KEMENTERIAN PENDIDIKAN TINGGI
JABATAN PENDIDIKAN POLITEKNIK DAN KOLEJ KOMUNITI

BAHAGIAN PEPERIKSAAN DAN PENILAIAN
JABATAN PENDIDIKAN POLITEKNIK DAN KOLEJ KOMUNITI
KEMENTERIAN PENDIDIKAN TINGGI

JABATAN KEJURUTERAAN AWAM

PEPERIKSAAN AKHIR

SESI II : 2025/2026

DCB20292: BUILDING ELECTRICAL SERVICES

TARIKH : 05 MEI 2026
MASA : 8.30 PAGI – 10.30 PAGI (2 JAM)

Kertas ini mengandungi **SEPULUH (10)** halaman bercetak.

Subjektif (4 soalan)

Dokumen sokongan yang disertakan : Lampiran

JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIARAHKAN

(CLO yang tertera hanya sebagai rujukan)

SECTION A: 100 MARKS

BAHAGIAN A: 100 MARKAH

INSTRUCTION:

This section consists of **FOUR (4)** subjective questions. Answer **ALL** the questions.

ARAHAN:

*Bahagian ini mengandungi **EMPAT (4)** soalan subjektif. Jawab **SEMUA** soalan.*

QUESTION 1

SOALAN 1

CLO1 (a) In Malaysia, electricity is supplied through a national grid system where several power stations are interconnected through transformers and a common busbar to form an integrated network.

Based on this statement, describe the operation of the national grid system.

Di Malaysia, bekalan elektrik disalurkan melalui sistem grid nasional di mana beberapa stesen janakuasa dihubungkan antara satu sama lain melalui transformer dan palang bas (busbar) bersama bagi membentuk satu rangkaian bersepadu.

Berdasarkan pernyataan ini, huraikan operasi sistem grid nasional.

[6 marks]

[*6 markah*]

CLO1 (b) A building project involves the construction of a new commercial office building as well as the provision of electrical supply during the construction phase. The completed office requires a wiring system that ensures neat appearance, safety, and long-term durability, while the construction phase requires an electrical supply for a short period to power tools and equipment.

Based on this scenario, explain **THREE (3)** suitable wiring types that should be used for these installations.

Satu projek pembinaan melibatkan pembinaan sebuah bangunan pejabat komersial yang baharu serta penyediaan bekalan elektrik semasa fasa pembinaan. Bangunan pejabat yang siap memerlukan sistem pendawaian yang memastikan kekemasan, keselamatan, dan ketahanan jangka panjang, manakala fasa pembinaan memerlukan bekalan elektrik untuk tempoh yang singkat bagi membekalkan kuasa kepada peralatan dan mesin.

*Berdasarkan senario ini, jelaskan **TIGA (3)** jenis pendawaian yang sesuai untuk digunakan bagi pemasangan tersebut.*

[9 marks]

[*9 markah*]

CLO1 (c) A residential house is supplied with a single-phase electrical system. Several final circuits are planned to be installed to supply socket outlets in the house, including Circuit 1 and Circuit 2 for 13A switched socket outlets (SSO), as shown in **Figure A1(c)**.

Based on **Figure A1(c)**, interpret Circuit 1 and Circuit 2 by drawing labelled circuit diagrams consisting of a 13A SSO, live (L), neutral (N), and earth (E/CPC) cables.

*Sebuah rumah kediaman dibekalkan dengan sistem elektrik satu fasa. Beberapa litar akhir dirancang untuk dipasang bagi membekalkan soket alir keluar di dalam rumah, termasuk Litar 1 dan Litar 2 bagi soket alir keluar bersuis 13 A (SSO), seperti yang ditunjukkan dalam **Rajah A1(c)**.*

*Berdasarkan **Rajah A1(c)**, tafsirkan Litar 1 dan Litar 2 dengan melukis gambarajah litar berlabel yang terdiri daripada SSO 13 A, konduktor hidup (L), neutral (N), dan bumi (E/CPC).*

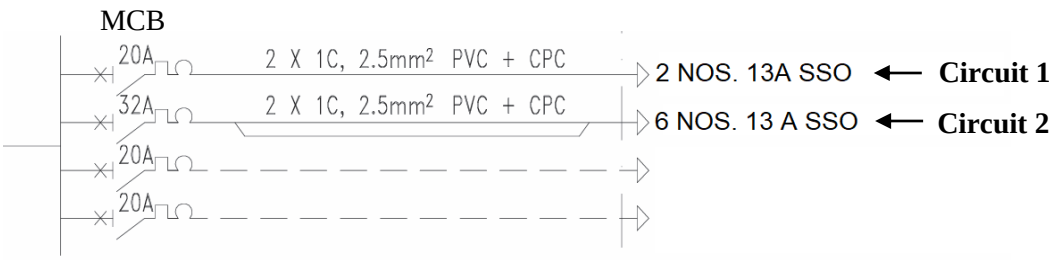

Figure A1(c)/*Rajah A1(c)*

[10 marks]

[*10 markah*]

QUESTION 2

SOALAN 2

CLO1 (a) A commercial building experienced damage to several electrical and electronic equipment following a lightning strike. An inspection revealed that the earthing resistance of the building was high, resulting in ineffective dissipation of lightning current.

Based on this scenario, identify the methods that can be used to reduce earthing resistance in order to prevent damage to electrical equipment in the future.

Sebuah bangunan komersial mengalami kerosakan pada beberapa peralatan elektrik dan elektronik berikutan satu kejadian sambaran petir. Pemeriksaan mendapati bahawa rintangan pembumian bangunan tersebut adalah tinggi, menyebabkan arus petir tidak dapat disalurkan ke bumi dengan berkesan.

Berdasarkan senario ini, kenalpasti kaedah-kaedah yang boleh digunakan untuk mengurangkan rintangan pembumian bagi mengelakkan kerosakan pada peralatan elektrik pada masa hadapan.

[5 marks]

[*5 markah*]

CLO1 (b) A residential electrical installation experienced frequent tripping of the protective device after renovation work. Preliminary inspection suggested a possible direct contact between the live conductor and earth, which may be caused by damaged cable insulation. Based on this scenario, explain the suitable test used to identify the fault.

Satu pemasangan elektrik kediaman mengalami kejadian pelindung litar kerap terpelantik selepas kerja pengubahsuaian dijalankan. Pemeriksaan awal menunjukkan kemungkinan berlaku sentuhan langsung antara konduktor hidup dan bumi yang berpunca daripada penebat kabel yang rosak. Berdasarkan senario ini, terangkan ujian yang sesuai digunakan untuk mengenal pasti kecacatan tersebut.

[10 marks]

[*10 markah*]

CLO1

(c) A newly constructed commercial building in Malaysia requires adequate electrical protection to ensure user safety and to protect electrical equipment from faults and surges. The electrical contractor proposes to install a Residual Current Device (RCD) and a Surge Protection Device (SPD).

Based on this scenario, explain the operating principles and installation locations of the RCD and the SPD.

Sebuah bangunan komersial yang baru dibina di Malaysia memerlukan perlindungan elektrik yang mencukupi bagi memastikan keselamatan pengguna serta melindungi peralatan elektrik daripada kerosakan akibat kerosakan litar dan lonjakan voltan. Kontraktor elektrik mencadangkan pemasangan Peranti Arus Baki dan Peranti Perlindungan Lonjakan.

Berdasarkan senario ini, terangkan prinsip operasi dan lokasi pemasangan bagi RCD dan SPD.

[10 marks]

[*10 markah*]

QUESTION 3

SOALAN 3

CLO2 (a) Two miniature circuit breakers (MCBs) are connected to the loads listed in **Table A3(a)**. If 230 V is supplied to the distribution board (DB), estimate the appropriate ratings of the MCBs. Given that the multiplication factor of the ceiling fan is 1.8. Refer to **Appendix 2** for MCB rating selection.

*Dua pemutus litar kenit (MCB) disambungkan kepada beban seperti yang disenaraikan dalam **Jadual A3(a)**. Jika bekalan 230 V dibekalkan ke papan agihan (DB), anggarkan nilai kadaran MCB yang sesuai. Diberi nilai faktor pendaraban bagi kipas siling ialah 1.8. Rujuk **Lampiran 2** bagi pemilihan kadar MCB.*

MCB	Load
MCB 1	10 nos. 40W ceiling fan/ *kipas siling*.
MCB 2	1nos. 2.5HP air conditioner/ *penghawa dingin*.

Table A3(a)/*Jadual A3(a)*

[6 marks]

[*6 markah*]

(b) A PVC-insulated core cable is to be used for an enclosed conduit wiring system in the installation of a 2 hp swimming pool water pump in a residential house. The water pump unit is supplied with 230 V, and the conduit length from the distribution board to the unit is 25 meters.

As a competent wireman, use **Table 4D1A** and **Table 4D1B** in **Appendix 3a** and **Appendix 3b** to determine the appropriate cable size for this installation.

Kabel teras berpenebat PVC akan digunakan bagi sistem pendawaian konduit tertutup dalam pemasangan pam air kolam renang berkuasa 2 hp di sebuah rumah kediaman. Unit pam air tersebut dibekalkan dengan 230 V, dan panjang konduit dari papan agihan ke unit ialah 25 meter.

*Sebagai seorang juruelektrik bertauliah, gunakan **Jadual 4D1A** dan **Jadual 4D1B** dalam **Lampiran 3a** dan **Lampiran 3b** untuk menentukan saiz kabel yang sesuai bagi pemasangan ini.*

[9 marks]
[*9 markah*]

CLO2 (c) A 4.5 kW water heater has been installed in a residential house using PVC-insulated core cable within an enclosed conduit wiring system. The unit operates at 230 V and is supplied through a 20-metre-long conduit, using a 1.5 mm² cable. The selection of this cable size results in a voltage drop that exceeds the permissible limit of 9.6 V. As a competent wireman, calculate the:

Sebuah pemanas air berkuasa 4.5 kW telah dipasang di sebuah rumah kediaman menggunakan kabel teras berpenebat PVC dalam sistem pendawaian konduit tertutup. Unit tersebut beroperasi pada 230 V dan dibekalkan melalui konduit sepanjang 20 meter, menggunakan kabel bersaiz 1.5 mm². Pemilihan saiz kabel ini menyebabkan susutan voltan yang melebihi had yang dibenarkan iaitu 9.6 V.
Sebagai seorang juruelektrik bertauliah, kirakan perkara berikut:

i. appropriate cable size required to reduce the voltage by referring to **Table 4D1A** and **Table 4D1B** in **Appendix 3a** and **Appendix 3b**.
*saiz kabel yang sesuai yang diperlukan untuk mengurangkan kejatuhan voltan dengan merujuk kepada **Jadual 4D1A** dan **Jadual 4D1B** dalam **Lampiran 3a** dan **Lampiran 3b**.*

[8 marks]
[*8 markah*]

ii. voltage drop if a 1.0 mm^2 cable is used for this installation.
susutan voltan sekiranya kabel bersaiz 1.0 mm² digunakan bagi pemasangan ini.

[2 marks]
[*2 markah*]

QUESTION 4
SOALAN 4

CLO2 (a) 10 nos. of 36 W fluorescent lamps (with a multiplication factor of 1.8) are connected to MCB 1, and 6 nos. of 13 A 3P switched socket outlets (SSO) are connected to MCB 2. The distribution board (DB) is supplied with 230 V.
Estimate the appropriate ratings of MCB 1 and MCB 2 using **Appendix 1** (Estimated Load) and **Appendix 2** (MCB Rating Selection).

10 unit 36W lampu pendafluor (dengan faktor pendaraban 1.8) disambungkan kepada MCB 1 dan 6 unit 13A 3P soket alir keluar disambungkan kepada MCB 2. Diberikan bahawa papan agihan (DB) dibekalkan dengan 230 V.
Anggarkan kadaran MCB1 dan MCB2 yang sesuai dengan menggunakan ***Lampiran 1*** *(Anggaran Beban) dan* ***Lampiran 2*** *(Pemilihan Kadaran MCB).*

[8 marks]
[*8 markah*]

CLO2 (b) A newly constructed office building requires an accurate estimation of its Total Connected Load (TCL) to ensure proper electrical distribution and compliance with the JKR Electrical Engineering Branch Technical Guideline Edition 4. The electrical loads installed in the building are listed in **Table A4(b)**.

Calculate the Total Connected Load (TCL) for the electrical items shown in **Table A4(b)** in accordance with the JKR Electrical Engineering Branch Technical Guideline Edition 4. Refer **Appendix 1** for estimated load.

Sebuah bangunan pejabat yang baru dibina memerlukan anggaran Jumlah Beban Terpasang (Total Connected Load, TCL) yang tepat bagi memastikan pengagihan elektrik yang betul serta pematuhan kepada Garis Panduan Teknikal Cawangan Kejuruteraan Elektrik JKR Edisi 4. Beban elektrik yang dipasang di bangunan tersebut disenaraikan dalam ***Jadual A4(b)****.*

Kirakan Jumlah Beban Terpasang (TCL) bagi item elektrik yang ditunjukkan dalam ***Jadual A4(b)*** *mengikut Garis Panduan Teknikal Cawangan Kejuruteraan Elektrik JKR Edisi 4. Rujuk* ***Lampiran 1*** *untuk anggaran nilai beban.*

Load	Nos
400W Metal Halide/SON	4
2HP Air-cond/ *Penghawa dingin*	3
400mm Automatic Fan/ *Kipas Automatik*	6

Table A4(b)/*Jadual A4(b)*

[7 marks]

[*7 markah*]

CLO2 (c) A hall supplied with a 230 V single-phase power supply requires the installation of electrical fittings in **Table A4(c)** by a competent wireman. With reference to the **JKR Electrical Engineering Branch Technical Guideline Edition 4**, **Appendix 1**, and **Appendix 4**, calculate the Maximum Demand (MD). For SATS-supplied loads, the diversity factor is taken as DF = 1.0.

Sebuah dewan yang dibekalkan dengan bekalan kuasa satu fasa 230 V memerlukan pemasangan kelengkapan seperti dalam ***Jadual A4(c)*** *oleh seorang juruelektrik bertauliah. Dengan merujuk kepada* ***Garis Panduan Teknikal Cawangan Kejuruteraan Elektrik JKR Edisi 4, Lampiran 1, dan Lampiran 4****, kira Permintaan Maksimum (Maximum Demand, MD).* Bagi beban yang dibekalkan melalui sistem SATS, faktor kepelbagaian diambil sebagai DF = 1.0.

Load/ *Beban*	Nos.
18W Fluorescent lamp/ *lampu pendarflor*	10
1500mm ceiling fan/ *kipas siling*	6
13A Switch Socket Outlet/ *Soket Alur Keluar*	6
7.5kW cooker/ *pemasak*	1
SATS System/ *Sistem SATS*	2

Table A4(c)/*Jadual A4(c)*

[10 marks]

[*10 markah*]

SOALAN TAMAT

APPENDIX 1/ *LAMPIRAN 1*

Appendix 1: TCL Guide (updated: 15.5.2006)

NO	DESCRIPTION	ESTIMATED LOAD
1	18W Fluorescent	24W
2	36W Fluorescent	42W
3	60W Tungsten	60W
4	100W Tungsten	100W
5	1 x 8W(F) EL	10W
6	2 X 8W(F) LAMPU 'K' SIGN	20W
7	9W PLC	15W
8	11W PLC	17W
9	13W PLC	19W
10	18W PLC	24W
11	9W PLCE	10W
12	11W PLCE	12W
13	13W PLCE	14W
14	18W PLCE	20W
15	50W Halogen Bulb	50W
16	70W Metal Halide/SON	80W
17	150W Metal Halide/SON	170W
18	250W Metal Halide/SON	280W
19	400W Metal Halide/SON	440W
20	Obstruction Light	100W
21	Electric Bell	Ignore
22	2 x 8W(F) Insect Killer	20W
23	1500mm Ceiling Fan	80W
24	1200 Ceiling Fan	60W
25	400mm Wall Fan	60W
26	500 Wall Fan	80W
27	400mm Automatic Fan	80W
28	200mm Exhaust Fan	15W
29	250mm Exhaust Fan	25W
30	300mm Exhaust Fan	40W
31	13A 3P Switched Socket Outlet	250W
32	15A Switched Socket Outlet	500W
33	15A SPN Isolator	Motor H.P. rating
34	20A SPN Isolator	Motor H.P. rating
35	30A SPN Isolator	Motor H.P. rating
36	15A TPN Isolator	Motor H.P. rating
37	20A TPN Isolator	Motor H.P. rating
38	30A TPN Isolator	Motor H.P. rating
39	45A TPN Isolator	Motor H.P. rating
40	60A TPN Isolator	Motor H.P. rating
41	1 HP Air-Cond	746W
42	1.5 HP Air-Cond	1119W
43	2 HP Air-Cond	1492W
44	2.5 HP Air-Cond	1865W
45	3 HP Air-Cond	2238W
46	Water Heater	3kW
47	Cooker	7.5kW
48	Booster Pump	Motor H.P. rating
49	Fire Fighting Pump	Motor H.P. rating
50	Fire Fighting Panel	250W
51	CO2 Point	500W
52	SATS System	500W
53	HI KLEEN System	Motor H.P. rating

APPENDIX 2/ *LAMPIRAN 2*

Fuse rate for MCCB, MCB and RCCB

Molded Case Circuit Breaker (**MCCB**)		
Voltage rating	:	230V/400V
Current rating	:	16A, 20A, 30A, 40A, 50A, 60A, 80A, 100A until 2000A
Double Pole/ TPN/4 Pole		

Miniature Circuit Breaker (**MCB**)		
Voltage rating	:	230V/400V
Current rating	:	2A, 4A, 6A, 10A, 16A, 20A, 25A, 32A, 40A, 50A, 63A
Single Pole/Double Pole/ 3 Pole/4 Pole		

Residual Current Circuit Breaker (**RCCB**)		
Voltage rating	:	230V/400V
Current rating	:	16A, 25A, 40A, 63A, 80A
Sensitivity ($I_{\Delta n}$)	:	10mA, 30mA, 100mA, 300mA, 500mA
Single Pole/Double Pole/ 3 Pole/4 Pole		

APPENDIX 3a/ *LAMPIRAN 3a*

TABLE 4D1A

Single-core pvc-insulated cables, non-armoured, with or without sheath
(COPPER CONDUCTORS)

BS 6004
BS 6231 **Ambient temperature : 30 °C**
CURRENT-CARRYING CAPACITY (amperes): **BS 6346** **Conductor operating temperature : 70°C**

Conductor cross-sectional area	Reference Method 4 (Enclosed in conduit in thermally insulating wall etc.)		Reference Method 3 (enclosed in conduit on a wall or in trunking etc.)		Reference Method 1 (clipped direct)		Reference Method 11 (on a perforated cable tray horizontal or vertical)		Reference Method 12 (free air)		
									Horizontal flat spaced	Vertical flat spaced	Trefoil
	2 cables, single-phase a.c or d.c	3 or 4 cables, three-phase a.c	2 cables, single-phase a.c or d.c	3 or 4 cables, three-phase a.c	2 cables, single-phase a.c or d.c flat and touching	3 or 4 cables, three-phase a.c flat and touching or trefoil	2 cables, single-phase a.c or d.c flat and touching	3 or 4 cables, three-phase a.c flat and touching or trefoil	2 cables, single-phase a.c or d.c or 3 cables three-phase a.c	2 cables, single-phase a.c or d.c or 3 cables three-phase a.c	3 cables trefoil, three-phase a.c
1	2	3	4	5	6	7	8	9	10	11	12
(mm^2)	(A)	(A)	(A)	(A)	(A)	(A)	(A)	(A)	(A)	(A)	(A)
1	11	10.5	13.5	12	15.5	14	-	-	-	-	-
1.5	14.5	13.5	17.5	15.5	20	18	-	-	-	-	-
2.5	19.5	18	24	21	27	25	-	-	-	-	-
4	26	24	32	28	37	33	-	-	-	-	-
6	34	31	41	36	47	43	-	-	-	-	-
10	46	42	57	50	65	59	-	-	-	-	-
16	61	56	76	68	87	79	-	-	-	-	-
25	80	73	101	89	114	104	126	112	146	130	110
35	99	89	125	110	141	129	156	141	181	162	137
50	119	108	151	134	182	167	191	172	219	197	167
70	151	136	192	171	234	214	246	223	281	254	216
95	182	164	232	207	284	261	300	273	341	311	264

APPENDIX 3b/ *LAMPIRAN 3b*

TABLE 4D1B

VOLTAGE DROP (per ampere per metre): **Conductor operating temperature : 70°C**

Conductor cross-sectional area	2 cables d.c	2 cables, single-phase a.c									3 or 4 cables, three-phase a.c											
		Reference Method 3 & 4 (Enclosed in conduit etc. in or on a wall)			Reference Method 1 & 11 (clipped direct or on trays, touching)			Reference Method 12 (spaced*)			Reference Method 3 & 4 (Enclosed in conduit etc. in or on a wall)			Reference Method 1, 11 & 12 (in trefoil)			Reference Method 1 & 11 (flat and touching)			Reference Method 12 (spaced*)		
1	2	3			4			5			6			7			8			9		
(mm^2)	(mV/A/m)	(mV/A/m)			(mV/A/m)			(mV/A/m)			(mV/A/m)			(mV/A/m)			(mV/A/m)			(mV/A/m)		
1	44	44			44			44			38			38			38			38		
1.5	29	29			29			29			25			25			25			25		
2.5	18	18			18			18			15			15			15			15		
4	11	11			11			11			9.5			9.5			9.5			9.5		
6	7.3	7.3			7.3			7.3			6.4			6.4			6.4			6.4		
10	4.4	4.4			4.4			4.4			3.8			3.8			3.8			3.8		
16	2.8	2.8			2.8			2.8			2.4			2.4			2.4			2.4		
		r	x	z	r	x	z	r	x	z	r	x	z	r	x	z	r	x	z	r	x	z
25	1.75	1.80	0.33	1.80	1.75	0.20	1.75	1.75	0.29	1.80	1.50	0.29	1.55	1.50	0.175	1.50	1.50	0.25	1.55	1.50	0.32	1.55
35	1.25	1.30	0.31	1.30	1.25	0.195	1.25	1.25	0.28	1.30	1.10	0.27	1.10	1.10	0.170	1.10	1.10	0.24	1.10	1.10	0.32	1.15
50	0.93	0.95	0.30	1.00	0.93	0.190	0.95	0.93	0.28	0.97	0.81	0.26	0.85	0.80	0.165	0.82	0.80	0.24	0.84	0.80	0.32	0.86
70	0.63	0.65	0.29	0.72	0.63	0.185	0.66	0.63	0.27	0.69	0.56	0.25	0.61	0.55	0.160	0.57	0.55	0.24	0.60	0.55	0.31	0.63
95	0.46	0.49	0.28	0.56	0.47	0.180	0.50	0.47	0.27	0.54	0.42	0.24	0.48	0.41	0.155	0.43	0.41	0.23	0.47	0.40	0.31	0.51

Note : * Spacings larger than those specified in Method 12 (see Table 4A1) will result in larger voltage drop

APPENDIX 4/ *LAMPIRAN 4*

Appendix 4: Diversity Factor (DF)

Updated: 21st March 2008

Building	School	Health		Mosque	Hall	Hostel		Dining Hall/ Canteen	Office	Lab		
		Essential	Non-Essential			School	Executive			Computer	Science	Quarters
Lamp/Fan	0.8	0.8	0.9	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
13A S/S/O	0.1	0.4	0.4	0.4	0.4	0.1	0.4	0.4	0.4	0.6	0.6	0.5
15A S/S/O	1	1	1	1	1	1	1	1	1	1	1	1
AC Motor Pump	1	1	1	1	1	-	1	1	1	1	1	1
Outdoor Lighting	1	1	1	1	-	-	-	-	1	1	1	1
Water Heater	-	-	-	-	-	-	1	1	-	-	-	1
Cooker Unit	1	1	1	-	-	-	-	-	-	-	-	-
Isolator	1	1	1	1	1	1	1	1	1	-	-	-

Note: * DF may be relook based on the day and night profile usage.