ANSWER KEY
with marking scheme

Country: _____

Student Code: _____

23rd INTERNATIONAL BIOLOGY OLYMPIAD

8th – 15th July, 2012

SINGAPORE

SINGAPORE

Finalised.

Titmeng's copy.

THEORETICAL TEST – PAPER 1

ANSWER SHEET

Theoretical Test Paper 1

Answer Sheet

1. (1.8 points) 0.3 × 6

a	b	c	d	e	f
✓	✓	✓	×	✓	×

2. (1.8 points) 0.2 × 9

Cell	Mitochondria present	Functions (a – d) if present
Sperm cell	—	c
Brown fat cell	✓	a
Red muscle fibers	✓	c
Intestine epithelia	—	b, c

3. (0.9 points) → all-or-none (all must be correct)

Lowest Tm	Medium Tm	Highest Tm
a	c	b

4. (2 points) 0.5 × 4

Condition	I	II	III	IV
Cell fate	a	b	b	c

5. (4.2 points)

5.1. (3.6 points) 0.4 x 9

Heptapeptide	pH 1 net charge	pH 7 net charge	pH 12 net charge
Peptide A Asp-Ala-Glu-Asp-Gly-Ser-Ser	+1	-3	-4
Peptide B Gly-Lys-Asp-Ala-Ala-Ser-Gly	+2	0	-2
Peptide C Ser-Lys-Ser-Lys-Gly-Asp-Ala	+3	+1	-2

5.2. (0.6 points) all-or-none (all must be correct)

pH 1	pH 7	pH 12
X	✓	X

6. (0.5 points) 0.1 x 5

a	b	c	d	e
X	✓	X	X	✓

7. (0.9 points)

7.1. (0.4 points) 0.1 x 4

a	b	c	d
X	X	X	X

7.2. (0.5 points)

The number is 92.

8. (1.8 points)

8.1. (0.6 points) 0.2 x 3

Bacterium A	Bacterium B	Bacterium C
X	✓	X

8.2. (0.6 points) — (all-or-none - all must be correct)

C > B > A

8.3. (0.6 points) 0.2 x 3

a	b	c
X	X	X

9. (1 point) 0.2 x 5

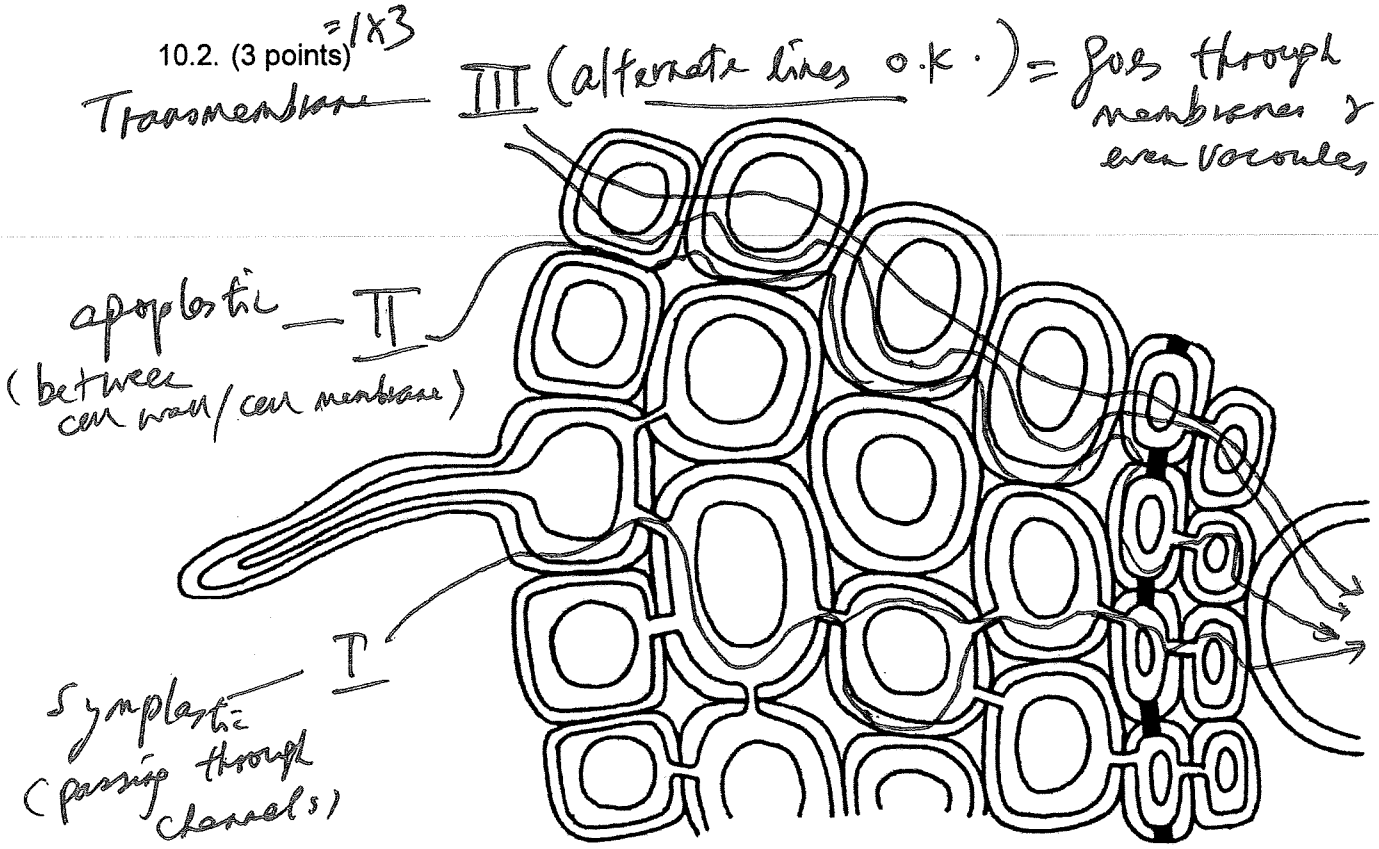
i	ii	iii	iv	v
X	X	✓	✓	✓

10. (4.6 points)

10.1. (1.6 points) 0.2 × 8

A	B	C	D	E	F	G	H
6	4	9	12	11	17	14	8

10.2. (3 points) =1×3



11. (3 points) 0.3 × 10

1	2	3	4	5	6	7	8	9	10
G	H	B	A	C	I	D	J	F	E

12. (1.4 points) 0.2 × 7

a	b	c	d	e	f	g
X	X	X	✓	X	✓	✓

13. (1.2 points) 0.4 x 3

a	b	c
✓	×	✓

14. (1.0 points) 0.2 x 5

a	b	c	d	e
✓	×	×	×	✓

15. (1.5 points) all-or-none – (all must be correct)

Most primitive	Intermediate	Most modern
B	C	A

16. (1.8 points) 0.2 x 9

1	2	3	4	5	6	7	8	9
E	A	B	H	G	I	C	J	D

17. ~~(1.5 points)~~ **[DELETED]**

18. (1.6 points)

18.1. (0.8 points) 0.2 x 4

A > C > B > D

18.2. (0.8 points) 0.2 x 4

D > B > C > A

19. (1.6 point) 0.2 x 8

Animal	Amphibians	Reptiles	Birds	Mammals
I	x	✓	✓	✓
II	x	x	✓	x

20. (2.6 points) 0.2 x 13

Animal	Frog	Salmon	Crayfish	Lizard	Earthworm	Dragonfly
Circulatory system	x	x	✓	x	x	✓
Respiratory organ	a, c	b	b	a	c	d

21. (2 points) 0.2 x 10

a	b	c	d	e	f	g	h	i	j
✓	✓	x	x	✓	x	x	✓	✓	x

note that box 3-10 was deleted. ✓

22. (0.8 points) 0.2 x 4

Saliva secreted/day (litres)	< 0.75	0.75 – 1.5	10 – 12	130 – 180
Animal	a wolf	d human	b horse	c cattle.

23. (0.8 points) 0.1 x 8

	Allergy	Pseudoallergy
a	✓	✗
b	✓	✗
c	✓	✓
d	✓	✗

24. (0.6 points) 0.2 x 3

a	b	c
✓	✗	✗

25. (1.2 points) 0.3 x 4

A	B	C	D
I	II	III	IV

26. (2.4 points)

26.1. (1.2 points) 0.3 x 4

I	II	III	IV
d	a	b	c

26.2. (1.2 points) 0.3 x 4

GI tract surface area/ body surface area ratio			
0.6:1	1.2:1	2:1	3:1
a	b	c	d

27. (0.9 points) 0.3 x 3 The Question asks about Stomach specialisation

I	II	III
c	a	b

c : Carnivore
a : non - ruminant herbivore
b : ruminant herbivore

28. (2.4 points) 0.2 x 12

Part of water column / Habitats					Swimming speed	
Surface	Middle	Bottom	Sea grass beds	Rock crevices	Fast	Slow
F	D, H	A, C, E	G	B	D, H	A, G

29. (3 points)

29.1. (1 point) 0.5 x 2

L/D < 1	b
θ > 45°	b

29.2. (2 points) 0.4 x 5

a	b	c	d	e
✓	x	x	✓	✓

30. (2 points)

30.1. (1 point)

The minimum number of enzymes needed to produce β -MSH = 3.

30.2. (1 point)

The minimum number of enzymes needed to produce α -MSH = 3.

31. (1.5 points) 0.3 x 5

a	b	c	d	e
✓	x	[illegible]	x	✓

32. (1.2 points) 0.2 x 6

a	b	c	d	e	f
x	x	x	✓	x	✓

33. (1.2 points) 0.3 x 4

a	b	c	d
X	—	—	✓

34. (4.8 points)

34.1. The expected ratio = 9:3:3:1 (1 point)

Phenotype	Observed	Expected
Purple flowers, long pollen grains	296	240
Purple flowers, round pollen grains	19	80
Red flowers, long pollen grains	27	80
Red flowers, round pollen grains	85	27
Total number of progenies	427	427

(1 point)

2 full mark if range : 219-223

value in χ^2 value = _____ (2 points)

(if student makes mistake but χ^2 calculation correctly done. Get 1 mark)

34.2. (0.8 points) 0.2 x 4

Complimentary epistasis	Dominant epitasis	Linkage	Maternal inheritance
X	X	✓	X

35. (2.3 points)

35.1. (1.5 points) 0.5 x 3

	homozygous	heterozygous	wild type
%	25	50	25

35.2. (0.8 points) 0.2 x 4

a	b	c	d
X	X	✓	X

36. (1.1 point)

36.1. (0.6 points) 0.1 x 6

	Homozygous dominant	Heterozygous	Homozygous recessive
Normal	X	X	✓
Creepers	X	✓	X

36.2. (0.5 points) 0.1 x 5

Normal	Short wings	Short legs	Short wings and legs	Lethal
X	X	X	X	✓

37. (2 points)

37.1. (1 point)

The fraction expected is = 2/3.

37.2. (1 point)

The fraction expected is = 1/12.

38. (3 points)

range

38.1. (2 points)

The estimated enzyme activity of X (R271Q/E290K) is ≈ 16.5. (15-17 ok)

The estimated enzyme activity of Y (Y424C/ R158Q) is ≈ 30 (28-32 ok)

38.2. (1 point)

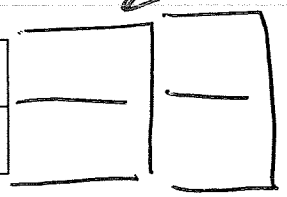
The critical range is somewhere between 10 % to 25 % of normal activity.

39. (2 points) 0.2X10

	Cross	Progeny ratio (purple to green)				
		3:1	9:7	15:1	1:7	1:1
i.	*ChsA chsA ChsJ chsJ C1C1* **X** *ChsA chsA ChsJ chsJ C1C1*	X	✓	X	X	X
ii.	*ChsA chsA ChsJ chsJ C1c1* **X** *chsA chsA chsJ chsJ c1c1*	X	X	X	✓	X

40. (0.6 points) 0.2X3

a	b	c
X	X	✓



← Note that these 2 boxes were removed.

41. (2.7 points)

41.1. (1.8 points) 0.3 x 6

Vombatus	Tyr	Asp	Arg
Notoryctes	Leu	STOP	Pro

Leu or (Leu Pro Ala) = also correct if STOP is not considered a.a.

41.2. (0.9 points) ~~to review~~ 0.3x3

a	b	c
✓	–	✓

42. (3. points)

42.1. (2 points) 0.4 X 5

a	b	c	d	e
X	X	✓	✓	–

42.2. (1 point)

Line	Taxon
o.....	EM

note that 2 rows were deleted

43. (1.8 points) 0.3 × 6

a	b	c	d	e	f
✓	✓	×	×	✓	–

44. (1.2 points) 0.2 × 6

a	b	c	d	e	f
✓	×	✓	✓	✓	×

45. (1.8 points) 0.2 × 9

a	b	c	d	e	f	g	h	i
✓	×	✓	✓	✓	✓	✓	✓	✓

46. (2.8 points) 0.4 × 7

a	b	c	d	e	f	g
×	✓	✓	×	✓	✓	✓

47. (1.2 points) 0.2 x 6

I	II	III	IV	V	VI
e	f	c	b	d	a

48. (1.2 points) 0.3 x 4

Type of plastids	Taxa
Two-membrane rhodoplast	d
Two-membrane chloroplast	a
Four-membrane rhodoplast	c
Three-membrane chloroplast	b

49. (2.6 points)

49.1. (0.2 points)

Answer: A1.

49.2. (0.2 points)

Answer: f.

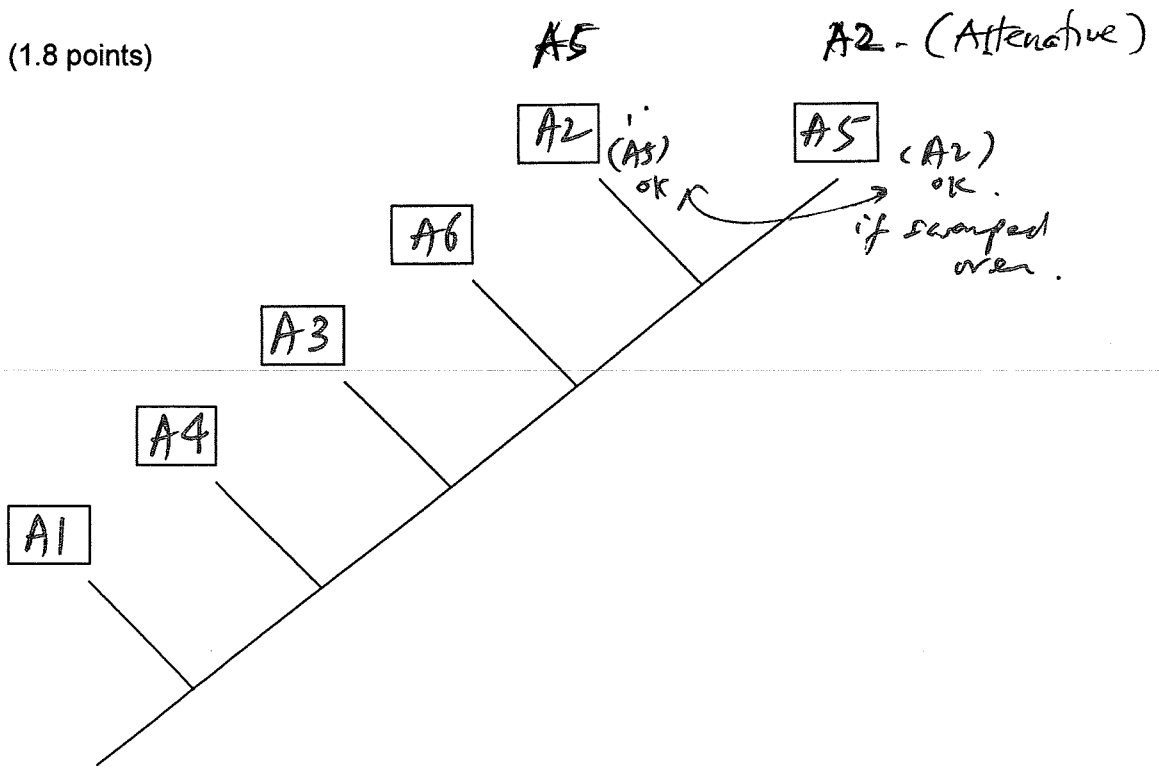
49.3. (0.2 points)

Answer: e.

49.4. (0.2 points)

Answer: b.

49.5. (1.8 points)



END OF PAPER