



Examination Answer Books

12 Pages

Instructions to Candidates

1. Please give the information requested in the boxes below.
2. Enter your name in the space provided to the right, fold over and seal down (using the label provided) to hide your name.
3. The answers must be legibly written. The Examiners can either ignore illegible script or have it typed and the expense of typing charged to the candidate.
4. Write your answers in ink.
5. Begin each answer on a fresh page. Do all rough work in the answer book and cross it through.
6. No part of this book is to be torn out; it must be handed in complete.
7. If more books than one are used, fasten them together using the tags available from the invigilator(s).
8. **Every book must be handed in. In no circumstances may answer books, used or unused, be taken out of the examination venue.**

Complete, fold and seal
(see note 2 below)

SURNAME: POPLHAM

FORENAME(S): SAM WILLIAM

1	Student Number	POP16829361
2	Title of Examination Paper	DESIGN of ELECTRICAL INSTALLATIONS
3	Module Code	GOEE 4001 (M4X00920)
4	Date and Time of Examination	12/1/22
5	Examination Venue	Gower College
6	Seat Number	9
7	Number of Answer Books handed in	

List the numbers of the questions you have attempted	Office Use
1a	3
1b	2
2a	0
2b	0
2c	0
3a	5
3b	1
3c	2
4a	9
5a	0
5b	5
6a	4
6b	1
6c	2
6d	
Total	34/60

= 57% ✓ KF

1a)

$9 \times 1.5 \text{ mm}^2$ Stranded
 $6 \times 2.5 \text{ mm}^2$ Stranded
 $9 \times 6 \text{ mm}^2$ Stranded
 $3 \times 10 \text{ mm}^2$ Stranded.

1.5 mm^2 cable factor = 9.6
 2.5 mm^2 cable factor = 13.9
 6 mm^2 cable factor = 22.9
 10 mm^2 cable factor = 36.3 ✓

$9 \times 9.6 = 86.4$
 $6 \times 13.9 = 83.4$ ~~86~~
 $9 \times 22.9 = 206.1$
 $3 \times 36.3 = 108.9$ ✓

$86.4 + 83.4 + 206.1 + 108.9 = 484.8$ ✓

By using the table the size trunking that will be best suited for will be $50 \text{ mm} \times 38 \text{ mm}$, this is because the over all cable factor is 484.8 and $50 \text{ mm} \times 38 \text{ mm}$ trunking ~~can~~ is suitable for a maximum cable factor of 767. ✓

(3)

1b) 10 mm^2 Stranded - Cable factor = 36.3 ✓

The maximum a $50 \text{ mm} \times 38 \text{ mm}$ trunking is suitable for is a cable factor of 767.

$$\frac{767}{36.3} = 21.12 \quad \checkmark$$

(2)

This means that the maximum amount of ~~10mm~~ cables that fit in a $50 \text{ mm} \times 38 \text{ mm}$ trunking is 21. ✓

5/5

Rhif y Cwestiwn

2 a)

Brown phase = 120 A

Black phase = 230 A

Grey phase = 90 A

$$120 + 230 + 90 = 440$$

$$\begin{aligned} \text{Neutral current} &= \frac{I_N}{\left((I_A^2 + I_B^2 + I_C^2) - (I_A \times I_B) - (I_B \times I_C) - (I_A \times I_C) \right)} \\ &= \frac{440}{\left((120^2 + 230^2 + 90^2) - (120 \times 230) - (230 \times 90) - (120 \times 90) \right)} \\ &= \frac{440}{(75400 - 27600 - 20700 - 10800)} \\ &= \frac{440}{16300} = 0.27 \text{ A} \end{aligned}$$

$$\text{Neutral current} = 0.27 \text{ A}$$

2 b) If the loads were to be partly reactive, this would affect the calculation as the loads could be changing which would result in unbalanced loads.

2 c) One action that should be taken if there are two or more phases supplying a single room is to ~~re~~ calculate the balancing to get the loads balanced as near as possible.



Q3 a)

School Hall 16m x 45m
 Lamps = 16000 lumens each

$$Uf = 0.8$$

$$Mf = 0.7$$

Lumen method

$$\text{Quantity of lamps} = \frac{E \times A}{F \times Uf \times Mf}$$

E = lux needed

A = Area of

F = lumens of each lamp.

Uf = Utilization factor

Mf = maintenance factor

$$\text{quantity of lamps} = \frac{370 \times (16 \times 45)}{16,000 \times 0.8 \times 0.7}$$

$$\text{quantity of lamps} = \frac{266400}{8960}$$

$$\text{quantity of lamps} = 29.7$$

$$= 30 \text{ lamps needed.}$$

(5)

Q3 b)

~~lamps~~ lighting level 8m below
 8000 cd

E = lux

d = distance from surface

I = luminous intensity

$$E = \frac{I}{d^2}$$

$$E = \frac{8000}{8^2}$$

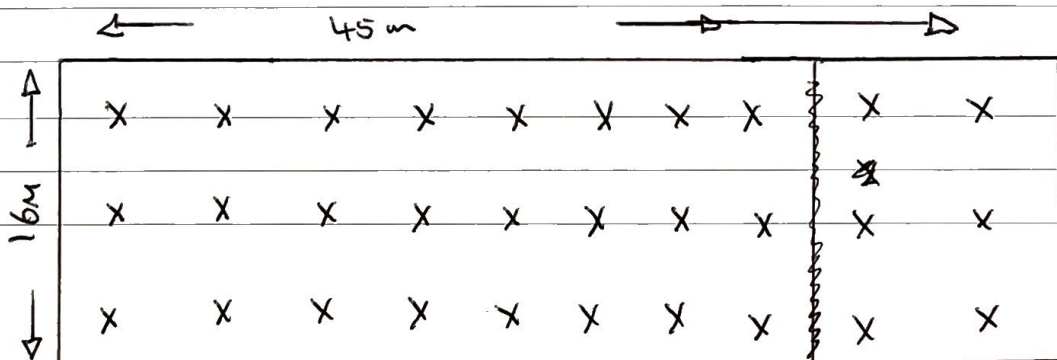
$$E = \frac{8000}{125}$$

(1)

$$E = 64 \text{ lux}$$

lighting level 8m below light is 64 lux.

Q3 c)



(2)

Q4 a)

- heater rated load of 38A.
- BS88-2 fuse
- 32m from DB
- Steel conduit
- 70°C PVC singles (ref method B)
- Ambient temp = 34°C
- Grouped with +2 circuits.
- TN-S System $Z_e = 0.58 \Omega$.

The best suited fuse for this line cable is a 40A fuse.

$$I_n = 40A \checkmark$$

$$I_z = \frac{I_n}{C_a \times C_g \times C_i \times C_c \times C_f}$$

$$I_z = \frac{40}{0.94 \times 0.70}$$

$$I_z = 60.79A \checkmark$$

The current carrying capacity of the cable is 60.79A.

~~Knowing that it is an industrial process heater I will assume that it is~~ Assuming that the supply is a single phase supply the best suitable size cable for the line is a 16mm² ✓

Voltage drop.

As this is not a lighting circuit

5% voltage drop is allowed maximum. = 11.5V of 230V

(mV/A/m) for 16mm² - ref B = 2.8

$$V_d = \frac{(mV/A/m) \times I_b \times \text{length}}{1000}$$

$$V_d = \frac{2.8 \times 38 \times 32}{1000}$$

$$V_d = \frac{3404.8}{1000}$$

$$V_d = 3.4V \checkmark$$

The voltage drop is within tolerance.

$$Z_s = Z_e + (R_1 + R_2)$$

$$\frac{R_1 + R_2}{1000} = \frac{(R_1 + R_2) \times \text{multiplier} \times \text{length}}{1000}$$

Tabulated $(R_1 + R_2) = 1.08$
(as I have not worked out cpc size yet)

$$R_1 + R_2 = \frac{1.08 \times 1.2 \times 32}{1000}$$

$$R_1 + R_2 = 0.04 \Omega$$

$$Z_s = 0.58 + 0.04 \Omega$$

$$Z_s = 0.62 \Omega$$

$$\text{Fault current} = I_f$$

$$I_f = \frac{U_{oc} \text{ (nominal voltage)}}{Z_s}$$

$$I_f = \frac{230}{0.62}$$

$$I_f = 371 \text{ A}$$

$$\text{maximum disconnection time is} = 0.1 \text{ seconds}$$

Cpc minimum size

$$S = \frac{\sqrt{I^2 \times t}}{k}$$

$$S = \frac{\sqrt{371^2 \times 0.1}}{1.20}$$

S = minimum cpc size

I = fault current

T = disconnection time

k = 115

$$= 97.8$$

9

9/15

Rhif y Cwestiwn

Q5a)

$$Z_e = 0.35$$

$$\text{Prospective fault current} = I_f \quad I_f = \frac{U_{oc}}{Z_s}$$

$$Z_s = Z_e + (R_1 + R_2)$$

If the cable is 6mm² line with 2.5mm² CPC.

$$R_1 + R_2 \text{ value} = 10.49 \Omega$$

$$6\text{mm}^2 \text{ line with } 6\text{mm CPC} = 6.16 \Omega$$

$$Z_s = 0.35 + 10.49 = 10.84 \Omega \quad I_f = \frac{230}{10.84} = 21.2 \text{ A}$$

$$Z_s = 0.35 + 6.16 = 6.51 \Omega \quad I_f = \frac{230}{6.51} = 35.3 \text{ A}$$

Q5b)

Disconnection time would be 0.20s

(5)

5/10

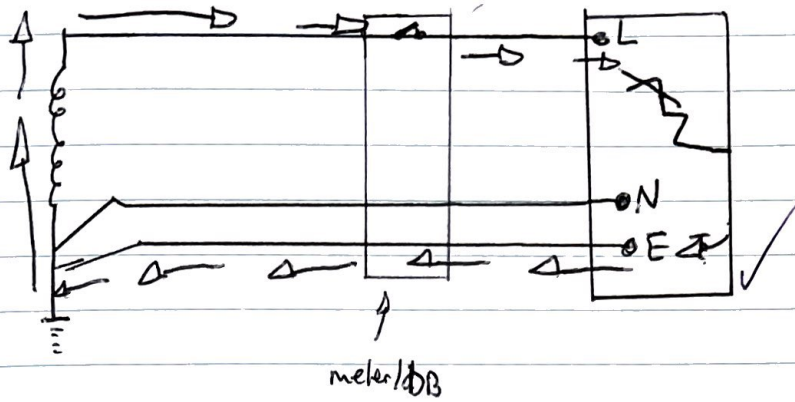
Q6a) An exposed conductive part is a part of the electrical system but it is not a live conductor or CPC. Two examples could be: Conduit or a distribution board. These would have to be metal or be able to pass electric current through a conductive material.

(4)

Q6b) Some require more additional electrodes in the supply system as there are multiple earths. ✓

(1)

Q6 C)



(2)

Q6 D)

Two advantages for TN-C-S System over a TT System would be:

- The main earth is with the supply all the way from the Substation as it is combined with the neutral until the meter.
- TT System uses rods the resistance can fluctuate with the rods for many reasons e.g. if the ground dries up. This will cause the resistance to go high.

✓ 7/10