FINAL - ET 57 - 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) (i) • 500 V • d.c. (ii) 0.01MΩ	(½ mark) (½ mark) (1 mark)	
(b) (i) The maximum value of torque the motor can produce. (ii) The motor will stall	(1 mark) (1 mark)	
(c) This type of motor develops higher starting torque under load.	(2 marks)	
(d) Because rewireable fuse have a maximum rupturing capacity of 1 kA	(2 marks)	
(e) 235 x 70 = 16450 VA = $\frac{15200}{16450}$ = 0.9241	(½ mark) (½ mark) (1 mark)	
(f) Any ONE of: • It runs a lot quieter • It develops a higher running torque • It develops a higher starting torque	(2 marks)	
(g) (i) This is the maximum current that the fuse is designed to carry continuously without deterioration (ii) The maximum fault current the fuse can safely interrupt.	(1 mark) (1 mark)	Award ½ mark if "continuously" not stated.

Question 1	*Reference Marks*	*Marking notes*
(h) ● To limit the current flowing through the electrode and tube. ● To produce a high voltage when the starter opens to start the tube glowing.	(1 mark) (1 mark)	
(i) (i) Any ONE of: ● Disconnect semi-conductor devices ● Bridge out between phase and neutral (ii) The voltage of the test instrument may be damage the semi-conductor devices.	(1 mark) (1 mark)	
(j) Any ONE of: ● The light from the fitting is thrown directly onto the surface being illuminated. ● 90% to 100% of the light is directed in a specific direction. ● There is no obstruction or shading between the light source and the surface being illuminated.	(2 marks)	

Question 2			*Marks*	*Reference*	*Marking notes*
(a)	(i)	• The start winding and the run winding are physically displaced.	(½ mark)		
		• The start winding and the run winding have different impedances.	(½ mark)		
		• This causes a phase displacement between the start winding current and the run winding current	(1 mark)		
		• Creating a rotating magnetic field effect.	(1 mark)		
	(ii)	• The capacitor increases the difference in the impedances between the start winding and run winding.	(1 mark)		
		• This causes a larger phase displacement between the start winding current and the run winding current	(1 mark)		
		• Creating a stronger rotating magnetic field	(1 mark)		
(b)	The start (or auxiliary) winding.		(1 mark)		
(c)	A	Main (run) winding.	(½ mark)		
	B	Centrifugal Switch.	(½ mark)		
	C	Start Capacitor.	(½ mark)		
	D	Rotor.	(½ mark)		
	E	Run Capacitor.	(½ mark)		
	F	Auxiliary (start) winding	(½ mark)		

Question 3	*Marks*	*Reference*	*Marking notes*
(a) I_L = $\frac{.....P.....}{\sqrt{3} \times V_L \times pf}$	(½ mark)		
= $\frac{.....25000.....}{1.732 \times 415 \times 0.75}$	(½ mark)		
= 46.37A	(1 mark)		
(b) (i) I_P = $\frac{I_S}{N}$	(½ mark)		
= $\frac{46.37}{47.8}$	(½ mark)		
= 0.97A	(1 mark)		
(ii) I_L = $\sqrt{3} \times I_{ph}$	(½ mark)		
= 1.732 x 0.97	(½ mark)		
= 1.68A	(1 mark)		
(c) Because kVA is the maximum current rating stated regardless of the pf of the load to be connected.	(2 marks)		
(d) The transformer at Scott Base can dissipate more heat than the transformer in Wellington because the ambient temperature is lower.	(2 marks)		

Question 4	*Reference Marks*	*Marking notes*
(a) Any TWO of: ● The cable must be made electrically safe. ● Protect the cables to prevent damage ● Prevent access to the cables. ● Prevent access to the cables. ● Replace the danger tag with an out-of-service tag.	(2 marks)	
(b) Isolating means: ● that the motor has been deliberately disconnected from the electricity supply ● and precautions taken to prevent reconnection Switched off means: that the electricity ceases to be supplied to the motor	(1 mark) (1 mark) (1 mark)	
(c) Any THREE of: ● Lock open the isolating switch. ● Lock open the MCBs or fuses. ● Disconnect the circuit supplying the electrical equipment. ● Use an access permit or "hold card" system.	(3 marks)	
(d) Where there is a possibility of personal danger through the supply being restored.	(1 mark)	
(e) ● Test between each phase and earth. ● Test between each phase and neutral.	(½ mark) (½ mark)	

Question 5	*Reference Marks*	*Marking notes*
(a) (i) $I_L = \frac{P}{V_L \times \sqrt{3}}$	(½ mark)	
$= \frac{18000}{400 \times \sqrt{3}}$	(½ mark)	
$= 25.98A$	(1 mark)	
(ii) $I_{fault} = \frac{V}{R}$		
$= \frac{230}{3.96}$	(½ mark)	
$= 58.08A$	(1 mark)	
(iii) $I_{total} = I_{fault} + I_{load}$	(½ mark)	
$= 58.08 + 25.98$	(½ mark)	
$= 84.06A$	(½ mark)	
(b) (i) 20 s	(½ mark)	
(ii) 195A	(½ mark)	Accept any value between 190A and 210A.
(iii) $Z = \frac{V}{I}$	(½ mark)	Accept a values between 110A and 130A.
$= \frac{230}{120}$	(½ mark)	
$= 1.92\Omega$	(1 mark)	
(c) $Vd_E = I \times R$	(½ mark)	
$= 58.22 \times 3.75.$	(½ mark)	
$= 218.33V$	(1 mark)	

Question 6	*Reference Marks*	*Marking notes*
(a) W = V_L x I_L x p.f.	(½ mark)	
= 230 x 20 x 0.75	(½ mark)	
= 3450W	(1 mark)	
(b) W = VA x pf	(½ mark)	
= 2500 x 0.92	(½ mark)	
= 2300W	(1 mark)	

(c)	Horizontal Watts (P)	Vertical Var (Q)	
Load 1	3450	3042.614	(½ mark)
Load 2	2300	979.796	(½ mark)
Total	5750	4022.41	(1 mark)

Total kVA

S = $\sqrt{P^2 + Q^2}$ (½ mark)

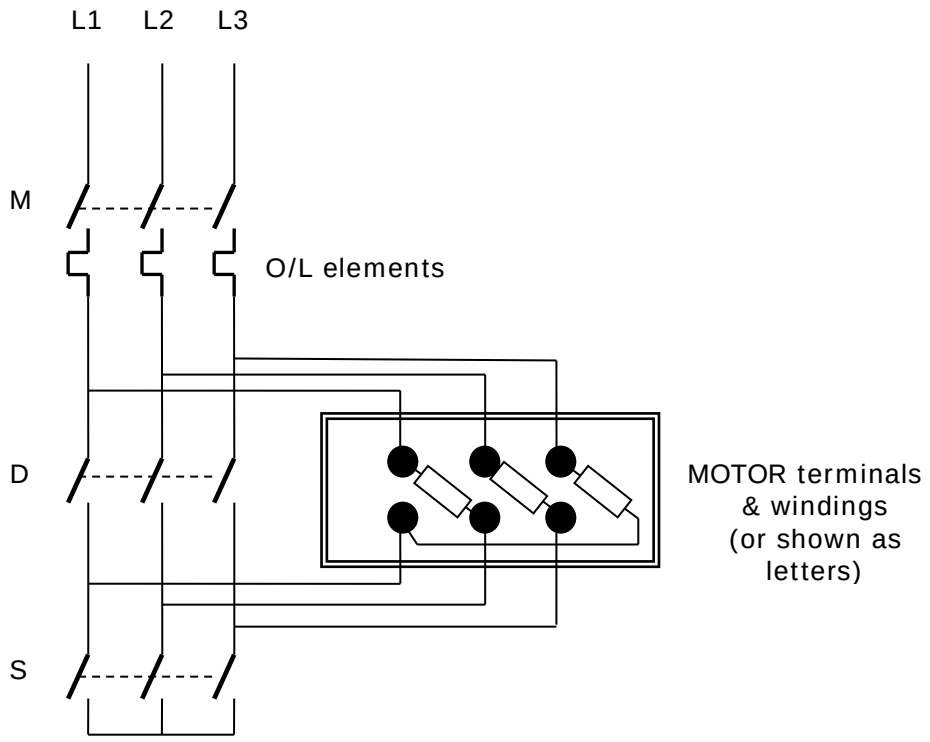
= $\sqrt{5750^2 + 4022.41^2}$ (½ mark)

= 7.017 kVA (1 mark)

(d) pf = $\frac{W}{VA}$	(½ mark)	
= $\frac{5750}{7017}$	(½ mark)	
= 0.82	(1 mark)	

Question 7	*Reference Marks*	*Marking notes*

(a)



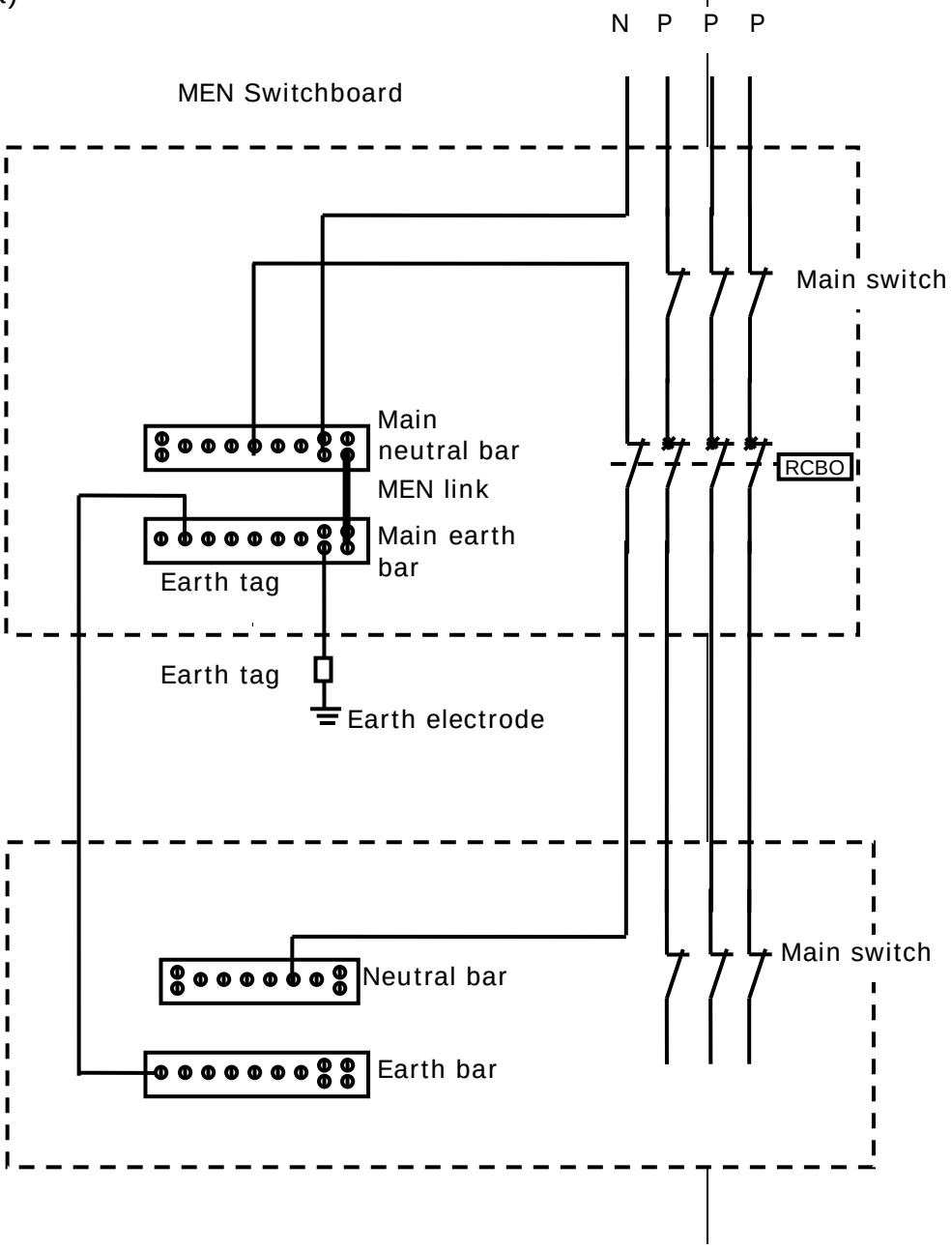
• Supply correctly connected	(½ mark)	
• Correctly connected overloads.	(½ mark)	
• Correctly connected main contactor	(½ mark)	
• Correctly connected delta contactor	(½ mark)	
• Correctly connected star contactor	(½ mark)	
• Correctly connected motor terminal block	(½ mark)	
• Correct working circuit	(2 marks)	

Question 7	*Reference Marks*	*Marking notes*
(b) (i) $L_1 - L_2$ 16Ω | $L_1 - L_3$ 16Ω | $L_2 - L_3$ 16Ω	(1 mark)	All answers must be correct to gain marks.
(ii) $L_1 - L_2$ 5.33Ω | $L_1 - L_3$ 5.33Ω | $L_2 - L_3$ 5.33Ω	(3 marks)	All answers must be correct to gain marks.
(c) A winding is open-circuited	(1 mark)	

Question 8			Reference Marks	Marking notes
(a)	(i)	• An insulation resistance tester	(½ mark)	
		• 500V d.c.	(½ mark)	
	(ii)	• Disconnect the MEN link	(1 mark)	
		• Disconnect the main neutral	(1 mark)	
		• Turn all switches and circuit breakers to the ON position	(1 mark)	
	(iii)	The description has to include:		
		• Any ONE of: * Bridging each phase and neutral in turn. Testing between the bridge and earth. * Testing between each phase and earth Testing between each neutral and earth	(1 mark)	
		• A minimum of 1 MΩ test value for each test	(1 mark)	
	(iv)	The description has to include:		
		• Testing between phase and earth Testing between neutral and earth	(1 mark)	
		• A minimum of 10,000 Ω test value	(1 mark)	
(b)	(i)	An earth fault loop impedance test in the socket outlet furthest from the switchboard.	(1 mark)	
	(ii)	To ensure the protection on the final subcircuit operates within the required time.	(1 mark)	

Question 9	Reference Marks	Marking notes

(a)



Question 9	*Reference Marks*	*Marking notes*
● Correct incoming supply to MEN switchboard	(½ mark)	No marks can be awarded for this question if there are any of the following hazards: <u>MEN switchboard</u> ● Phase/neutral transposition ● No main neutral ● No main earthing lead or electrode <u>Either switchboards</u> ● Neutral switched (other than the RCBO) <u>Distribution Switchboard</u> ● Phase/neutral transposition ● Neutral/earth transposition
● Earth electrode installed at MEN switchboard	(½ mark)	
● Main earthing conductor installed between MEN switchboard earth bar and earth electrode	(½ mark)	
● Tag attached to main earthing conductor at earth electrode on MEN switchboard.	(½ mark)	
● Correctly connected supply from MEN switchboard to RCBO	(½ mark)	
● Correctly connected supply from RCBO to the distribution switchboard	(½ mark)	
● Correctly connected conductors between the MEN switchboard earth bar and the distribution switchboard earth bar.	(1 mark)	
● Working diagram	(1 mark)	
(b) Any ONE of: ● To prevent the protective earthing conductor between the MEN switchboard and the distribution from carrying load current. ● Any load will cause the RCBO to trip.	(2 marks)	
(c) The installation operates normally	(1 mark)	Read the answers to (c) and (d) together.
(d) Any TWO of: ● The voltage to earth could rise above 230V ● The protection may not operate ● There may be a shock hazard on exposed conducive parts or extraneous conductive parts.	(2 marks)	