Maris Stella High School
2020 Sec 4 Pure Biology

Name: _____
Class (Index No.): Sec 4____ (  )

# Prelim Mark Scheme

**Paper 1: MCQ [40m]**

| Question | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Answer** | **D** | **A** | **D** | **B** | **C** | **A** | **B** | **C** | **A** | **A** |
| Question | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| **Answer** | **D** | **C** | **B** | **B** | **A** | **C** | **D** | **C** | **D** | **A** |
| Question | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| **Answer** | **B** | **D** | **C** | **C** | **C** | **C** | **A** | **B** | **B** | **A** |
| Question | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
| **Answer** | **C** | **C** | **C** | **C** | **C** | **D** | **D** | **B** | **A** | **D** |

***Questions with most mistakes: Q1, 8, 9, 23, 35 and 40.***

**Paper 2 Section A: Structured Questions [50m]**

**1 (a)** **Agglutination** is the forming of a complex between **antigen** (found on red blood cells) and **antibody** (in plasma) produced by white blood cells; [1]
Whereas **clotting** is the formation of a **mesh of insoluble fibrin thread (protein)** trapping **red blood cells and some white blood cells;** [1]

**Agglutination** happens during blood transfusion when the donated blood is **incompatible** with the recipient blood; (**R:** different – Blood group O can donate to Blood group AB) [1]
Whereas **clotting** happens when one has a cut / wound; [1]

**@**: Agglutination is a **physical** reaction but clotting is a **chemical** action;

**@:** Agglutination requires **no enzyme** action so is not **temperature affected**, but clotting is a series of **enzyme-based** reactions, hence affected by **temperature**.

**(b)** People with blood group O has **no antigens A and B types** on their red blood cells; [1]
The **antibodies a and b types, (**if present in the recipients' blood plasma) **will not be able to attack/ bind to the red blood cells in the donated blood.** Hence no agglutination will be formed. Therefore, they are universal donors – can give / donate blood to other people of blood groups A, B and AB; [1]

In comparison, people with AB blood group **have no antibodies a and b types** (in the plasma) **to bind/ clump with any antigens A and B (**if present on the red blood cells) **of the donated blood**. Therefore, they are universal recipients – can accept blood of any types; [1] [1]

*@: There could be little amount of antibodies a and b types in a packet of donated blood group O. There will be some agglutination if it is given to people of blood groups A and B. The amount of agglutination will not cause death to the recipients*

**2** Enters the intercellular air spaces within the leaf through the stomatal pores; [0.5]
By diffusion (from the atmosphere into the intercellular air spaces); [0.5]
Dissolves in film of water/ moisture around spongy mesophyll cell; [0.5]
Diffuses into mesophyll cells (@ chloroplasts); [0.5]
Presence of sunlight; [0.5]
Carbon dioxide is incorporated into glucose molecule; [0.5]
Through photosynthesis; [0.5]
Glucose diffuses out of chloroplast and mesophyll cell; [0.5]
Moves into phloem & out of leaf; [0.5]
Transported as dissolved sucrose till it reaches fruit; [0.5]

**3** **(a)** **(i)**
**Graph increases but should not start from zero;** [0.5]
**plateaus well before 10 min is up and decreases back to normal a few minutes after resting;** [0.5]

**(ii)**
**Glycogen** broken down **to glucose** /increasing glucose concentration; [1]
To ***increase***[1] rate of **respiration** to meet ***increased***[1] energy demand; [1]

**(iii)**
**From 10-20min** (during rest), oxygen supply **exceeds oxygen demands** / excess oxygen intake is used to **pay back oxygen debt**; [1]

**Lactic acid** is removed from cells and transported **to liver**; [1]

**Part** of the lactic acid is **broken down**. The **energy released** is used to **convert the rest of lactic acid into glucose**; [1]

**(b)** **(i)**
Arrow showing leaving plasma (as hydrogen carbonic ions) to RBC; [0.5]
Arrow showing leaving RBC (as carbon dioxide gas) to alveolar air; [0.5]

**(ii)**
Removal + from body / organism. Waste + of respiration / metabolism. Or /AW [1]
**{Removal of metabolic waste (from the body/organism) is excretion.}*

**4** **(a)** Label line must touch the sweat gland; [0.5]
Label line must touch some part of receptor under Malpighian layer; [0.5]

**(b)** Body temperature increases / rises; [1]
Activation of sweat glands to produce **MORE** sweat; [1]
**Vasodilation** of **arterioles** in the dermis of skin; [1]
**increase blood flow** to **capillaries** near the surface of the skin; [1]
to radiate more heat away from the body by radiation …; [1]
**[max: 4 marks]**

**5** **(a)** Any factor that directly affects the rate at which a process (e.g. a chemical reaction) occurs if its quantity is changed; [1]

**(b)**

| experiment | light intensity/arbitrary | limiting factor |
|---|---|---|
| **A** | 20 | light intensity |
| **B** | 20 | temperature |
| **C** | 20 | carbon dioxide concentration<br>**A**: % carbon dioxide |
| **D** | 5 | light intensity |

[1]
[1]
[1]

**6** - with compost, $CO_2$ (concentration) reaches a peak; [0.5]
**A**: increases and decreases
- at 24–26 days/600 – 610 ppm; [0.5]
*units must be given at least once*

- without compost, $CO_2$ (concentration) remains constant; [0.5]
**A**: very slight fluctuations
- at about 200 ppm; [0.5]

Reasons why the two graphs show very different trends
For the one with composting units:

1) Composting requires / is a decomposition process which involves microorganisms / enzymes
Initially **concentration of "substrate" (crop residue and animal manure) is high**, thus **rate of decomposition is high** and **carbon dioxide is produced in addition** to the atmospheric carbon dioxide; [0.5]
Therefore, total concentration of carbon dioxide produced and atmospheric carbon dioxide is **more than the concentration of carbon dioxide absorbed by plants for photosynthesis**; [0.5]
Thus, there is a **net increase of concentration of carbon dioxide**;

2) As concentration of carbon dioxide produced increases, **concentration of "substrate" decreases (as the crop residue and animal manure are used up);** [0.5]
**Rate of reaction decreases** and concentration of carbon dioxide produced decreases, resulting in **net decrease of concentration of carbon dioxide**; [0.5]

For the one without composting units:

3) There is no composting units and thus, there are no other factors that contribute to the carbon dioxide concentration other than the surrounding atmospheric carbon dioxide present in both glasshouses; [1]

**[max: 4 marks]**

**7** **(a)** **A**: a double-stranded **chromosome**; **R**: chromatin. [1]
**B**: centromere; [1]

**(b)** Anaphase I; **R**: Anaphase. [1]

**(c)** Spindle fibres contract and **homologous chromosomes** separate and move to opposite poles of the cell; [2]
{1 mark only if the word 'homologous' is not used.}

**(d)** **Crossing over** between homologous chromosomes in **Prophase I**; [1]
**Description of crossing over**: (e.g.) equivalent portions of the two non-sister chromatids are broken and rejoined to the other chromatid; [1]

**Independent assortment** of homologous chromosomes at **metaphase I**; [1]
**Description of independent assortment**: the homologous chromosomes line up along the equatorial plane RANDOMLY. How one chromosome pair lines up at the plate does not affect how another pair lines up. Each member of a pair of homologous chromosomes then separates independently of the members of other pairs (into different daughter cells). This random arrangement and separation of chromosomes during meiosis give rise to all possible combinations of genes in the gametes formed. Along with chromosomal crossing over, these processes aid in increasing genetic diversity; [1]

*In short, ***independent assortment: aligned randomly; separate independently.***
*Reject: pairing up of the homologous chromosomes is random. (Wrong concept)*

**8** **(a)** **A**: Transcription; [1]
**B**: Translation; ***R**: translocation* [1]

**(b)** DNA does not exit nucleus / too large to exit the nucleus; [1]
A: cannot pass through the nuclear pores.

**(c)** **(i)**
ACUCCUGAGGAG; [1]

**(ii)**
Gene mutation; [1]
@: Substitution

**(iii)**
Sequence of bases determines amino acid sequence in protein; [1]
Wrong amino acid in the sequence will lead to a different protein being formed; [1]
Results in different 3D/ physical structure/ protein folds differently; [1]
A: change in bases – call for a different amino acid – different protein formed…
***[Any 2]***

## Paper 2 Section B: Free Response Questions [30m]

**9** **(a)** **A**xes labeled; [0.5]
accurate **P**lotting of both datasets; [1]
key/legend; (distinguish the 2 sets of data) [0.5]

**(b)** The phenotypic ratio of the seeds from **plants 1 and 2** is **3 smooth : 1 wrinkled**; [1]
R: majority / more smooth than wrinkled seeds…

This can only happen if the parental plants are both heterozygotes; [1]
by either self-pollination or cross-pollination between plants 1 and 2;

The phenotypic ratio of the seeds from **plant 3** is **1 smooth : 1 wrinkled**; [1]
R: more wrinkled seeds than smooth seeds…
This **can only happen from cross-pollination between a homozygous recessive and a heterozygous plant**; [1]
Since plants 1 and 2 are heterozygous, plant 3 has to be the homozygous recessive individual;

**(c)** Tom should **self-pollinate** all 3 plants, taking precaution to prevent cross-pollination by covering the flowers of the plants; [1]

If his hypothesis is correct, the expected results should be

**Plant 1 and Plant 2 self-cross: *{Show genetic diagram once}***

| | | | | | |
|---|---|---|---|---|---|
| Parents' genotypes: | Ss | x | Ss | | [0.5] |
| Gametes: | S | s | S | s | [0.5] |
| Offspring genotypes: | SS | Ss | Ss | ss | [0.5] |
| Offspring phenotypes: | Smooth | Smooth | Smooth | Wrinkled | [0.5] |

Result: 3 smooth: 1 wrinkled; [0.5]

**Plant 3 self-cross:** ss x ss
Result: All wrinkled (ss); [0.5]

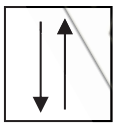
**Note:**
***Accept answer for doing a test cross with homozygous recessive plant and explain the expected result clearly).***

**10 (a)** For bile:
bile emulsifies **fats** to fat droplets; [1]
**R:** *breaks down fats*
**R:** *emulsifies **fat molecules***
**increases surface area** (to volume ratio) for enzyme / lipase action; [1]
neutralizes stomach acid / hydrochloric acid / raises pH / provides optimum pH for enzymes in small intestine; [1]

For lipase:
lipase **hydrolyses** / **chemically digests** fats; [1]
to **fatty acids and glycerol**; [1]

**(b)** The roles of the liver:
liver cells **break down glucose to release energy** in **tissue respiration**; [1]
liver cells **convert excess glucose to glycogen** + for storage; [1]
***R:** if the named hormones facilitating the conversion is wrongly stated.*
liver carries out **deamination** of excess **amino acids**; [1]
removes amino groups to form **urea**; [1]
carbon residue to glucose; [1]

*NB: students must explicitly identify the products of carbohydrate and protein digestion.*

**11 (a)**  [1]

**(b)** Production & changes in hormonal level after fertilisation:
*- The zygote develops into an embryo which implants itself in the uterine lining.*
*- The embryo secretes a hormone [not in syllabus: HCG[5]] which prevents the corpus luteum from degenerating. {Not necessary}*

- The **corpus luteum continues to secrete oestrogen, and later progesterone** until the placenta is formed; [1]
- About **after 6 weeks** of pregnancy, the **placenta takes over** the production of these two female hormones; [1]
-The rise in progesterone level **stimulates further development** of the uterus lining, causes it to **grow thicker and spongier** / vascularised; [1]
- ready **for implantation** / to nourish the embryo; [1]
- The combined high levels of oestrogen and progesterone also trigger an **inhibitory effect on the pituitary, preventing the ripening and growth of more follicles**; [1]

*The combined high levels of oestrogen and progesterone inhibits FSH and LH production. {Not necessary.}*

**(c)** *Occur when pollen grains from the anthers (G); [0.5]
are transferred to the stigma (F) of the same flower, or a flower in the same plant. [0.5]

Pre-fertilisation:
The mature stigma produces a **sugary substance** to stimulates the germination of the pollen grains to pollen tubes; [0.5]
The pollen tube secretes enzymes; [0.5]
grows down the style (E); [0.5]
towards the ovary (D); [0.5]
Along the way, the generative nucleus divides to form 2 male gametes; [0.5]
2 male gametes enters the embryo sac; usually through the micropyle; [0.5]
The vegetative nucleus disintegrates; [0.5]
after the pollen tube has grown to reach the **ovule** (B); R: ovum [0.5]

Fertilisation
1 male gamete fertilizes the ovum (R: ovule), forming the zygote, which divides to form the embryo of the seed; R: forming fruit [0.5]
The 2nd male gamete fertilizes the definitive nucleus, forming the endosperm nucleus that divides to form the endosperm; [0.5]
*Disintegrates in non-endospermic seeds. {Not necessary}

Post-fertilization: Fruit formation
The ovary develops into fruit / ovules into seeds; [0.5]
The stamens (G and E) wither and fall off and the stigma (F) and style (E) wither and fall off, or may persist; [0.5]

**[Max: 4 marks]**

*Note: Candidates who did not identify structures B,D,E,F,G will still be able to get full 4 marks.*