.27 = \mathbf{0.45 \Omega Z_s}$$

Disconnection must occur within 0.4 seconds and maximum  $Z_s$  values are, depending on CB type selected from Table 41.3

- Type B – 1.37 so acceptable
- Type C – 0.68 so acceptable

Test spec references:

302.02.01  
302.02.04  
303.02.01  
303.02.02  
303.02.03  
303.04.01  
303.04.02  
303.05.06  
303.05.08  
307.02.01  
307.03.01  
307.05.02