MARKING GUIDE P530/2 2018

1. (i) **Similarities**

- *Population size of both tribolium and oryzaephilus reaches maximum*
- *Population size of both tribolium and oryzaephilus increases at the start of experiment*

Differences

Population size of tribolium	**Population size of oryzaepilus**
• *Reaches maximum later*	• *Reaches maximum earlier;*
• *Does not reach a peak*	• *Attains a peak;*
• *Higher throughout the experiment*	• *Lower throughout the experiment;*
• *Increases rapidly at the start of the experiment*	• *Increases gradually at the start of the experiment;*
• *Increases gradually in the middle of the experiment*	• *Decreases gradually in the middle of the experiment;*
• *Increase gradually and then rapidly at the end of the experiment*	• *Decreases gradually to extinction at the end of the experiment;*

1mark@, max 06marks

(ii) **Similarities**

- *Population size of both tribolium and oryzaephilus attains a peak;*
- *Population size of both tribolium and oryzaephilus increase at the start of the experiment;*
- *Population size of both tribolium and oryzaephilus decrease after the peak;*
- *Population size of both tribolium and oryzaephilus increases gradually in the middle;*
- *Population size of both tribolium and oryzaephilus increase at the start of the experiment;*

Differences

• **Population size of tribolium**	**Population size of oryzaephilus**
• *Attains a higher peak*	• *Attains a lower peak;*

• *Attains a peak earlier*	• *Attains a peak later;*
• *Increases rapidly at the start of the experiment*	• *Increases gradually at the start of the experiment;*
• *Decreases rapidly after the peak*	• *Decreases gradually after the peak;*
• *Higher throughout the experiment*	• *Lower throughout the experiment;*
• *Increases rapidly at the end of the experiment*	• *Decreases gradually at the end of the experiment;*

1mark@, max 07marks

(b)(i) *Population size of tribolium increases rapidly as that of oryzaephilus decreases to extinction due to higher reproductive potential/growth rate of tribolium; hence putting oryzaephilus at a disadvantage in terms of competition for food/flour;*

At the end of the experiment the population size of tribolium increases rapidly in the absence of oryzaephilus; due to reduced competition for food/flour/habitat; ***1mark@,max 04marks*** (ii) *Glass tubings provide a microhabitat for oryzaephilus and hence giving it some advantage to compete with tribolium;*

In the middle of the experiment, population size of oryzaephilus increases gradually as that of tribolium is decreasing rapidly due to increased inter-specific competition;

At the end of the experiment population size of tribolium increases rapidly as that of oryzaephilus deceases since tribolium is a better competitor;

However population size of oryzaephilus does not decrease to extinction; due to some oryzaephilus avoiding direct competition from tribolium by utilising the microhabitats provided by the glass tubings;

1mark@, max 05marks

(**c**)(**i**) *Gauase's competitive exclusion principle; where two different species competing for the same resource; cannot co-exist; so the weaker species is outcompeted to extinction;*

1mark@, max 04marks

(**ii**) *Resource partitioning; where two different species share the same resource; allow co-existence; so both species survive;*

1mark@, max 04marks

(**d**)*Harmful to both species; as they don't adequately utilise the resources as they would do in the absence of the other species;*

Important in spacing out individuals; in areas where they can adequately obtain resources;

Allows niche differentiation/specialization preventing niche overlap;

1mark@, max 05marks

(**e**) (**i**)*Population size of tribolium would continue increasing; as that of oryzaephilus decreases;*

Population of both tribolium and oryzaephilus later decreases to extinction; due to food resources becoming scarce; and due to accumulation of wastes;

$^{1}/_{2}$mark@, max 02$^{1}/_{2}$marks

(**ii**)*Population of oryzaephilus would increase rapidly than when mixed with tribolium; to a carrying capacity; where it stabilizes; and later decreases; due to scarcity of food;*

$^{1}/_{2}$mark@, max 02$^{1}/_{2}$marks

SECTION B (60 marks)

2(**a**) (**i**) *Increased selection pressure occurs under harsh conditions; such as predation/competition/diseases/very hot temperatures/very cold temperatures etc;*

When the population is large resources become scarce leading to stiff intra-specific completion; causing a large number of poorly adapted individuals to die due to starvation/predation;

Only the individuals well adapted/specialised at obtaining food/avoiding predation survive; leading to reduced variability and the population becomes uniform;

1mark@, 06 marks

(**ii**) *Stabilizing selection eliminates extremes of a phenotypic range; and selects for the intermediates; enhancing their reproductive success of the intermediates;*

By selecting phenotypes close to the mean; stabilizing selection reduces variation in the population; and therefore reduces the opportunity for evolutionary change;

Accept illustrations 1mark@, max 06marks

(**b**)*Homologous structures have the same basic plan in the different organisms but modified to perform different functions/serve different niches; for example the pentadactyl limb in*

vertebrates; like in monkeys the digits are elongated for grasping tree branches and in man the same pentadactyl limb is modified for manipulation;

Also the basic structure of all flowers consists of petals, sepals, carpels and stamens; yet number of petals and other aspects differ;

Some homologous structures are reduced in size and these are called vestigial structures;

Homologous structures and vestigial structures show that organisms possessing them descended from a common origin; and this confirms divergent evolution;

Analogous structures have different basic structures but are modified to perform the same function; for example wings of insects and wings of birds/eyes of mammals and those of cephalopods etc; analogous structures confirm convergent evolution;

1mark@, max 08marks

3(**a**)

- *Meristematic tissues consist of small cuboid cells with dense cytoplasm;*
- *Thin walls;*
- *Many small vacuoles;*
- *Undifferentiated plastids;*
  1mark@, max 03marks

(**b**)

Apical meristems	***Lateral meristems***
Cause increase in height/length of the plant	*Cause increase in girth/diameter/width of the stem;*
Lead to formation of primary tissues	*Lead to formation of secondary tissues;*
Located at root and shoot tips	*Located inside the sides of a stem;*

1mark@, max 03 marks

(**c**) *Xylem parenchyma tissue; has spherical/polygonal cells; that form radial sheets/medullary rays for support;*

Parenchyma tissue has cells with a flexible membrane; that allow the cells to expand and become turgid; with cells closely packed; hence offering hydrostatic support;

Collenchyma tissue; has polygonal/rectangular cells; that have cellulose cell wall; to offer tensile

strength; and compressional strength; for extra support;

Sclerenchyma tissue; in the form of fibres; is lignified; elongated; and longitudinally arranged in sheets/bundles for support;

Stone cells/sclereids are also a form of sclerenchyma; which are also lignified; spherical; arranged in groups; to offer firmness;

Xylem also comprises of the trachieds; and vessel elements; that are also lignified to offer strength;

In stems vessels are at the peripheral of the stem for support;

Trachieds have tapering ends that interlock with neighboring trachieds for firm support;

In roots vessels run longitudinally as separate rods to resist collapsing due to tugging strains caused by bending of aerial parts;

Mature xylem completes development by annular; or spiral; or reticulate lignification to increase support;

$^{1}/_{2}$mark@, max 14marks

4(**a**) (**i**) *Let **B** represent allele for broad abdomen;*

*Let **A** represent allele for long wing;*

*Let **b** represent allele for narrow abdomen;*

*Let **a** represent allele for vestigial wing;*

*Let **XX** represent the genotype for female drosophila;*

*Let **XY** represent the genotype of male drosophila;*

½mark@, 03marks

Parental phenotypes: Vestigial winged, broad abdomen male; x *long winged, narrow abdomen female;*

Parental genotypes: $X^{aB}Y$ *x* $X^{Ab}X^{Ab}$ *;*

Meiosis:

Gametes: X^{aB} , Y X^{Ab} , X^{Ab} *;*

Random fertilisation;

F_1 genotypes: $X^{aB}X^{Ab}$, $X^{Ab}X^{aB}$, $X^{Ab}Y$, $X^{Ab}Y$ *;*

*F_1 phenotypes; **2** long winged, broad abdomen female flies;: **2** long winged, narrow abdomen*

male flies;

½mark@, 04marks

(**ii**) *F_1 genotypes:* $X^{Ab}Y$; x $X^{Ab}X^{aB}$;

Meiosis:

Gametes: X^{Ab} , Y X^{Ab} , X^{aB} ;

Random fertilisation;

F_2 genotypes: $X^{Ab}X^{Ab}$, $X^{Ab}X^{aB}$, $X^{Ab}Y$, $X^{aB}Y$;

*F_2 phenotypes: **1**long winged, narrow abdomen female fly;*

***1**long winged, broad abdomen female fly;*

***1**long winged, narrow abdomen male fly;*

***1** vestigial winged, broad abdomen male fly;*

½mark@, 04marks

(**b**) *The lack of 1:1:1:1 ratio is an indication of crossing over between the gene for wing length and that for size of abdomen;*
1mark

Parental phenotypes: Vestigial winged, narrow abdomen male; x *long winged, broad abdomen female*

Parental genotypes: $X^{ab}Y$ x $X^{Ab}X^{aB}$;

Meiosis:

Gametes: X^{ab} , Y X^{AB}, X^{Ab}, X^{aB} , X^{ab} ;

Random fertilisation by punnett square:

	X^{AB}	X^{Ab}	X^{aB}	X^{ab};
X^{ab}	$X^{AB}X^{ab}$	$X^{Ab}X^{ab}$	$X^{aB}X^{ab}$	$X^{ab}X^{ab}$;
Y	$X^{AB}Y$	$X^{Ab}Y$	$X^{aB}Y$	$X^{ab}Y$;

Phenotypes: 35 long winged, narrow abdomen flies: 17long winged, broad abdomen fly: 36 vestigial winged and narrow abdomen fly: 18 vestigial winged and broad abdomen flies;
$^1/_2$mark@, Max 04½marks

(c)

- *Breed quickly/mature faster;*
- *Breed throughout the year;*
- *Have only 4 pairs of chromosomes;*
- *Have giant chromosomes in their salivary glands;*
- *Sex can easily be distinguished;*
- *Cheap to culture;*

5(**a**)

- *Body size; Small organisms have a higher heart rate than larger ones due to their higher metabolic rate;*
- *Age; Young organisms have higher metabolic rate due to rapid growth and hence higher heart rate;*
- *Environmental temperature; Increase in temperature increases metabolic/respiratory rate leading increase in heart rate to eliminate excess carbon dioxide and to supply metabolites;*
- *State of health; Illness increases heart rate due to increased temperature and carbon dioxide;*
- *Exercise; increases metabolic rate leading to increase in heart rate in order to supply nutrients to muscles and to eliminate carbon dioxide;*
- *State of emotion/level of hormones/drugs; increase heart beat causing supply of more nutrients to tissues;*
- *Sex; heart rate is higher in males than females since males are poorly insulated leading to higher metabolic rate;*

Any 4 factors, ½mark for a factor, 1mark for correct explanation, max 06 marks

(**b**)(**i**) *Waves of excitation/stimulation are initiated by the sino-atrio node (SAN); the pacemaker;*

From the SAN waves of excitation spread across both atria; causing them to contract at the same time;

From the atria the waves of excitation reach another special group of muscles fibres called the atrio-ventricular node (AVN) ;and then spread to purkinje fibres/purkyne tissues via bundle of His; from where they spread across both ventricles causing them to contract simultaneously starting from the apex;

Heart beat is controlled by the nervous system; via the sympathetic nerve and vagus nerve that

are connected to the SAN;

Sympathetic nerve sends impulses to the SAN that accelerate heart beat; and vagus nerve brings impulses that slow down heart beat;
1mark@, max 10marks

(**c**)

- *Pumping action of the heart forces blood through the thin walled veins;*
- *Contraction of skeletal muscles squeezes blood in veins to flow towards the heart;*
- *Valves in veins prevent back flow of blood and allow blood flow in one direction;*
- *Inspiratory movements create a negative pressure in in the thoracic cavity hence blood flows towards the heart;*
- *Gravity causes blood in organs above the heart to flow towards the heart;*

1mark@,04marks

6(**a**)

- *Can live in a wide range of temperatures; hence can live in a wide range of habitats;*
- *Can move long distances;*
- *Can easily obtain food since they are always active;*
- *Young ones have higher survival rate since they are born active;*

1mark@, max 03marks

(**b**)

- *Metabolic rate increases; generating more heat;*
- *Arterioles in the skin; constrict; less blood flows near the skin surface; reducing heat loss; by convection/radiation/conduction;*
- *Hairs stand erect; trap a layer of air; which insulates the skin;*
- *Skeletal muscles contract/shivering occurs; generating more heat;*
- *Sweating ceases; reducing heat loss; through evaporation;*

- *Decrease in body surface area/huddling; reduces heat loss;* ***½mark@,max 08 marks***

(**c**) (**i**) *Thermoreceptors in the skin; detect temperature changes;*

Cold thermoreceptors detect decrease in temperature; and heat/hot thermoreceptors detect increase in temperature;

Thermoreceptors are connected to the brain by nerves; and therefore send impulses to the brain/control centre about changes in skin temperature; and the control centre sends stimulate appropriate corrective measures; to return the temperature back to norm;
½mark@, max 04 marks

(ii) *The hypothalamus in the brain; detects changes in temperature of blood passing through the brain;*

When temperature increases above norm stimulates the heat loss centre; in the (anterior) hypothalamus; that stimulates corrective measures; to decrease temperature back to norm;

Decrease in temperature of blood flowing through the brain below norm stimulates the heat gain centre; in the (posterior) hypothalamus; which stimulates corrective mechanisms that increase heat gain; to raise temperature back to norm;
½mark@, 05marks