
UNIVERSITI SAINS MALAYSIA

Kursus Semasa Cuti Panjang
Academic Session 2007/2008

Jun 2008

BMT 203/3 – Microbial Genetics
[Genetik Mikrob]

Duration: 3 hours
[Masa : 3 jam]

Please ensure that this examination paper contains EIGHT printed pages before you begin the examination.

[Sila pastikan bahawa kertas peperiksaan ini mengandungi LAPAN muka surat yang bercetak sebelum anda memulakan peperiksaan ini.]

Instructions: Answer **FIVE** (5) out of **SIX** (6) questions, in English or Bahasa Malaysia. Each question carries 20 marks.

Arahan: Jawab **LIMA** (5) daripada **ENAM** (6) soalan yang diberikan dalam Bahasa Inggeris atau Bahasa Malaysia. Tiap-tiap soalan bernilai 20 markah.]

1. Explain the function of the following and the effect if they are mutated:

[a] *Chi* sequence

[b] *recBCD*

[c] *ruvA*

[d] *polA*

[e] *dnaG*

(20 marks)

2. Explain the mechanism of the following DNA repair systems:

[a] Mismatch repair

[b] Nucleotide excision repair

[c] Recombinational repair

[d] "SOS" system

(20 marks)

3. [a] The following is the leader peptide sequence located at the upstream region of the tryptophan biosynthetic operon:

5' -AUGAAAGCAAUUUUCGUACUGAAAGGUUGGUGGCGCACUCCUGA-3'

MetLysAlaIlePheValLeuLysGlyTrpTrpArgThrSer***

Explain the role of the leader peptide in the regulation of the tryptophan operon.

(10 marks)

- [b] Explain what will happen if the two *Trp* codons above encountered a deletion mutation and became just one *Trp* codon.

(5 marks)

- [c] Explain what will happen if a frameshift mutation happened one nucleotide after the AUG (Met) codon.

5'-AUGGAAAGCAAUUUUCGUACUGAAAGGUUGGUGGCGCACUCCUGA-3'

(5 marks)

4. [a] Explain the "antitermination" mechanism employed by the bacteriophage lambda.

(5 marks)

- [b] The host nutritional condition is extremely important in the the bacteriophage lambda life cycle. Explain the mechanism that enables lambda to undergo transition from a lysogenic form to an active lytic state.

(15 marks)

5. [a] Explain the regulatory mechanisms acting within *E. coli* cell during these conditions:

[i] Presence of glucose and lactose simultaneously

[ii] Absence of glucose and presence of lactose

[iii] Absence of both glucose and lactose

(12 marks)

- [b] A bacterium named *E. nazalanus* requires two enzymes to metabolize a type of sugar called tigarose. Enzyme Y hydrolyzes tigarose to duarosa and enzyme Z digests duawose into saturose. The genes of both enzymes are located in a single operon and this operon is regulated by tigarose. You had successfully isolated types of mutants in this operon and the expression pattern had changed. The amount of enzyme activities of each mutant are as follow:

Strain	Enzyme Y	Enzyme Z	Enzyme Y	Enzyme Z
Wild type	-	-	+++	+++
Mutant A	-	-	-	-
Mutant B	+++	+++	+++	+++
Mutant C	-	-	-	-
Mutant D	-	-	-	+++
Mutant E	-	-	+++	-
Mutant F	+++	+++	+++	+++
Mutant G	-	-	+++	-

(-) means very low activity
 (+++) means very high activity

- [i] Which mutant has a mutation located in the structural gene of enzyme Y?
- [ii] Which mutant has a mutation located in the structural gene of enzyme Z?
- [iii] Which mutant has a mutation located in the promoter?
- [iv] Which mutant has a mutation located in the repressor gene?

Give reasons for your answers.

(Note: The answer for each question may have more than one mutant)

(8 marks)

6. The genome of the bacterium responsible for typhoid fever, *Salmonella typhi*, has been sequenced. Discuss the impact of this new knowledge on developing new strategies to fight the disease.

(20 marks)

1. Terangkan fungsi yang tersebut serta akibatnya jika dimutasikan:

- [a] *jujukan Chi*
- [b] *recBCD*
- [c] *ruvA*
- [d] *polA*
- [e] *dnaG*

(20 markah)

2. Terangkan mekanisme sistem pembaikan DNA tersebut:

- [a] Pembaikan kesilappasangan (*mismatch repair*)
- [b] Pembaikan pemotongan nukleotida (*nucleotide excision repair*)
- [c] Pembaikan secara rekombinasi (*recombinational repair*)
- [d] Sistem "SOS"

(20 markah)

3. [a] Berikut adalah jujukan peptida pemimpin yang didapati pada bahagian hulu operon biosintesis triptofan:

5' -AUGAAAGCAAUUUUCGUACUGAAAGGUUGGUGGCGCACUCCUGA-3'
MetLysAlaIlePheValLeuLysGlyTrpTrpArgThrSer***

Terangkan bagaimana peptida pemimpin tersebut boleh memainkan peranan dalam pengawalaturan operon biosintesis triptofan.

(10 markah)

- [b] Terangkan apa akan berlaku jika dua kodon *Trp* di atas mengalami mutasi pemotongan dan menjadi hanya satu kodon *Trp* sahaja.

(5 markah)

- [c] Terangkan apa akan berlaku jika mutasi anjakan rangka satu nukleotida berlaku selepas kodon AUG (Met).

5'-AUGGAAAGCAAUUUUCGUACUGAAAGGUUGGUGGCGCACUCCUGA-3'

(5 markah)

4. [a] Terangkan mekanisme "antiterminasi" yang digunakan oleh bakteriofag lambda.

(5 markah)

- [b] Keadaan nutrisi sel perumah sangat penting dalam kitar hidup bakteriofag lambda. Terangkan mekanisme yang membolehkan lambda bertukar daripada keadaan lisogen kepada keadaan lisis yang aktif.

(15 markah)

5. [a] Terangkan mekanisme pengawalan yang bertindak dalam sel *E. coli* dalam keadaan berikut:

- [i] kehadiran serentak glukosa dan laktosa
- [ii] ketiadaan glukosa dan kehadiran laktosa
- [iii] ketiadaan glukosa dan ketiadaan laktosa

(12 markah)

- [b] Satu bakteria baru bernama *E. nazalanus* memerlukan dua enzim untuk metabolisme sejenis gula bergelar tigarosa. Enzim Y mencerna tigarosa kepada duarosa dan enzim Z pula mencerna duawosa kepada saturosa. Gen kedua-dua enzim terletak dalam satu operon dan operon ini diaruh oleh tigarosa. Anda telah memencil 7 jenis mutan dalam operon ini dan corak ekspresi telah berubah. Keputusan amaun aktiviti kesemua mutan adalah seperti berikut:

Strain	Enzim Y	Enzim Z	Enzim Y	Enzim Z
Jenis liar	-	-	+++	+++
Mutan A	-	-	-	-
Mutan B	+++	+++	+++	+++
Mutan C	-	-	-	-
Mutan D	-	-	-	+++
Mutan E	-	-	+++	-
Mutan F	+++	+++	+++	+++
Mutan G	-	-	+++	-

(-) bermaksud amaun aktiviti rendah
 (+++) bermaksud amaun aktiviti tinggi

- [i] Mutan mana yang mempunyai mutasi dalam gen struktur enzim Y?
- [ii] Mutan mana yang mempunyai mutasi dalam gen struktur enzim Z?
- [iii] Mutan mana yang mempunyai mutasi dalam promoter?
- [iv] Mutan mana yang mempunyai mutasi dalam represor?

Berikan sebab untuk setiap jawapan ada.

(Nota: Jawapan boleh mempunyai lebih daripada satu mutan)

(8 markah)