



**Qualification: 8202 Level 3 Advanced Technical Diploma in Electrical Installation (450)**

**Exam name: 8202-031/531 Level 3 Electrical Installation - Theory exam**

**Version: April 2017**

**Exam date: 26/04/2017**

**Exam time: 09:00 – 11:00**

**Base mark: 75**

Permitted reference material;

- BS 7671 2008 (2015)
- IET On-site Guide

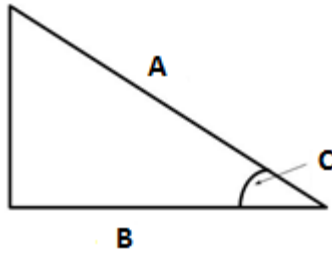
<b>1</b>	
Describe how an electrician, working as a self-employed sole trader, can prove to potential customers a level of competence.	(3 marks)
Answer; By being registered (1) as a member of a recognized (1) competent persons' scheme (1) [accept scheme names such as NICEIC, NAPIT or IET professional register]  Answers relating to references etc. from other customers are not proof of competency.	

<b>2</b>	
Calculate the approximate transformer ratio that would step down the maximum super grid voltage to 33 kV.	(3 marks)
Answer; $\frac{400 \times 10^3}{33 \times 10^3} = 12.12 \text{ therefore } 12:1$ 400 kV (1) answer (1) ratio (1)	

3

Identify what is represented by A, B and C from the impedance triangle shown.

(3 marks)



Answer;

A – Impedance

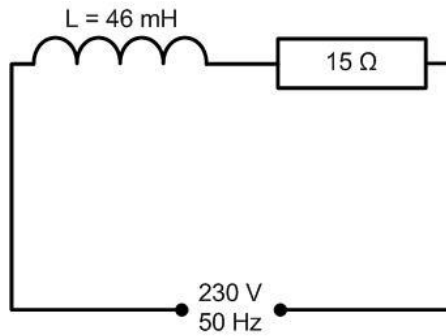
B – Resistance

C – Power Factor or cos

4

Determine, for the circuit shown below, the inductive reactance and impedance.

(3 marks)



Answer;

$$X_L = 2\pi fL = 2 \times \pi \times 50 \times (46 \times 10^{-3}) = 14.45 \text{ ohms}$$

$$Z = \sqrt{R^2 + X_L^2} = \sqrt{15^2 + 14.45^2} = 20.82 \text{ ohms}$$

$X_L$  answer 1

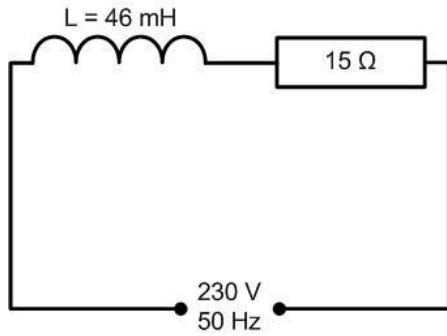
Z answer 1

Reasonable calculations 1

5

Determine, for the circuit shown below, the power factor and the voltage across the inductor.

(3 marks)



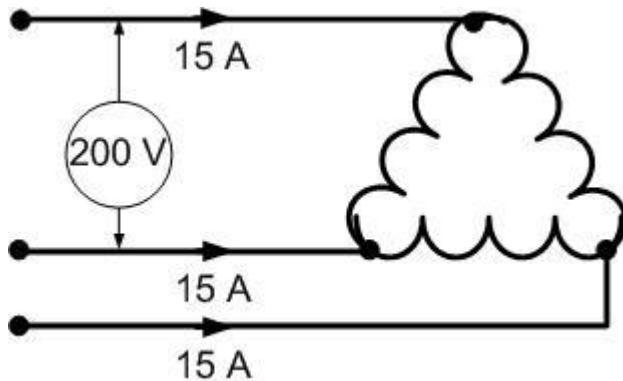
Answer;

PF =  $R/Z = 15 / 20.82 = 0.72$  (within 0.1) (1)  
Calculating current as 11 A (1) +/- 1 A  
Calculating voltage as 155.65 (1)

6

Calculate the phase current ( $I_p$ ) and phase voltage ( $V_p$ ) for the circuit shown below.

(3 marks)



Answer:

- a)  $V_p \frac{V_L}{\sqrt{3}}$  so  $V_p \frac{15}{\sqrt{3}} = 8.66 A$  (within 1 A acceptable. 1 formula, 1 answer)  
b) As  $V_p = V_L = 200 V$  (1)

7

List **three** component parts, within a d.c. compound motor, that involve a magnetic process.

(3 marks)

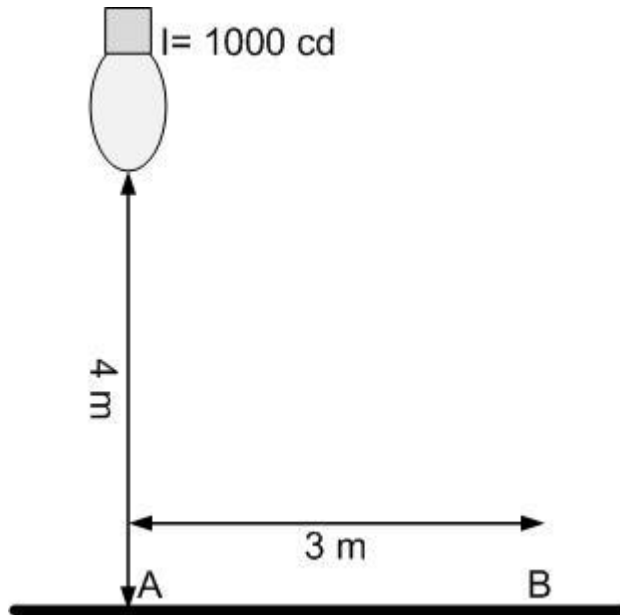
Answer;

Armature winding or rotor (1)  
Shunt or parallel winding or field (1)  
Series or in-line winding or field (1)

8

Calculate, for the luminaire shown below, the illuminance at point B.

(3 marks)



Answer;

$$E = \frac{I}{d^2} \times \cos\phi$$
$$d = \sqrt{\text{side } A^2 + \text{side } B^2}$$

$$\cos\phi = \frac{\text{side } A}{d}$$

So

$$d = \sqrt{4^2 + 3^2} = 5 \text{ m (1)}$$

$$\cos\phi = \frac{4}{5} = 0.8 \text{ (1)}$$

$$E = \frac{1000}{5^2} \times 0.8 = 32 \text{ lux (within 4 lux acceptable) (1)}$$

Summary- Hypotenuse (1)

Cos (1)

Answer within 4 lux (1)

Note- hypotenuse or cos may give wrong answers by marks are for process

<b>9</b>	
State the <b>maximum</b> permitted disconnection times for <b>each</b> of the following circuits.	
a) A 230 V, 6 A, lighting circuit on a TN system.	(1 mark)
b) A 110 V, 16 A, socket-outlet on a construction site.	(1 mark)
c) A 400 V, 45 A, pump on a TT system.	(1 mark)
Answer;	
a) 0.4 seconds (Table 41.1)	
b) 5 seconds (411.8)	
c) 1 second (Over 32 A)	

<b>10</b>	
A socket-outlet circuit in a public library is protected by a 32 A, RCBO to BS EN 61009.	
a) State the <b>most</b> suitable type to be used.	(1 mark)
b) Determine how quickly, in seconds, the RCBO would disconnect with a current of 100 A.	(1 mark)
c) State the component within the RCBO that would cause disconnection if a short circuit of 300 A occurred.	(1 mark)
Answer;	
a) Type B (C accepted with reason)	
b) Approx. 50 seconds (accept range of 30-80) if other type given in a) accept answer based on type	
c) Magnetic trip	

<b>11</b>	
a) Determine the <b>maximum</b> permissible rating for a lighting circuit containing B15 and B22 lamp-holders.	(1 mark)
b) Determine the current in the extra-low voltage section of a 12 V lighting circuit containing 3 x 50 W halogen lamps.	(1 mark)
c) Determine the <b>most</b> appropriate rating of BS 1362 fuse to be used in a fused connection unit supplying a 3 kW hand drier unit.	(1 mark)
Answer;	
a) 16 A	
b) 12.5 A	
c) 13 A (note BS 1362 fuse)	

<b>12</b>	
<p>a) An inspection is to be carried out to items within a distribution board during initial verification. Describe, for <b>each</b> of the following senses, <b>one</b> inspection that would be undertaken.</p> <p>i) Sight. ii) Touch.</p> <p>b) State the document that satisfactory inspections are recorded on.</p>	<p>(1 mark) (1 mark) (1 mark)</p>
<p>Answer;</p> <p>a) Any suitable such as i) rating of devices or ii) connection of conductors b) Inspection schedule for initial verification</p>	

<b>13</b>	
List all the test results that are entered onto a schedule of test results under the heading ring-final circuit continuity.	(3 marks)
<p>Answer; (1 mark each)</p> <p>r1 (line) rn (neutral) r2 (CPC) or accept end to end values L N E</p>	

<b>14</b>	
Explain why a test of prospective fault current is undertaken as part of an initial verification and what is meant by the rating $I_{cs}$ on a circuit breaker.	(3 marks)
<p>Answer;</p> <p>a) To confirm that the breaking/short circuit capacities (1) are higher than <math>I_{pf}</math> (1) b) Fault capacity up to which remains serviceable.</p>	

<b>15</b>	
Describe <b>two</b> requirements of GS38 regarding test leads.	(2 marks)
<p>Answer;</p> <p>Any two suitable such as</p> <ul style="list-style-type: none"> <li>• 2-4 mm probe tips</li> <li>• Finger guards</li> <li>• Fused</li> <li>• Colour</li> <li>• condition</li> </ul>	

<b>16</b>	
List <b>four</b> items of documentation, relevant to a particular electrical installation, that could be used for fault diagnosis work.	(4 marks)
<p>Answer;</p> <p>Any suitable such as</p> <ul style="list-style-type: none"> <li>• as fitted drawings</li> <li>• certification</li> <li>• previous test data</li> <li>• O&amp;M manuals</li> <li>• Manufacturers' manuals</li> <li>• Not acceptable- individual documents forming part of test data given as individual answers so if EIC and test results given as two answers, 1 mark only</li> </ul>	

<b>17</b>	
List <b>three</b> types of electrical installation work excluded from the scope of BS 7671.	(3 marks)
<p>Answer;</p> <p>Any three from regulation 110.2</p>	

<b>18</b>	
Describe <b>one</b> type of circuit that <b>must</b> have additional protection, as given in BS 7671.	(3 marks)
<p>Answer may be either;</p> <p>Socket-outlets (1) with a rating not exceeding (1) 20 A (1)</p> <p>Or</p> <p>Mobile (1) equipment rated no more than 32 A (1) for use outdoors (1)</p> <p>Or a strong description of a special location from Part 7 of BS 7671 that requires AP</p>	

<b>19</b>	
PVC trunking housing non-sheathed cables is to be installed 2 m above finished floor level in an escape route. Describe the requirements of BS 7671 with regard to the protection of the installed cables by the trunking and how the trunking is to be supported.	(4 marks)
<p>Answer;</p> <p>Trunking should provide a degree of protection of IPXXD or IP4X and the cover can only be removed by means of a tool or deliberate action.</p> <p>Any suitable IP (1) Removal method (1)</p> <p>Cables shall be supported so that they will not be liable to premature collapse in the event of a fire. Where non-metallic cable trunking is used, suitable fire resistant means of support/retention must be provided to prevent cables from falling out if there is a fire.</p> <p>Metal (1) Collapse (1)</p>	

<b>20</b>	
Describe the requirements of BS 7671 for lighting installed in Zone 0 of a swimming pool.	(2 marks)
<p>Answer;</p> <p>Description covering any two areas including</p> <ul style="list-style-type: none"> <li>• SELV</li> <li>• IPX8</li> <li>• 30 mA RCD</li> <li>• Electrical Separation</li> <li>• BS equipment</li> </ul>	



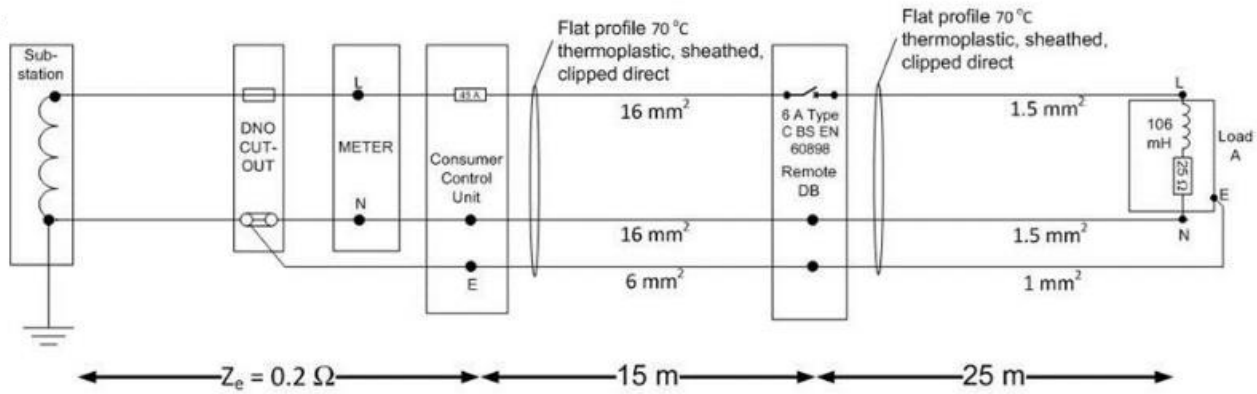


Figure 1

- a) Identify **three** important characteristics of the supply for the installation shown in Figure 1. (3 marks)
- b) Analyse the final circuit shown in Figure 1 and evaluate the suitability for loading and earth fault protection. (12 marks)

Answer;

a) Any from-  
 TN-C-S (1) single-phase or 230 V (1) PEN conductor (1) or will also accept- source electrode (1) class II protection from head to meter (1) PFC will be 1.15 kA (1)

b) Below are some of the calculations that candidates will use to analyse the data.

$$X_L = 2\pi \times 50 \times 106 \times 10^{-3} = 33.3 \Omega$$

$$Z = \sqrt{33.3^2 + 25^2} = 41.6 \Omega$$

$$I = \frac{230}{41.6} = 5.52 A$$

From OSG distribution cct 16/6- 4.23 and final cct 1.5/1- 30.20

From BS 7671 Table 41.3- max  $Z_s$  – 3.64  $\Omega$

$$\text{Distribution cct } R_1 + R_2 - \frac{4.23 \times 15 \times 1.2}{1000} = 0.076 \Omega$$

$$\text{Final cct } R_1 + R_2 - \frac{30.2 \times 25 \times 1.2}{1000} = 0.9 \Omega$$

$$\text{Total } Z_s - 0.2 + 0.08 + 0.9 = 1.18 \Omega$$

As  $3.64 > 1.18$ , disconnection will occur

Band 1	These candidates may provide answers that state that a 2.5 mm <sup>2</sup> cable is suitably protected by a 16 A circuit breaker without determining load current. Research maximum Z <sub>s</sub> values from BS 7671	1-4 marks
Band 2	Be able to determine load current OR total circuit earth loop impedance Compare load values to device ratings OR circuit loop impedance to published data	5-8 marks
Band 3	Be able to determine all load characteristics and compare to all circuit criteria including all earth fault loop impedance values Compare cable ratings from BS 7671 making assumptions of typical cable type and the application of temperature factors	9-12 marks