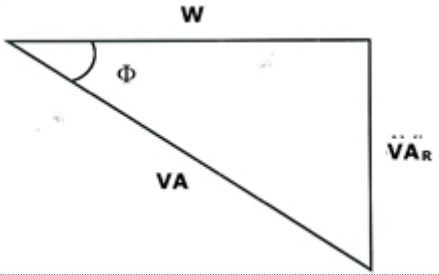
EIN - ELECTRICAL INSTALLER THEORY EXAMINATION
MARKING SCHEDULE

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

2. This schedule sets out the expected answers to the examination questions. The 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

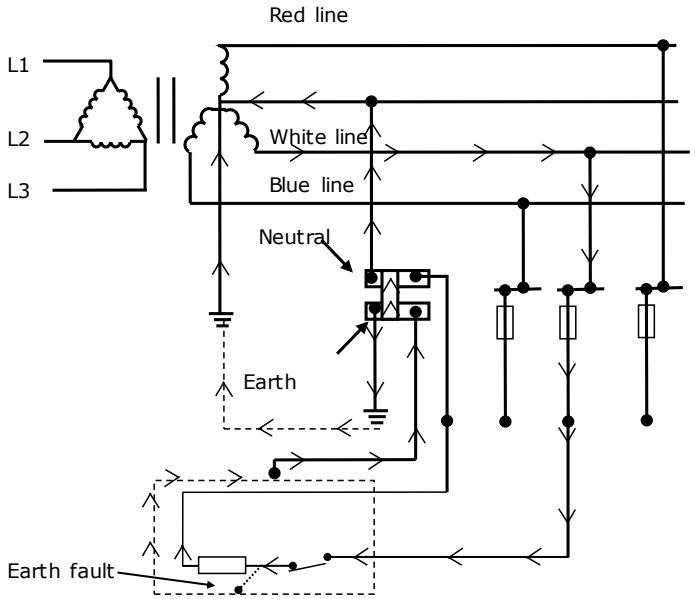
SECTION 1			*Marks*	*Reference*	*Marking notes*
Qu					
1	• A capacitor in the start winding circuit • The start winding having higher resistance than the run winding.		(2 marks)		
2	(a)	• Thermal function (overload)	(½ mark)		
		• Electromagnetic function (short-circuit)	(½ mark)		
	(b)	The fuse can safely interrupt a prospective fault current of 80,000 A.	(1 mark)		
3	• Better mechanical protection. • Lessens chance of shock if cable pierced - fault is contained within cable		(1 mark) (1 mark)		
4	There is an internal volt drop due to the current flowing through the impedance of the windings.		(2 marks)		
5	(a)	30 mA.	(1 mark)		
	(b)	10 mA	(1 mark)		

SECTION 1		*Marks*	*Reference*	*Marking notes*
Qu				
6				
	• VA in correct position	(½ mark)		
	• VAr in correct position	(½ mark)		
	• W in correct position	(½ mark)		
	• Phase angle in correct position	(½ mark)		
7	• The variable speed controller varies frequency and voltage to vary the speed.	(1 mark)		
	• The electronic soft start varies voltage on starting to limit starting current.	(1 mark)	Reference to limiting the start current is required	
8	(a) A star/delta starter	(1 mark)		
	(b) They have a constant rotating magnetic field	(1 mark)		
9	(a) Any ONE of: • Clamped around the phase (active) conductor. • Clamped around the neutral conductor.	(1 mark)		
	(b) The current flowing in the phase and neutral are balanced so no reading can be obtained.	(1 mark)		

SECTION 1		Marks	Reference	Marking notes
Qu				
10	A fluorescent tube gives 100 flashes of light per second that can make rotating machinery appear stationary.	(2 marks)		

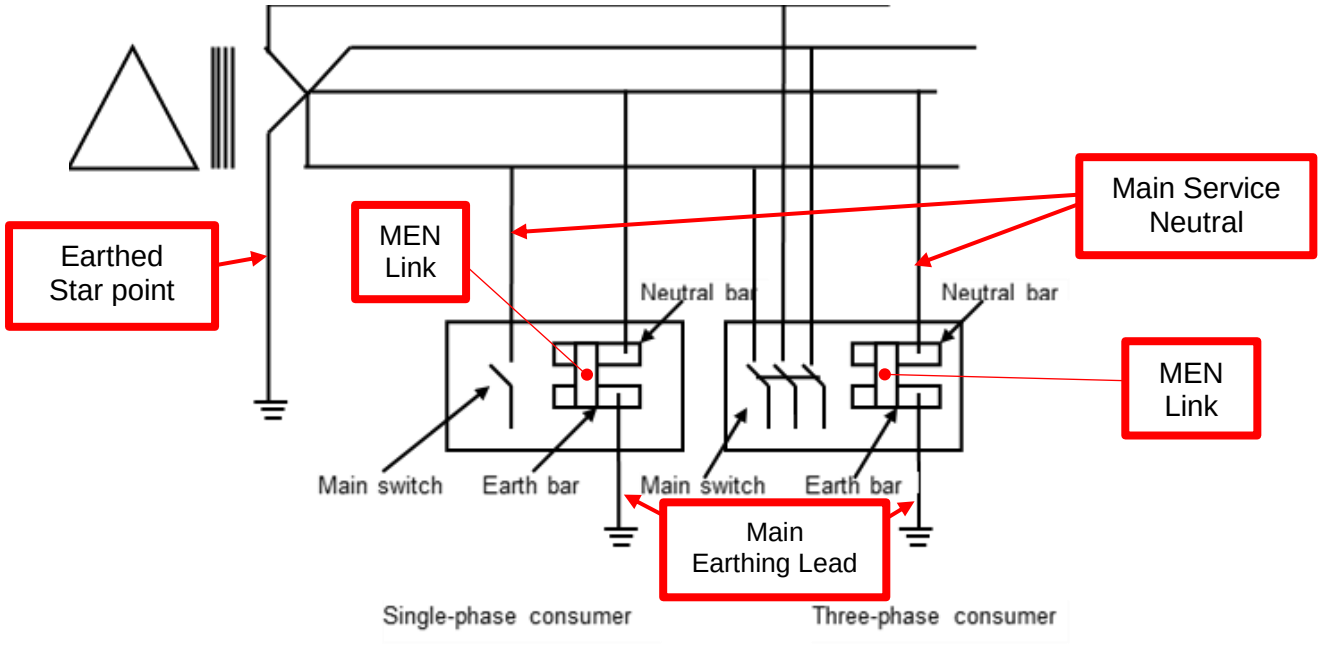
SECTION 2		*Marks*	*Reference*	*Marking notes*
Qu				
11	$I_{ph} = \frac{P}{V_L \times \sqrt{3}}$	(½ mark)		
	$= \frac{18000}{400 \times \sqrt{3}}$	(½ mark)		
	= 25.98A	(1 mark)		
	$I_{fault} = \frac{V}{R}$			
	$= \frac{230}{(4 + 0.25)}$	(½ mark)		
	= 54.12A	(1 mark)		
	$I_{total} = I_{fault} + I_{load} = 25.98 + 54.12$	(½ mark)		
	= 80.09A	(1 mark)		
12	• The 40A fuses have a fusing factor (gG Utilisation Category) of 1.5	(1 mark)		
	• Fusing current = 1.5 x 40 = 60A because the fault current of 80.09A the fuse will operate.	(1½ marks)		
13	Vd across protective earthing conductor equals touch voltage			
	$Vd_E = I \times R$			
	= 54.12 x 0.25.	(½ mark)		
	= 13.53V	(½ mark)		
	No touch voltage hazard exists between the oven frame and earth	(1½ marks)		

SECTION 3			*Marks*	*Reference*	*Marking notes*
Qu					
14	(a)	• It shows that the higher the fault current	(1 mark)		
		• The lower the time it takes the fuse to trip.	(1 mark)		
	(b)	• With a 50A fault current flowing in the 16A fuse it will blow in 3 seconds.	(1 mark)		
		• With a 100A fault current flowing in the 16A fuse it will blow in 0.1 s.	(1 mark)		
	(c)	20 x 1.5	(½ mark)		
		= 30A	(½ mark)		
	(d)	95A	(1 mark)		
15	Correct discrimination occurs when only the protective device protecting the final subcircuit operates.		(2 marks)		
16	• To provide short-circuit protection for the circuit and motor. • Because the thermal overloads are not designed for short circuit protection.		(1 mark) (1 mark)		

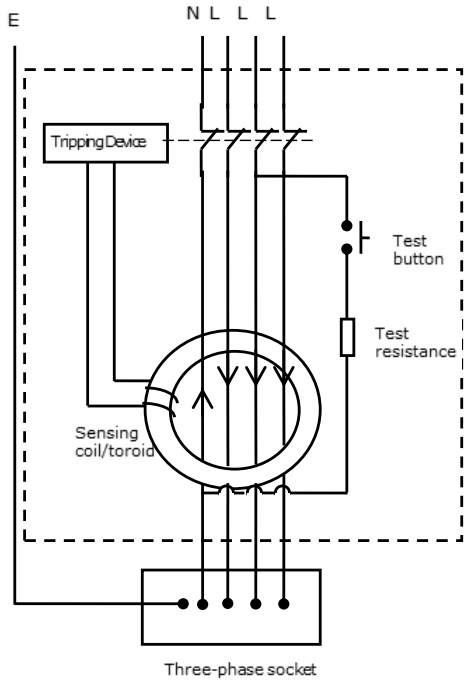
SECTION 4	Marks	Reference	Marking notes
17 			
The path showing			
• From the fault through the protective earthing conductor, (PE), main earthing terminal bar and MEN link.	(½ mark)		
• The neutral-return path, consisting of the neutral conductor between the main neutral terminal or bar and the neutral point at the transformer (the earth return path between the consumer earth and the star point of the transformer has a relatively high resistance and can be ignored in an MEN system).	(½ mark)		
• The path through the neutral point of the transformer and the transformer winding.	(½ mark)		
• The active conductor as far as the point of the fault.	(½ mark)		

SECTION 4		*Marks*	*Reference*	*Marking notes*
Qu				
18	Any **two** of: • Determine the prospective short circuit current at the switchboard • Determine if the rated Breaking Capacity of all Switch board MCB's is high enough to interrupt the Propective Short Circuit Current safely. • Determine if the main neutral is connected to the MEN system	(2 marks)		
19	It is the path with the lowest impedance so that automatic disconnection of supply occurs quickly if an earth fault occurs.	(1 mark)		
20	Any **one** of: • The fault loop impedance is lower. • Because the distribution transformer is close to the installation or on-site. • The supply transformer is capable of delivering considerably more energy that a domestic distribution transformer.	(1 mark)		
21	(a) Rewireable fuses will not operate within 4 hours at 1.5 times their current rating.	(2 marks)		
	(b) gG HRC fuses and MCBs will operate within 4 hours at 1.5 times their current rating.	(2 marks)		

SECTION 5	Marks	Reference	Marking notes
Qu			
22			



• Star point earth	(1 mark)		
• Earthing leads to each Earth bar	(1 mark)		
• MEN link between the Neutral and Earth bars at each installation.	(1 mark)		
• Main Service Neutral conductor between each Neutral bar and the Network Neutral conductor	(1 mark)		

SECTION 5	Marks	Reference	Marking notes
23 			
• Correctly connected phases, neutral and earth.	(2½ marks)		
• Correctly connected test button and resistance	(½ mark)		
• Correctly connected sensing coil/toroid	(½ mark)		
• Correctly connected tripping circuit	(½ mark)		
• Correctly connected socket	(½ mark)		
• Working circuit	(½ mark)		
24 Any **one** of: • It is the current imbalance required to trip the RCD • It is the rated residual current of the device	(1 mark)		

SECTION 6				*Marks*	*Reference*	*Marking notes*
25	pf	=	cosΦ	(½ mark)		
		=	cos 35^0			
		=	0.8191 lag	(½ mark)		
26	Input =	$\frac{\text{output}}{\text{efficiency}}$		(½ mark)		
		=	$\frac{4000}{0.83}$	(½ mark)		
		=	4819.27 W	(1 mark)		
27	I_L	=	$\frac{P_{Input}}{\sqrt{3} \times V_L \times pf}$	(½ mark)		
		=	$\frac{4819.27}{\sqrt{3} \times 400 \times 0.8191}$	(½ mark)		
		=	8.5A	(1 mark)		
28	(a) N	=	$\frac{60f}{P}$	(½ mark)		
		=	$\frac{60 \times 50}{2}$	(½ mark)		
		=	1500 rpm	(½ mark)		
	Slip speed	=	N x slip	(½ mark)		
		=	1500 x 4%	(½ mark)		
		=	60 rpm	(½ mark)		

(b)	Rotor speed	=	N – slip speed	(½ mark)		
		=	1500 - 60	(½ mark)		
		=	1440 rpm	(1 mark)		

SECTION 7		*Marks*	*Reference*	*Marking notes*
29	• AS/NZS 3000	(1 mark)		
30	• Ohmmeter	(½ mark)		
	• Test between the end of the protective earthing conductor of the cable	(½ mark)		
	And the earth pin on the socket outlet.	(½ mark)		
	• The resistance of the PEC is consistent with the characteristics of the cable.	(½ mark)		Accept 1Ω as an alternative
31	• Insulation resistance tester	(½ mark)		Live conductors include the phase or active conductor and the neutral conductor
	• 500V	(½ mark)		
	• DC	(½ mark)		
	• Test between each live conductor	(1½mark)		
	• Test between each live conductor and earth conductor	(1½mark)		
	• 1 MΩ minimum	(½ mark)		
32	• Ohmmeter	(½ mark)		
	• Each phase connected to the correct phase pin	(½ mark)		
	• Neutral connected to neutral pin	(½ mark)		
	• Earth connected to the earth pin	(½ mark)		

SECTION 8		*Marks*	*Reference*	*Marking notes*
Qu				
33	The isolation method has to show:			
	• Identifying and removing the correct fuses.	(1 mark)		
	• Using the prove test prove method	(1 mark)		
	• To test for voltage on the supply side of the isolating switch.	(1 mark)		
	• Attaching a danger tag to the fuse bases	(1 mark)		
34	• A danger tag is for personal safety	(1 mark)		
	• Each installer must take steps to ensure supply is not inadvertently restored	(1 mark)		
35	• To ensure that the test meter/instrument is operating correctly.	(1 mark)		
	• To ensure that the circuit has been isolated before it is worked on.	(1 mark)		
36	Contacts in the isolating switch have failed to open.	(2 marks)		

SECTION 9			*Marks*	*Reference*	*Marking notes*
Qu					
37	A	Main winding	(½ mark)		
	B	Centrifugal switch	(½ mark)		
	C	Start capacitor	(½ mark)		
	D	Rotor	(½ mark)		
	E	Run capacitor	(½ mark)		
	F	Start Winding 'or' Auxiliary winding	(½ mark)		
38	(a)	By an external current relay	(1 mark)		
	(b)	60% to 80% of full-load speed	(1 mark)		
39	• Develops higher starting torque • Develops higher running torque		(1 mark) (1 mark)		
40	VA = 235 x 14.7		(½ mark)		
	= 3454.5 VA		(½ mark)		
	Pf = $\frac{W}{VA}$		(½ mark)		
	= $\frac{3000}{3454.5}$		(½ mark)		
	= 0.87		(1 mark)		