ET 54 - Electrician Theory Examination Marking Schedule

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

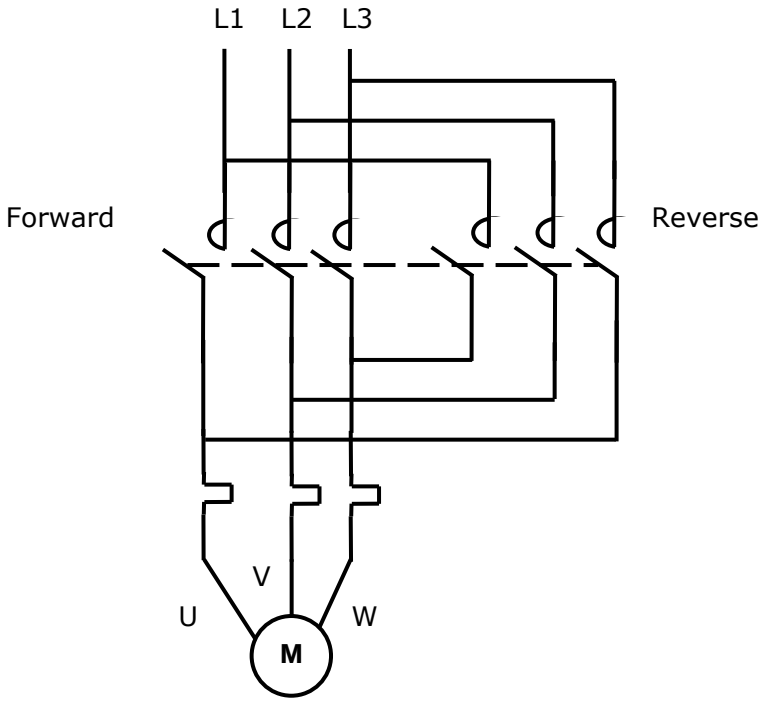
2. This schedule sets out the accepted answers to the examination questions. A marker can exercise their discretion and decide on the overall accuracy of any answer that is presented in the candidate's own words.

3. Symbols and terms - alternatives

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

Question 1	*Reference Marks*	*Marking notes*
(a) Any ONE of: ● Transposed connections on the RCD have no effect ● Ensure there are no transient voltages on the neutral ● Removes the danger if the neutral is above earth potential	(2 marks)	
(b) Any ONE of: ● The current in the two live phases rises. ● The motor will stall ● The thermal overload will operate	(2 marks)	
(c) Any ONE of: ● To ensure that a fault on one phase will fully disconnect the supply to the load ● Where the load supplied is sensitive to the loss of one phase ● It is easier to reset after a fault ● MCB cost is significantly less than equivalent HRC fuses	(2 marks)	
(d) $P = \sqrt{3} \times V_L \times I_L$ $I_L = \frac{15000}{1.732 \times 400}$ $= 21.65A$	(½ mark) (½ mark) (1 mark)	
(e) Any ONE of: ● About 2250W ● $(218.5 \div 230)^2 \times 2500$ $= 2256.25W$ ● $(0.95)^2 \times 2500$ $= 2256.25W$	(2 marks)	
(f) (i) A thermistor is a device which changes	(1 mark)	A graphical

Question 1	*Reference Marks*	*Marking notes*
resistance with temperature		representation is an acceptable alternative
(ii) It would be located in the windings of the motor	(1 mark)	
(g) Any TWO of: ● A touch voltage hazard between conductive parts and the mass of earth. ● Protective devices within the installation may not operate under fault conditions. ● The neutral is being switched throughout the installation. ● The protective device for the installation may not operate.	(2 marks)	
(h) Any TWO of ● Flash over on switchboard between protective devices ● A protective device could rupture and expose live parts ● A protective device could rupture and cause a fire	(2 marks)	
(i) (i) To stress the insulation at a voltage above 325V a.c. (or peak a.c. voltage.	(1 mark)	
(ii) Any ONE of: ● To ensure capacitive or inductive reactance does not influence the test result. ● A constant maximum voltage is a more stringent test than the momentary peaks of an a.c. waveform.	(1 mark)	
(j) $R_2 = \frac{R_1 \times L_1}{L_2}$	(½ mark)	
$= \frac{100 \times 100}{500}$	(½ mark)	
$= 20M\Omega$	(1 mark)	

Question 2	*Reference Marks*	*Marking notes*
(a)  • Correct forward circuit • Correct reverse circuit • Overload protect motor in both directions • Correct circuit	(1 mark) (1 mark) (1 mark) (1 mark)	
(b) The time taken for the motor to change from one speed to another.	(1 mark)	
(c) • Additional motor cooling is required • As conventional cooling is inadequate at low speeds for extended periods	(1 mark) (1 mark)	
(d) • To enable the motor to be connected in star on starting. • And to be connected in delta while running	(1 mark) (1 mark)	
(e) To protect the motor against excessive temperature in the motor windings.	(1 mark)	

Question 3	*Reference Marks*	*Marking notes*
(a) (i) Only the protective device electrically closest to the fault operates.	(1 mark)	
(ii) ● The 10A fuse will operate first	(1 mark)	
● Because it will operate within 0.015 s	(1 mark)	
● Whereas the 20A would take 0.4s to operate	(1 mark)	
(iii) (A) ● 16 x 1.5 = 24A	(1 mark)	
● It will operate in 7000 s or more	(1 mark)	
(B) 70A to 80A	(1 mark)	
(b) (i) It is the time taken between the fuse elements beginning to melt and the initiation of the arc	(1 mark)	
(ii) The time between the initiation of the arc and the extinguishing of the arc.	(1 mark)	
(c) Any ONE of: ● Ensure that the fuse markings show an equivalent DC rating. ● Obtain correct information from manufacturer if there is no DC rating.	(1 mark)	

Question 4	*Reference Marks*	*Marking notes*
(a) ● To start the motor a simulated rotating magnetic field is required ● The field is created by the different electrical characteristics between the start and run windings. ● An open-circuit run winding means no rotating magnetic field effect can be produced	(1 mark) (1 mark) (1 mark)	
(b) (i) By an external current relay (ii) 60% to 80% of full-load speed	(1 mark) (1 mark)	
(c) Any ONE of: ● The motor would stall and burn out ● The centrifugal switch will re-engage and the motor will burn out	(1 mark)	
(d) (i) Any ONE of: ● To limit the no-load speed of the motor ● To produce a high torque at a reduced speed (ii) At no-load the motor could attain excessive speed and self-destruct (iii) Any ONE of: ● Reverse the connections to the armature ● Reverse the connections to the field windings	(1 mark) (1 mark) (1 mark)	
(e) Any ONE of: ● Reverse the connections to the start winding ● Reverse the connections to the run winding	(1 mark)	

Question 5	*Reference Marks*	*Marking notes*
(a) ● The control circuit is connected to a phase on which there is no fault.	(½ mark)	
● The other two elements are still connected	(½ mark)	
(b) ● Short-circuit between phase and earth	(1 mark)	
● Short-circuit between phase and neutral	(1 mark)	
(c) The description has to cover:		Faults can be located solely with an ohmmeter
● Disconnecting the star point of the elements	(½ mark)	
● Using a insulation resistance tester	(1 mark)	
A test voltage of 500V d.c.	(½ mark)	
Testing between each phase and earth	(1 mark)	
The result for a fault between phase and earth will show a very low IR result	(1 mark)	
● Using an ohmmeter	(1 mark)	
Testing between each phase and neutral	(1 mark)	
The result for a fault between phase and neutral will show a resistance mush lower than the resistance of an element	(1 mark)	

Question 6			Reference Marks	Marking notes
(a)	(i)	Any ONE of: ● The power of a light source to emit light in a given direction. ● The luminous flux per unit solid angle in a specified direction. ● A measure of the perceived power of light in a particular direction	(1 mark)	
	(ii)	Any ONE of: ● The brightness of a light source ● The light emitted by a source or received by a surface, irrespective of the directions in which I is distributed. ● A measure of the perceived power of light (flux) - emitted in all directions irrespective of the radiation pattern of the light source.	(1 mark)	
	(iii)	Any ONE of: ● The amount of light that arrives upon a given area of a surface. ● The ratio of the luminous flux emitted by a lamp to the power consumed by it. ● The specific efficiency that a lamp has in converting the power in electrical watts into lumens	(1 mark)	
	(iv)	Any ONE of: ● ● The ability of a light source to reveal the natural colours of an object. ● How accurate a light source renders colour to the human eye.	(1 mark)	
(b)	(i)	● Tungsten molecules are evaporated from the filament and convection currents carry the tungsten towards the lamp wall.	(1 mark)	
		● Near the lamp wall the tungsten combines with a halogen and convection currents carries the tungsten halide back to near the filament.	(1 mark)	
		● The tungsten disassociates from the halide and re-deposits on the filament	(1 mark)	
	(ii)	● The tungsten is being re-	(1 mark)	

Question 6	*Reference Marks*	*Marking notes*
deposited on the lamp filament at the same rate as it is being evaporated • Therefore, the filament maintains the initial output and colour temperature over its life.	(1 mark)	
(c) The current through the lamp rises rapidly, and the lamp will fail.	(1 mark)	

Question 7	*Reference Marks*	*Marking notes*
(a) $I_{load} = \frac{P}{V}$	(½ mark)	
$= \frac{6000}{230}$	(½ mark)	
$= 26.1A$	(1 mark)	
$I_{fault} = \frac{V}{R}$	(½ mark)	
$= \frac{230}{(6 + 0.38)}$	(½ mark)	
$= 36A$	(1 mark)	
$I_{total} = I_{load} + I_{fault}$	(1 mark)	
$= 26.1 + 36$	(½ mark)	
$= 62.1A$	(1 mark)	
(b) 200 s to 250 s	(1 mark)	
(c) Vd across protective earthing conductor equals touch voltage		
$Vd_E = I \times R$		
$= 36 \times 0.28$	(½ mark)	
$= 10.08V$	(1 mark)	
No touch voltage hazard exists	(1 mark)	

Question 8			*Reference Marks*	*Marking notes*
(a)	(i)	Where there is a possibility of personal danger through the supply being restored	(1 mark)	
	(ii)	Where equipment is faulty or damaged and using that equipment would cause damage or injury.	(1 mark)	
	(iii)	Any TWO of: ● Make sure the correct isolating switch is tagged. ● Make sure the switch is in the "OFF" position before it is tagged ● Fasten the Danger Tag securely so that it will not come off. ● Test to ensure isolation has taken place. ● Appropriate details are entered on the tag	(2 marks)	
(b)	(i)	Means that the electricity ceases to be supplied to the equipment.	(1 mark)	
	(ii)	● Means the equipment has been deliberately disconnected from the electricity supply	(1 mark)	
		● And precautions have been taken to prevent reconnection of the supply to the equipment.	(1 mark)	
(c)		● The test instrument is checked to be operating correctly on a known live source.	(1 mark)	
		● The equipment is tested to confirm (or otherwise) that it is isolated.	(1 mark)	
		● The test instrument is again checked on a known live source to ensure is still operates correctly.	(1 mark)	

Question 9	*Marks*	*Reference*	*Marking notes*
(a) $I_L = \frac{\sqrt{3} \times V_L}{R}$	(½ mark)		
$= \frac{\sqrt{3} \times 400}{17.77}$	(½ mark)		
$= 39A$	(1 mark)		
From table 27(1), column 5 the rating factor for 30^0C is 1	(1 mark)		
From table 13, column 5 a $6mm^2$ cable has a rating of 42A.	(1 mark)		
(b) $P = \sqrt{3} \times I_L \times V_L \times pf$	(½ mark)		
$= \sqrt{3} \times 39 \times 400 \times 1$	(½ mark)		
$= 27019.2W$	(1 mark)		
(c) 40A HRC fuses	(1 mark)		
(d) In star	(½ mark)		
$P = \frac{27019.2}{3}$			
$= 9006.33W$	(1 mark)		
27019.2 – 9006.33	(½ mark)		
$= 18078.87W$	(1 mark)		