ET 62 - Electrician Theory Examination Marking Schedule

Notes: 1. (1 mark) means that the preceding statement/answer earns 1 mark.

2. This schedule sets out the accepted answers to the examination questions. A marker can exercise their discretion and decide on the overall accuracy of any answer that is presented in the candidate's own words.

3. Symbols and terms - alternatives

Power	W or P
Voltage	V or E or U
Phase	Active

Question 1	*Reference Marks*	*Marking notes*
(a) P = $\sqrt{3} \times V_L \times I_L \times pf$	(½ mark)	
I = $\frac{19000}{\sqrt{3} \times 400 \times 0.875}$	(½ mark)	
= 31.34A	(1 mark)	
(b) N = $\frac{60f}{P}$	(½ mark)	
= $\frac{60 \times 50}{24}$	(½ mark)	
= 125 rpm	(1 mark)	
(c) (i) It is the total opposition in Ω to the current flow in an a.c. circuit.	(1 mark)	
(ii) Any TWO of: ● Resistance (R) ● Inductive reactance (X_l) ● Capacitive reactance (X_C)	(1 mark)	
(d) Because the transformer in the low ambient temperature environment can dissipate more heat than the transformer in the high ambient environment.	(2 marks)	
(e) Any ONE of: ● A flash-over could occur on the switchboard due to inadequate kA rating of protective devices ● The protective devices could be damaged.	(2 marks)	
(f) (i) An earth-fault loop impedance tester.	(1 mark)	

Question 1			*Reference Marks*	*Marking notes*
	(ii)	At or close to the switchboard.	(1 mark)	
(g)	(i)	Any ONE of: ● Split-phase motor ● Capacitor start motor ● Cap-start, cap-run motor	(1 mark)	
	(ii)	Any ONE of: ● Universal motor ● Series motor	(1 mark)	
(h)	●	To prevent a high voltage developing in the circuit.	(1 mark)	
	●	To prevent damage to the CT winding insulation	(1 mark)	
(i)	(i)	To prevent the star and delta contactors closing simultaneously	(1 mark)	
	(ii)	Any ONE of: ● It could prevent the motor starting. ● It could cause a phase-to-phase short.	(1 mark)	
(j)	●	The windings have an impedance.	(½ mark)	
	●	When the increased current flows through the impedance.	(½ mark)	
	●	A voltage drop occurs across the windings	(½ mark)	
	●	So, the transformer terminal voltage is lower.	(½ mark)	

Question 2			*Reference Marks*	*Marking notes*
(a) Sec V_{PH}	=	Pri $\frac{V_L}{N_P}$	(½ mark)	Rounded values of 230V and 400V can be used for calculations.
	=	$\frac{11000}{47.8}$	(½ mark)	
	=	230.12	(1 mark)	
(b) Sec. V_L	=	$V_{Ph} \times \sqrt{3}$	(½ mark)	
	=	$230.12 \times \sqrt{3}$	(½ mark)	
	=	398.56 V	(1 mark)	
(c) Pri. I_L	=	$\frac{VA}{\sqrt{3} \times \text{Pri. } V_L}$	(½ mark)	
	=	$\frac{150000}{\sqrt{3} \times 11000}$	(½ mark)	
	=	7.87 A	(1 mark)	
(d) Sec. I_L	=	$\frac{VA}{\sqrt{3} \times \text{Sec. } V_L}$	(½ mark)	
	=	$\frac{150000}{\sqrt{3} \times 398.56}$	(½ mark)	
	=	217.3A	(1 mark)	
(e) P	=	$\sqrt{3} \times V_L \times I_L \times pf$	(½ mark)	
I	=	$\frac{25000}{\sqrt{3} \times 398.56 \times 0.75}$	(½ mark)	
	=	48.29 A	(1 mark)	

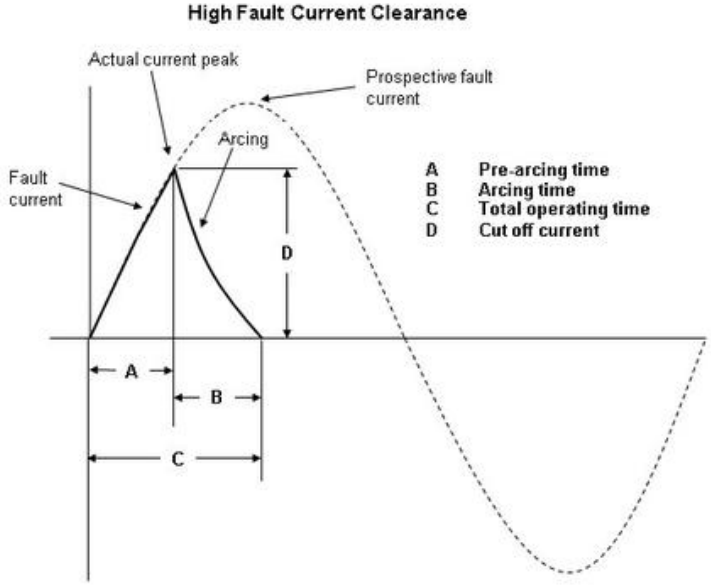
Question 3	*Reference Marks*	*Marking notes*
(a) The description must cover:		
● Using an ohmmeter.	(1 mark)	
● Testing between the ends of the phase conductors.	(1 mark)	
● A low resistance between two phase conductors indicates a winding.	(½ mark)	
● Each winding will be a similar resistance.	(½ mark)	
(b) (i) The test result is too high for the length of the flexible cable.	(2 marks)	
(ii) There is a high resistance joint in the connection to the motor frame.	(1 mark)	
(c) ● Use an insulation resistance tester	(½ mark)	
● A test voltage of 500V d.c.	(½ mark)	
● Test between each of the three windings.	(1 mark)	
● Test between each of the three windings and the motor framework	(1 mark)	
● A test result test of 1MΩ or more for each test.	(1 mark)	

Question 4	*Reference Marks*	*Marking notes*
(a) Output kW = HP x 746 = 30 x 746 = 22.38 kW	(½ mark) (½ mark) (½ mark)	
(b) Input power P = $\frac{\text{Output power}}{\text{Efficiency}}$ = $\frac{22380}{0.936}$ = 23.91 kW	(½ mark) (½ mark) (1 mark)	
(c) (i) P = $\frac{2\Pi \times N \times T}{60}$ = $\frac{2 \times 3.142 \times 1440 \times 142.63}{60}$ = 21.51 kW (ii) ● Yes ● The motor can develop an output power of 22.38 kW.	(½ mark) (½ mark) (1 mark) (½ mark) (1 marks)	
(d) P = $\sqrt{3} \times 415 \times I \times pf$ I = $\frac{23910}{1.732 \times 415 \times 0.87}$ = 38.24 A	(½ mark) (½ mark) (1 mark)	
(e) Any ONE of: ● A 40 A gM fuse ● A 50 A gG fuse ● A 50 A gM fuse ● A 63 A gG fuse ● A 63 A gM fuse	(1 mark)	

Question 5	*Reference Marks*	*Marking notes*
(a) Earth terminal of the socket outlet ● The final subcircuit earth conductor ● The main earth bar ● The MEN link ● The main neutral bar ● The consumers main neutral ● The distribution neutral ● The star point ● The transformer winding ● The white active (phase) conductor ● The main switch ● The switchboard cables ● The final subcircuit active conductor Phase terminal of the socket outlet	 (½ mark) (½ mark) (½ mark) (½ mark) (½ mark) (½ mark) (½ mark) (½ mark) (½ mark) (½ mark) (½ mark) (½ mark) (½ mark)	
(b) $I_F = \frac{V}{Z}$ $= \frac{230}{0.27}$ = 851.9 A	(½ mark) (½ mark) (1 mark)	
(c) Any ONE of: ● To ensure that the voltage cannot rise above 230V. ● To ensure that the potential difference between the neutral and earth is 0 V. ● To connect earthing conductors and exposed conducive parts of the installation to earth.	(2 marks)	

Question 6	*Reference Marks*	*Marking notes*
(a) Any TWO of: ● The main fuse will not operate. ● Exposed conductive parts will be live at up to 230V. ● Opening the main switch does not make the installation safe. ● Internal components of equipment are live with control switch in the off position.	(2 marks)	
(b) (i) ● Remote (independent) earth	(½ mark)	No marks if for (b) if the MEN link is removed
● Trailing lead	(½ mark)	
(ii). ● Insert the remote earth stake in the ground a reasonable distance away from the installation earth	(1 mark)	
● Connect trailing lead between the remote earth and the voltmeter.	(1 mark)	
● Use the voltmeter to test at the supply side of the main switch.	(½ mark)	
● Use the voltmeter to test at the earth/neutral bar.	(½ mark)	
(iii) ● At the supply side of the main switch – about 230V.	(½ mark)	
● At the earth/neutral bar – about 0 V.	(½ mark)	
(iv) ● At the supply side of the main switch – about 0 V.	(½ mark)	
● At the earth/neutral bar – about 230 V.	(½ mark)	
(c) The impedance of the fault path between to earth stake and the star point of the distribution transformer is too high.	(2 marks)	

Question 7			*Marks*	*Reference*	*Marking notes*
(a)	(i)	The motor will operate normally regardless of the phase/neutral polarity of the supply.	(1 mark)		
	(ii)	The current detected between the phase and the neutral is still balanced so the RCCB will not operate.	(1 mark)		
	(iii)	Any earth leakage in the motor final subcircuit means that the phase and neutral currents are out of balance so the RCCB will operate.	(1 mark)		
	(iv)	There is no overcurrent or short-circuit between phase and neutral so the MCB will not operate.	(1 mark)		
	(v)	Any overcurrent or short-circuit between phase and neutral will still cause the MCB to operate.	(1 mark)		
	(vi)	The motor is live with the isolating switch in the off position.	(1 mark)		
(b)	●	The RCCB will trip.	(1 mark)		
	●	The phase and neutral currents would be unbalanced as the PEC would carry return current.	(2 marks)		
(c)	●	Circuit connections test (polarity)	(½ mark)		
	●	Visual check	(½ mark)		

Question 8	*Reference Marks*	*Marking notes*
(a) I = $\frac{V}{Z}$	(½ mark)	
= $\frac{230}{0.1}$	(½ mark)	
= 2300 A	(1 mark)	
(b) (ii) 63 A	(1 mark)	
(ii) Any voltage rating of 400V a.c. and above.	(1 mark)	
(iii) Any rating in excess of 15 kA	(1 mark)	
(c) (i) This is the value of fault current that cuts off (operates) the fuse that is less than the prospective short-circuit current.	(1 mark)	
		
(ii) This is the time it takes to interrupt the flow of current and extinguish the arc.	(1 mark)	
(d) (i) Because rewireable fuse have a maximum rupturing capacity of 1 kA	(2 marks)	
(ii) • MCBs • HRC fuses	(1 mark)	

Question 9	*Reference Marks*	*Marking notes*
(a) (i) $I_{ph} = \frac{P}{V_L \times \sqrt{3}}$	(½ mark)	
$= \frac{30000}{400 \times \sqrt{3}}$	(½ mark)	
$= 43.3$ A	(1 mark)	
$I_{fault} = \frac{V}{R}$	(½ mark)	
$= \frac{231}{(6 + 9.75)}$	(½ mark)	
$= 14.67$A	(1 mark)	
$I_{total} = I_{fault} + I_{load} = 14.67 + 43.3$	(½ mark)	
$= 57.97$ A	(1 mark)	
(b) (i) • The 50A fuses have a fusing factor (gG Utilisation Category) of 1.5 Fusing current = 1.5 x 50 = 75 A.	(1 mark)	
• Because the fault current is 57.97 A, the fuses will not operate within 5 s	(1 mark)	
(ii) Vd across protective earthing conductor equals touch voltage		
$Vd_E = I \times R$	(½ mark)	
$= 14.67 \times 9.75.$	(½ mark)	
$= 142.35$V	(½ mark)	
A touch voltage hazard of 142.35V exists between frame and earth	(1 mark)	