BIOLOGY SCHEME
TRIAL STPM 2009
PAPER 1

No	Answer
1	C
2	D
3	C
4	B
5	C
6	D
7	A
8	D
9	A
10	C
11	B
12	C
13	A
14	C
15	C
16	D
17	B
18	A
19	B
20	D
21	C
22	C
23	D
24	B
25	A

No	Answer
26	B
27	C
28	C
29	D
30	C
31	A
32	A
33	C
34	C
35	A
36	B
37	C
38	D
39	B
40	C
41	A
42	D
43	B
44	B
45	C
46	C
47	D
48	A
49	A
50	B

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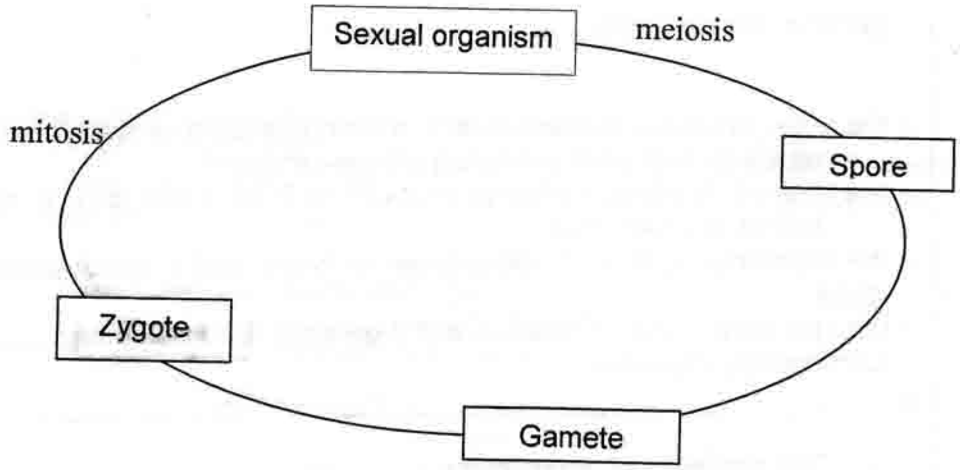
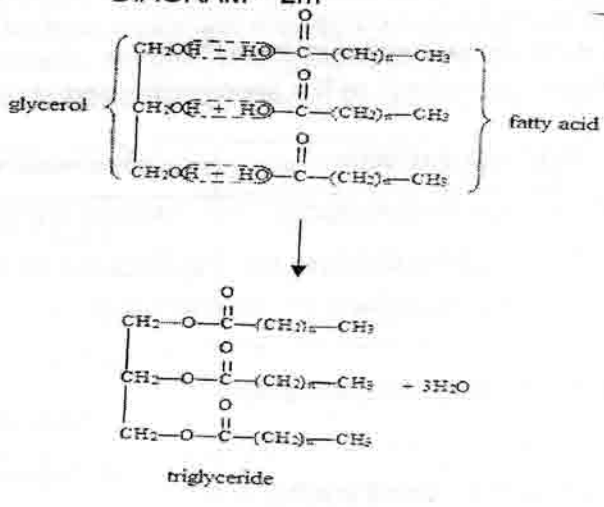
No	Answer	Marks
1(a)	The alternation between a haploid gametophyte generation that produces haploid gametes and a diploid sporophyte generation that produces diploid spores	1
	where one of the generations is a dominant generation.	1
(b)	F	1
(c)	male : antheridum	1
	Female: archegonium	1
(d)		1 1
(e)	Body is differentiated into stem, leaves and fibrous roots.	1
	Vascular tissue consists of tracheids and sieve tubes.	1
	Dominant sporophyte.	1
	Free gametophyte. (Any 3)	1
		3
	Total	10
2(a) (i)	- q^2 = 1/2,500 or 0.0004, q =0.02.	1
	- The frequency of the cystic fibrosis (recessive) allele in the population is 0.02 (or 2%).	1
(ii)	- The frequency of the dominant (normal) allele in the population (p) is simply 1 - 0.02 = 0.98 (or 98%).	1
(iii)	- Since 2pq equals the frequency of heterozygotes or carriers, then the equation will be as follows: 2pq = (2)(.98)(.02) = 0.04 or 1 in 25 are carriers.	1
(b)(i)	- bb = q^2 = 0.4, q = 0.63,	
	- Since p + q = 1, then p must be 1 - 0.63 = 0.37,	1
	- 2pq = 2 (0.37) (0.63) = 0.47.	1
(ii)		1
	- p^2 or (0.37)2 = 0.14.	
(iii)		1
	- No mutations	1

	- No Migration - Random mating must occur - Large population - No selection (Any Two) Total	1 1 1 1 2 10
3 a(i)	- lac operon	1
a(ii)	- inducible operon	1
a(iii)	- it is stimulated to be switched on when lactose is present	1
b(i)	- lac z	1
b(ii)	- glucose and galactose	1
c	- the active repressor molecule binds to the operator gene and blocks the attachment of RNA polymerase to the promoter - this prevents the transcription of genes of lac Z, lac Y and lac A so no mRNA can be made	1 1
d	- the inactivated repressor molecule can no longer bind to the operator gene - the operon remains switched on and β-galactosidase would be continuously produced -	1 1
4 (a) (i)	- The presence of chlorophyll a - The presence of cellulose	1 1
(ii)	- The presence of fucoxanthin - The presence of alginic acid	1 1
(iii)	- Polysaccharides in the cell wall are different - The storage compounds are different. - Difference in pigment (Any Two)	1 1 1 2
(b)	- Movement/motility -	1
(c) (i)	- A taxon ia a group that contains organisms that share some basic features that indicate they share a common ancestry.	1
(ii)	- Natural classification reflects the evolutionary or phylogenetic relationship based on homologous characteristics.	1
(iii)	- In artificial classification, the analogous characters are used to classify the species without any regard to its origin. Total	1 10

5	a. important role as structural and storage - cellulose-structural compound - made of long chain of B-glucose - unbranched chain run parallel to each other - have cross-linkage that gives stability and strength - insoluble - fibers laid in layers in different directions adding further strength	[max 4]
	- starch-storage compound - mixture of amylase and amylopectin - amylase – unbranched chain of a-glucose forms helix structure - amylopectin – branched chains of a-glucose - compound stabilized by countless hydrogen bond - compact and insoluble - readily hydrolysed to form sugar when required	[max 4]
	b i. the esterification process involves condensation reaction - between one molecule of glycerol and three molecules of fatty acids - three ester bonds are formed to produce a molecule of triglyceride and three molecules of water	1
	DIAGRAM – 2m 	2
	ii. importance of lecithin in cell membrane structure	
	- lecithin is a type of phospholipids molecule consisting of a hydrophilic head and two hydrophobic tails	1
	- The cell membrane is made up of two phospholipids layers with the hydrophilic head on the outside of the bilayer.	1
	- The lecithin bilayer forms a boundary separating the cell contents from the external environment	1
	- Being hydrophobic, it is selectively permeable and regulates the movement of substances across the membrane.	1

6(a)

Chemoautotroph	Photoautotroph	Mark
Done by bacteria	Done by green plants or organisms which has the chlorophyll pigment	1
Synthesise organic compounds from carbon dioxide and water	Synthesise organic compounds from inorganic compounds such as carbon dioxide, water	1
Energy - from oxidation of inorganic substances such as H_2S, ammonia and iron	Energy supply - from the (sun)light	1

3

6(b)

- Saprophytic organisms can be defined as: organisms that obtain their nutritional needs from dead and decaying organic materials 1
- Cannot synthesise their own food 1
- Secrete enzymes such as amylase, proteases, lipase which digest their food extracellulary 1
- Absorb the digested products through the cell surfaces 1
- Give example: *Mucor, Rhizopus*, mushroom 1
- Ecologically important because they act as a decomposer 1
- Break down the dead organism and waste product 1
- The decomposed material which contains chemical elements can be reused (absorbed) by the saprophytes and other autotrophs. 1

8

Obligate parasite	Facultative parasite	Mark
Unable to live independently without the presence of a host for supply of nutrient	Able to live independently without the presence of a host for supply of nutrient	1
Unable to reproduce independently	Able to reproduce independently	1
e.g. Tapeworm (*Taenia solium*)	e.g. bootlace fungus (Armillaria mellea)	1
Always exist as an obligate parasite	When under stressful condition; it can be an obligate parasite.	1
(Any 2) Max 2 mark	(Any 2) Max 2 marks	

Total 4

15

7(a)	- dissociation of carbonic acid in the erythrocytes causes an increase in the concentration of hydrogen ions resulting in reduction of the pH	1	
	- this results in the oxyhaemoglobin dissociating to release haemoglobin which combines with the excess hydrogen ions to form haemoglobinic acid (HHb), as a buffering effect	1	
	- increasing the carbon dioxide concentration increases the rate of oxyhaemoglobin dissociation	1	
	- thus increasing the carbon dioxide concentration reduces the affinity of haemoglobin towards oxygen, a process called Bohr's effect	1	
	- Bohr's effect results in a shift of the oxygen dissociation curve of haemoglobin to the right	1	5
(b)	- the breathing cycle is controlled by the breathing centre located in the medulla oblongata	1	
	- this breathing centre consist of the inspiratory centre and the expiratory centre	1	
	- the inspiratory centre sends impulses to the outer intercostal muscles and diaphragm bringing about contraction while the inner intercostal muscle relaxes	1	
	- this results in an increase in the thoracic cavity volume, bringing about inspiration	1	
	- alveolus and bronchioles expands during inspiration stimulating the stretch receptors within the walls of the alveoli and bronchioles to send impulses to the expiratory centre	1	
	- the expiratory centre sends inhibitory impulses to the inspiratory centre	1	
	- the inspiratory centre then stops sending impulses to the diaphragm and outer intercostals muscle causing them to relax.	1	
	- this brings about a decrease in thoracic cavity volume resulting in expiration	1	
	- when the volume in the alveolus and bronchioles are reduced, the stretch receptors are no longer stimulated to fire inhibitory impulses to the expiratory centre	1	
	- inspiratory centre once again sends impulse to the diaphragm and outer intercostal muscle bringing about contraction and inspiration	1	
	- the cycle is repeated		10
	Total		<u>15</u>
8 (a)	- when a myelinated neurone is sufficiently stimulated, an action potential is generated.	1	
	- this sets up a local current which depolarizes the adjacent region	1	
	- the influx of sodium ions from the extracellular fluid into one region of the axon creates a local circuit in that region	1	
	- the increase in sodium ions in the axoplasm repels the cations to move to the adjacent region which is more negatively charged	1	
	- this increases the membrane potential in the adjacent region and opens up sodium voltage gated channels	1	
	- sodium ions diffuse into the neurone and the membrane is depolarized	1	
	- when the threshold level is exceeded, a new action potential is generated	1	
	- the local current at one region, therefore, induces a new action potential in the adjacent region which keeps moving in a forward direction	1	
		Max:7	

	- when a nerve impulse arrives at a synaptic knob, calcium gated channels in the presynaptic membrane opens - Ca^{2+} ions diffuse quickly from synaptic cleft or extracellular fluid into the synaptic knob - this influx of Ca^{2+} causes the synaptic vesicle to fuse with the presynaptic membrane - vesicles release neurotransmitter molecules into the synaptic cleft by exocytosis - neurotransmitter molecules diffuse across the cleft and bind to the receptors on the postsynaptic membrane - this binding triggers the opening of sodium channels - Na^{+} ions diffuse into the postsynaptic neurone, depolarising the postsynaptic membrane - a new potential, known as excitatory postsynaptic potential (EPSP) is generated - if the EPSP is large enough to reach the threshold level, an action potential is generated and is transmitted along the postsynaptic neurone.	1 1 1 1 1 1 1 1 1 Max:8
9 (a) (b)	- Gene mutation is the change in the sequence of nucleotide bases of the DNA that corresponds to a particular gene in an organism - also known as point mutation. - frameshift mutation and missense mutation are different forms of gene mutation. - Chromosomal mutation is the change in the structure of the chromosome also known as chromosomal aberration - or the change in the number of the chromosomes in an organism. - aneuploidy and euploidy which consists of allopolyploidy and autopolyploidy are different forms of chromosomal mutation. max - The four possible ways that gene mutation can occur are through substitution, inversion, insertion, and deletion. - in substitution, a nucleotide base pair is replaced by another base pair in the DNA nucleotide sequence of the gene. - and they are usually missence mutations as the new nucleotide base alters one genetic code to a different code which may still code for an amino acid but it is a different amino acid. - an example of genetic disorder caused by substitution is sickle-cell anaemia, where the base thymine in the code for glutamic acid is substituted by the base adenine in the gene that codes for the β-polypeptide chain. - in inversion, two or more nucleotide base pairs have been reversed in the DNA base sequence within the gene. - the altered genetic code may result in a different amino acid in the polypeptide chain and the formation of a non-functional protein. - in insertion, an extra nucleotide base pair is inserted into the DNA base sequence of a gene causing the whole base sequence to be shifted one place backward. - in deletion, a nucleotide base pair is deleted from the DNA base	1 1 1 1 1 4 1 1 1 1 1 1 1 1 1

		sequence of a gene causing the whole base sequence to be shifted one place forward.	
		- both insertion and deletion are frameshift mutation and every single triplet code after the insertion or deletion point is altered.	1
		- insertions and deletions are usually more harmful than substitution and inversion because of the frameshift mutations which often lead to production of non-functional proteins.	1
		- β- Talassaemia major is a genetic disorder caused by the deletion of a base in the β-globin allele and this results in a lack of β-polypeptide chains of the haemoglobin molecule.	1
(c)		max	8
		- Down syndrome is an example of aneuploidy that is instead of 46 chromosomes there are 47 chromosomes in the individual.	1
		- it is a result of non-disjunction during meiosis.	1
		- the two chromosomes number 21 fail to separate during anaphase I or anaphase II of meiosis.	1
		- the gametes produced contain 24 chromosomes (2 copies of chromosome 21) and 22 chromosomes (no chromosome 21)	1
		- when a sperm containing 23 chromosomes fuses with an ovum containing 24 chromosomes and the zygote formed contains three chromosome 21, trisomy.	1
		- the individual may be a male or female usually with flat, broad faces, slanted eyes, short palms and are mentally retarded.	1
		max	4

10(a) (i)	There are three ways to obtain a desired gene:	
	(1) Producing the gene from mRNA by using reverse transcriptase	
	- When a gene is active/expressed, it can produce a few thousand molecules of mRNA which are complementary to the gene. A probe is used to identify the required mRNA.	1
	- From the mRNA, a copy of the original gene/DNA can be produced by using retrovirus. The enzyme involved is reverse transcriptase.	1
	- DNA produced this way is known as complementary DNA or cDNA.	1
	(2) Synthesising the desired gene artificially	
	- The sequence of bases in a gene can be determined from the sequence of amino acids in the protein that it codes for.	1
	- Based on that knowledge, a gene can be synthesised by using nucleotides and joining them in the right order.	1
	(3) Cutting the desired gene from the donor's DNA by using restriction endonucleases.	
	- Restriction endonucleases are enzymes produced by bacteria to cut up the DNA of viruses which attack them. Restriction endonucleases are used to cut a donor's DNA to obtain the desired gene.	1
	- Restriction enzymes cut DNA at specific base sequences known as restriction sites. More than 2000 restriction enzymes have been discovered, each with its specific restriction sites.	1
	- Restriction sites are polindromes. This means the base sequence of one strand reads the same as its complementary strand in the opposite direction.	1
	- Restriction enzymes make staggered cuts, producing single-stranded sticky ends which can be used to join up DNA fragments by hydrogen bonding.	1
	- By using restriction endonucleases, the DNA of donor organism is cut into many fragments of various lengths. The fragments are then separated by means of gel electrophoresis.	1
	- The DNA fragment which contains the desired gene is identified by using a gene probe. It is called the target DNA.	1
	Total = 11 (maximum = 7)	
	- The desired gene is joined to a fragment of DNA known as a vector.	

	Two commonly used vectors are bacterial plasmids and bacteriophage lambda (λ) DNA.	1
(a)(ii)	- Bacterial plasmids are cut by using the same restriction endonuclease as those used to cut the donor DNA so as to produce complementary sticky ends.	1
	- The target DNA is joined to the bacterial plasmid or phage λ DNA by means of their sticky ends. The deoxyribose sugars and the phosphate groups are ligated by using DNA ligase.	
	- The resulting recombinant DNA molecules are then transferred into host cells, usually *E. coli* bacteria. This is done by adding recombinant DNA molecules to a culture flask containing *E. coli*. Calcium ions are added and the flask is warmed. Such a treatment gives rise to pores in the cell surface membrane of *E.coli*, thus allowing the recombinant DNA molecules to enter. The process is called transformation/transduction.	1 1
	- If bacteriophage λ is used as a vector, insertion of recombinant DNA is done by infecting *E. coli* with the phage.	1
	Total 5	
(b)	(1) Recombinant DNA technology has been used to make bacteria produce humulin (human insulin) for use by diabetics.	1
	(2) Farm animals have been engineered to be "pharmaceutical factories", i.e. made to produce rare human proteins such as α-1 – antitrypsin enzyme and human growth hormone for treating diseases like emphysema and dwarfism.	1
	(3) Diseases such as haemophilia, cystic fibrosis, muscular dystrophy and cancer are caused by defective genes. Recombinant DNA technology is used in gene therapy for treating such diseases by replacing defective genes with normal genes.	1
	Total 3	