UNIVERSITI SAINS MALAYSIA

Second Semester Examination
Academic Session 2008/2009

April/Mei 2009

BMT 203/3 – Microbial Genetics
[Genetik Mikrob]

Duration: 3 hours
[Masa : 3 jam]

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

[Sila pastikan bahawa kertas peperiksaan ini mengandungi TUJUH 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.]*

...2/-

1. Describe the function of the following genes and the resultant effect if they are mutated.

   recA

   recBCD

   polA

   Chi sequence (χ)

   cIII (bacteriophage lambda gene)

(20 marks)

2. [a] Describe the mechanisms of transcriptional termination in *Escherichia coli*.

(6 marks)

   [b] The host nutritional condition is very important in the bacteriophage lambda life cycle. Describe the mechanism that enables lambda to change from the lysogenic position to an active lytic condition.

(14 marks)

3. [a] Draw a diagram showing the arrangement of the genetic sites that are involved in the *lac* operon and briefly summarize the role of each site.

(6 marks)

   [b] Describe the role of catabolite activator protein (CAP) in creating two separate regulatory mechanisms for the *lac* operon, with one responsive to glucose and the other responsive to lactose?

(14 marks)

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4. *Genetic diversity* refers to any variation in the nucleotides, genes, chromosomes, or whole genomes of organisms. Describe the mechanisms of the generation of diversity from a molecular genetics point of view.

(20 marks)

5. [a] Describe in detail what would happen if the *E. coli* tryptophan (*trp*) operon has the following situation:

[i] deletion of promoter

[ii] deletion of operator

[iii] replacement of every *trp* codon in the leader peptide coding region with *leu* (leucine) codon

[iv] deletion of stem and loop structure 1 in the attenuator

Explain the reasoning behind your answers.

(12 marks)

[b] You perform a P1 transduction experiment using the following strains:

Donor: KanR, His+, Trp+
Recipient: KanS, His-, Trp-

You obtain the following data:

Selection for His$^+$	
Kan^R Trp+	108
Kan^R Trp-	212
Kan^S Trp+	5
Kan^S Trp-	675

Determine the gene distance and order of *Kan^R*, *his*, and *trp*.

(8 marks)

6. [a] Four different *E. coli* Hfr strains were conjugated with F^- recipients to determine the entry time of various genetic markers. The results are as stated below:

Hfr #1	*thr (10 min) lys(21 min) xyl(30) leu(40 min) ade(67 min)*
Hfr #2	*phe(5 min) ade(10 min) bio(32 min) fad(47 min) tyr(48 min) xyl(63 min)*
Hfr #3	*ade(11 min) phe(16 min) ilv(35 min) leu(38 min) lys(57 min)*
Hfr #4	*lys(9 min) fad(16 min) bio(31 min) ade(53 min)*

Use the data above to develop a genetic map containing all the genetic markers as well as the distances between every marker.

(10 marks)

[b] Describe the mechanism of transposition of a transposon.

(10 marks)

1. Terangkan fungsi gen tersebut serta akibatnya jika dimutasikan,

   recA

   recBCD

   polA

   jujukan Chi (χ)

   cIII (gen bakteriofag lambda)

(20 markah)

2. [a] Terangkan mekanisme terminasi transkripsi dalam *Escherichia coli*.

(6 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.

(14 markah)

3. [a] Lukiskan gambarajah menunjukkan aturan tapak genetik yang terlibat dalam operon *lac* dan berikan ringkasan peranan setiap tapak.

(6 markah)

   [b] Terangkan peranan protein aktivator katabolit (CAP) dalam membentuk dua mekanisme berasingan untuk operon *lac* di mana satu bergerak balas terhadap glukosa dan yang lagi satu bergerak balas terhadap laktosa?

(14 markah)

...6/-

4. *Kepelbagaian genetik* merujuk kepada variasi dalam nukleotida, gen, kromosom atau seluruh genom organisma. Terangkan mekanisme penjanaan kepelbagaian dari sudut genetik molekul.

(20 markah)

5. [a] Terangkan dengan terperinci apa akan berlaku jika operon triptofan (*trp*) *E. coli* mengalami keadaan berikut:

[i] mutasi pemotongan terhadap promoter

[ii] mutasi pemotongan terhadap operator

[iii] penggantian setiap kodon *trp* dalam kawasan pengkodan peptida pemimpin dengan kodon *leu* (leusina)

[iv] mutasi pemotongan terhadap terhadap struktur "stem dan loop" 1 dalam attenuator

Berikan taakulan untuk setiap jawapan anda.

(12 markah)

[b] Anda telah melakukan eksperimen transduksi P1 dengan menggunakan strain berikut:

Penderma: KanR, His+, Trp+
Penerima: KanS, His-, Trp-

Anda telah memperolehi data berikut:

Pemilihan untuk His$^+$	
Kan^R Trp+	108
Kan^R Trp-	212
Kan^S Trp+	5
Kan^S Trp-	675

Tentukan jarak serta tertib gen *Kan^R*, *his*, and *trp*.

(8 markah)

6. [a] Empat strain Hfr *E. coli* yang berbeza telah dikonjugasikan dengan strain penerima F^- untuk menentukan masa kemasukan beberapa penanda genetik. Keputusannya adalah seperti dibawah:

Hfr #1	*thr(10 min) lys(21 min) xyl(30) leu(40 min) ade(67 min)*
Hfr #2	*phe(5 min) ade(10 min) bio(32 min) fad(47 min) tyr(48 min) xyl(63 min)*
Hfr #3	*ade(11 min) phe(16 min) ilv(35 min) leu(38 min) lys(57 min)*
Hfr #4	*lys(9 min) fad(16 min) bio(31 min) ade(53 min)*

Gunakan data tersebut untuk membentuk peta genetik merangkumi semua penanda genetik serta jarak antara setiap penanda genetik.

(10 markah)

[b] Terangkan mekanisme transposisi dalam transposon.

(10 markah)

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