

**PART A / BAHAGIAN A**

- (1). (a). **Differentiate** between the series circuit and parallel circuit in electric detonator system.

***Bezakan** antara litar bersiri dan litar selari di dalam sistem detonator elektrik.*

(6 marks/markah)

- (b). Based on the sources of extraneous electricity hazards listed below, **discuss** and **rank** according to their potential hazard that may occur during the execution of the electric system:

- Lightning
- Stray current
- Electromagnetic induction
- Static electricity
- Galvanic electricity

*Berdasarkan kepada punca-punca arus elektrik luaran berikut, **bincangkan** dan **susunkan** berdasarkan tahap risiko yang mungkin berlaku semasa sistem inisiasi elektrik sedang dijalankan*

- *Kilat*
- *Arus liar*
- *Induksi electromagnetik*
- *Elektrik statik*
- *Elektrik Galvani*

(15 marks/markah)

...3/-

- (c). A parallel circuit with 50 detonators (each with a resistance of 1.0 ohms) with 350 m of twin core firing cable (resistance of 0.0033 ohms/m) is proposed for a blasting. Note that the average current required is stipulated as 0.7 amps per detonator in the circuit. Given the initiation time is 7 ms.

*Sebuah litar bersiri dengan 50 peledak (setiap satu dengan kerintangan 1.5 ohms) mempunyai panjang 350 m kabel ledakan pusat berganda (kerintangan sebanyak 0.0033 ohms/m) dicadangkan untuk suatu aktiviti peletupan. Nota: Purata arus diperlukan adalah pada kadar 0.7 amps per detonator di dalam litar. Diberi masa inisiasi adalah 7 ms.*

**Determine:**

***Tentukan:***

- i. The power requirement  
*Kuasa diperlukan*  
(3 marks/markah)
- ii. The energy input to a detonator  
*Tenaga diperlukan oleh peledak*  
(1 marks/markah)

**...4/-**

- (2). (i). Discuss and explain the causes of misfire that's due to explosives failure and initiation systems failure.

*Bincangkan dan terangkan punca salah cetus yang disebabkan oleh kegagalan bahan letupan dan kegagalan sistem pemula .*

(6 marks/markah)

- (ii). Explain the transportation of explosives from the supplier to blasting site and back.

*Terangkan kaedah pengangkutan bahan letupan dari lapangan (tempat peletupan) pergi dan balik*

(6 marks/markah)

- (iii). Discuss the parameters that will influence the degree of fragmentation during blasting

*Bincangkan parameter yang memberi kesan terhadap pemecahan semasa proses peletupan.*

(7 marks/markah)

- (iv). Discuss the selection procedure for drill and drilling method.

*Bincangkan kaedah pemilihan gerudi and pengerudian.*

(6 marks/markah)

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**PART B / BAHAGIAN B**

- (3). (a). Briefly, **discuss** the potential that may occur during the blasting in the following situations:

*Secara ringkas, **bincangkan** kemungkinan yang berlaku ketika pembedilan dijalankan di dalam situasi berikut:*

- (i). Undersized burden vs Oversized burden  
*Beban terkecil lawan Beban terlalu lebar*

(3 marks/markah)

- (ii). Under stemming vs. Over stemming  
*Pemadatan tercetek lawan Pemadatan terlebih dalam*

(3 marks/markah)

- (iii). Too short delay vs. Too long delay  
*Lengah masa terlalu singkat lawan Lengah masa terlalu panjang*

(4 marks/markah)

...6/-

- (3). (b). **Illustrate** the following blasthole design given the delay timing options for the detonator as follows: 17 ms, 25 ms, 42 ms and/or 62 ms.

*Ilustrasikan* reka bentuk lubang letup berpandukan pilihan peledak lengah-masa yang berikut: 17 ms, 25 ms, 42 ms dan/atau 62 ms.

Note: Please submit the answers using the figures provided

*Nota: Sila hantar jawapan menggunakan helaian rajah yang disediakan.*

- (i). **Maximum** of two (2) holes per delay (Figure 1).  
*Maksimum dua (2) lubang per lengah (Rajah 1).*

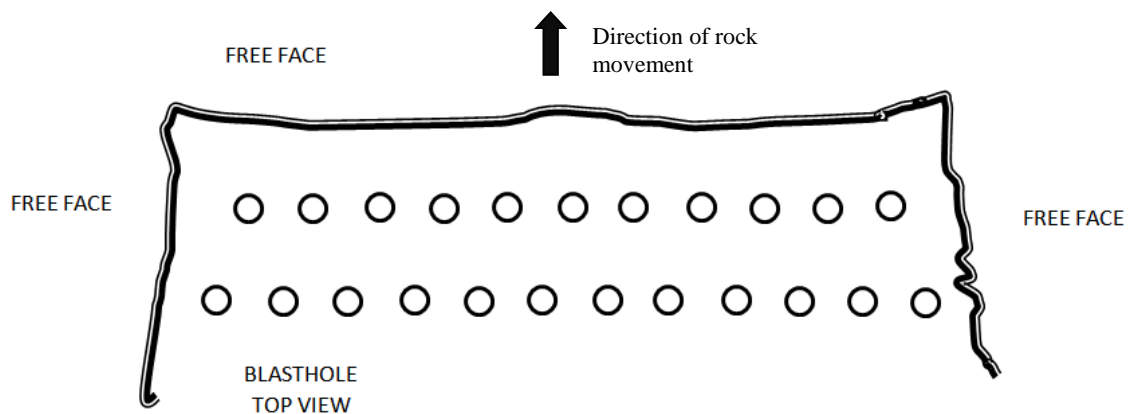


Figure 1/ *Rajah 1*

(3 marks/*markah*)

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- (ii). Maximum of one (1) hole per delay (Figure 2)  
*Maksimum satu (1) lubang per lengah (Rajah 2).*

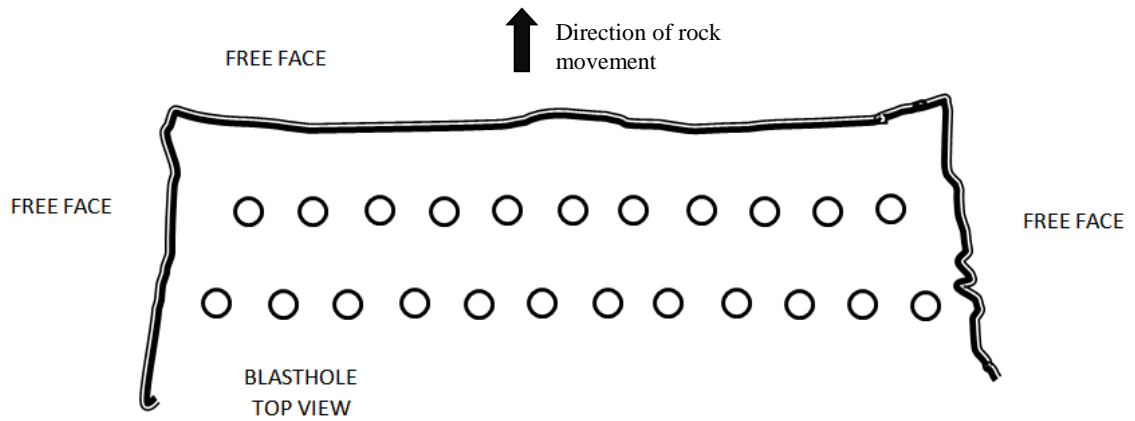


Figure 2 /Rajah 2

(3 marks/markah)

- (iii). Maximum of one (1) hole per delay  
*Maksimum satu (1) lubang per lengah.*

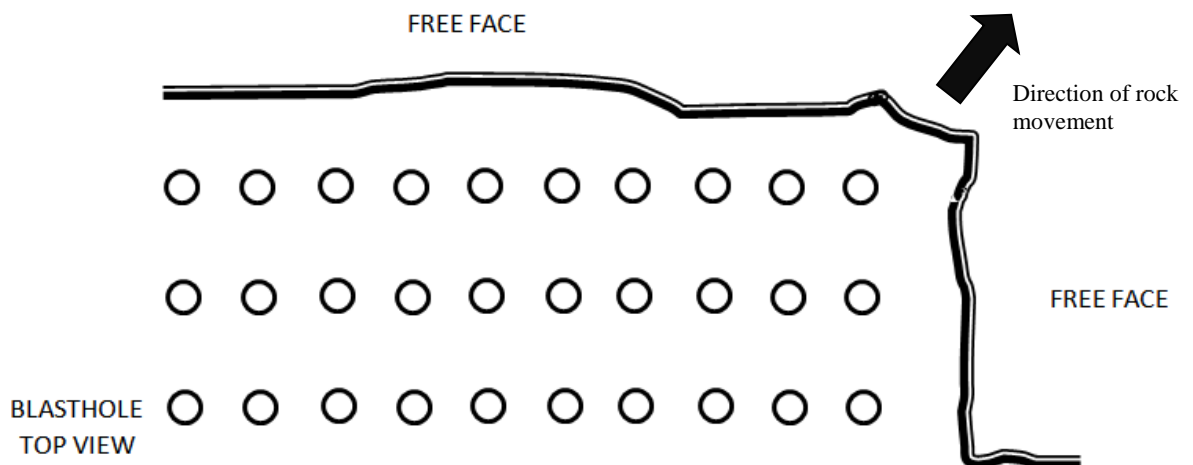


Figure 3/ Rajah 3

(3 marks/markah)

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- (3). (c). There are two (2) types of high explosive; the primary explosive and secondary explosive. Briefly, **distinguish** these two types of high explosive.

*Terdapat dua (2) jenis letupan kuasa tinggi; letupan primer dan letupan sekunder. Secara ringkas, **bezakan** antara kedua-dua jenis letupan kuasa tinggi tersebut.*

(6 marks/markah)

- (4). (a). Before a blaster can design a blast, there are a number of site specific parameters to be taken into consideration that will have an impact on the design. **Define** the parameters to be considered during the design according to the following topics:

*Sebelum seseorang pembedil merekabentuk peletupan, terdapat beberapa parameter yang boleh memberi impak terhadap rekabentuk peletupan dan perlu dipertimbangkan. **Perincikan** parameter-parameter tersebut berdasarkan topik berikut:*

- (i). Site limitations  
*Had lapangan*

(4 marks/markah)

- (ii). Equipment limitations  
*Had peralatan*

(4 marks/markah)

- (iii) Safety limitations  
*Had keselamatan*

(4 marks/markah)

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- (4). (b). A specific drilling hole design for a quarry bench were given as follows:

Drill hole diameter	89 mm
Bench height	15 meter
Inclination of drill holes	vertical
Density of the rock	2.7 tonnes/m <sup>3</sup>
Density of ANFO	0.85 tonnes/m <sup>3</sup>
Spacing	1.2 x Burden
Burden	35 x blast hole diameter
Subdrill	1.00 meter
Stemming	1 x Burden

**Determine** the required

- (i). Volume and weight of explosive (2 marks/*markah*)
- (ii). Blast ratio (2 marks/*markah*)
- (iii). Powder factor (1 marks/*markah*)

...10/-



*Rekabentuk suatu lubang letup untuk undak kuari adalah seperti berikut:*

<i>Diameter lubang letup</i>	<i>89 mm</i>
<i>Ketinggian undak</i>	<i>15 meter</i>
<i>Kecondongan lubang letup</i>	<i>Tegak</i>
<i>Ketumpatan batuan</i>	<i>2.7 tan/m<sup>3</sup></i>
<i>Ketumpatan ANFO</i>	<i>0.85 tan/m<sup>3</sup></i>
<i>Jarak</i>	<i>1.2 x Beban</i>
<i>Beban</i>	<i>35 x garispusat lubang letup</i>
<i>Sub-penggerudian</i>	<i>1.00 meter</i>
<i>Pemadatan</i>	<i>1 x Beban</i>

**Tentukan**

- i. Isipadu dan berat bahan letupan (2 markah)*
- ii. Nisbah ledakan (2 markah)*
- iii. Faktor serbuk (1 markah)*

- (c). If unexploded explosives are discovered in the rockpile during loading operations, **recommend** the best practice to handle this misfire.

*Jika sesuatu bahan letupan yang tidak meletup dijumpai di dalam longgokan batuan ketika operasi pemunggaan, **cadangkan** kaedah terbaik baik menyelesaikan masalah ini.*

(8 marks/markah)

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- (5). (i). Discuss and explain mechanism of drilling and their applications  
*Bincang dan terangkan mekanisma pengerudian dan kegunaannya.*

(6 marks/markah)

- (ii). Discuss factors influencing selection of drill bits  
*Bincangkan faktor-faktor yang mempengaruhi pemilihan mata gerudi.*

(6 marks/markah)

- (iii). Storage and transport are critical parts of using explosives and can affect the safety, performance and economic of blasting operations. Discuss the procedure required to safely store explosives and ammonium nitrates (AN).

*Penyimpanan dan pengangkutan bahan letupan sangat penting kerana ianya boleh menjejaskan keselamatan, prestasi dan ekonomi operasi letupan. Bincangkan prosedur yang diperlukan untuk menyimpan bahan letupan dan ammonium nitrat (AN) dengan selamat dan dapat dioptimumkan penggunaannya.*

(6 marks/markah)

- (iv). Discuss how to achieve optimized blasting conditions (optimum fragmentation, muck pile etc)  
*Bincangkan bagaimana untuk mencapai keadaan peletupan paling optimum (pemecahan optimum dsb)*

(7 marks/markah)

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