EMPA PAST QUESTIONS:

***ALL TASK 1 QUESTIONS:***

1. The filter paper the maggot was placed on was damp. Suggest why this was important.

Maggot moves more slowly/maggot turns more often/more favourable environment for maggot/prevents maggot drying out

1. Why was it important to place the maggot at the centre of the filter paper?

Equal distance to edge/same starting point for each maggot

1. How did you determine the centre of the filter paper?

Fold filter paper in half twice and use intersection/draw 2 diameters and use crossing point/measure diameter and use half way

1. You used a teaspoon to place a maggot on the filter paper. It would not have been appropriate to use forceps for this. Suggest why.

May harm maggot

1. You were told to decide for yourself when the maggot had changed direction. Describe what you counted as a change of direction.

Maggot’s whole body changed direction

1. You were told to turn the filter paper over before replacing the maggot. Suggest why this was important.

To prevent maggot being influenced by its previous movement

1. In this task, it is an advantage to record the number of changes of direction made by the same maggot in ordinary laboratory light and in reduced light. Explain why it is an advantage to use the same maggot.

One reading acts as a control for the other/light intensity is the only factor that changes

1. In brighter light, maggots usually make fewer changes of direction and thus reach the edge of the filter paper sooner. Suggest and explain the advantage of this behaviour to the maggot.

Move more quickly out of bright light/less favourable environment. Reduces chance of predation/dying out.

1. What gas makes up the biggest proportion in the bubbles produced by the aquatic

plant?

Oxygen

1. Rate of production of bubbles can be used for measuring the rate of photosynthesis.

Explain why.

Proportional to/correlates with the rate of photosynthesis; Oxygen produced in lightdependent reaction/photolysis

1. The cells in the aquatic plant will also be carrying out respiration. Will this affect your

results? Explain your answer.

Yes. Respiration uses oxygen; fewer bubbles. OR no, respiration uses oxygen/produces CO2;rate of respiration likely to be constant/CO2 soluble.

1. You placed the boiling tube containing the aquatic plant into a beaker of water. Explain why.

To minimise or prevent temperature changes

1. you were told to leave the aquatic plant for 10 minutes before starting to count bubbles. Suggest why.

To allow the rate of bubbleing/photosynthesis to stabilise/become constant

1. You could use the apparatus in Figure 2 to investigate the effect of light intensity on the rate of photosynthesis by positioning the lamp at different distances from the plant.

Give three variables that would need to be controlled in an investigation into the effect of light intensity using the apparatus in Figure 2. For each variable named, describe how it would be controlled.

Temperature – an additional measure to reduce healing

Piece of plant/species of plant – use the same piece/mass/length of aquatic plant throughout

Cos/sodium hydrogencarbonate – use the same water source/use same concentration of sodium hydrogencarbonate

Wavelength/colour/light intensity of source – use the same light bulb/control the background light

1. Explain why it is essential to control variables in this investigation.

To ensure only the light intensity/independent variable affects the results/photosynthesis/dependant variable.

1. Describe how you selected the seeds at random.

Allow any method that does not involve any element of conscious choice

1. Selecting the seeds at random prevents bias. Explain what is meant by bias in selecting seeds.

Selector influenced (by some feature)/selector makes conscious choice

1. Use your ruler and the scale on the photograph to find the magnification of the seeds in the photograph. Explain how you arrived at your answer.

Principle that magnification is apparent size divided by real size; 4.0 – 4.2

1. Calculate the actual length of seed 1. Explain how you arrived at your answer.

Two marks for correct answer in range 5.7 – 6.5;; One mark for incorrect answer in which incorrect measured length of seed has been divided by magnification / measured length of seed has been compared to given scale

1. You could have calculated the standard deviation from your results. Explain why it would be more useful to know the standard deviation than the lengths of the smallest and largest seeds.

(Involves lengths of) all the seeds/shows spread (of all lengths)

1. Hogweed seeds are normally shaken from the plant by gusts of wind. Explain how a large standard deviation in seed length affects the distances that the seeds land from the parent plant.

Large standard deviation means greater variation (in seed length/size); Greater variation in distance (from the parent plant) /more spread out; Description of why seed size/mass affects distance travelled

1. You were told to wipe the inside of the maze between trials. Suggest why.

Maggots may leave smell/substances/trail; Which could affect (the behaviour of) other maggots

1. Light intensity affects the behaviour of maggots. Describe how you might use a lamp to minimise the effect of changes in light intensity. Explain your answer.

Method which would even out light intensity in maze; To produce uniform/constant light intensity

1. Temperature also affects the behaviour of maggots. Describe how you would find out if there were temperature changes that could have affected the behaviour of maggots in your investigation.

Take temperature continually/when each maggot is used; Determine if changes have occurred (during the experiment)

1. Is it possible to conclude from your data that maggots turn left or right at random when given the choice? Explain your answer.

No. Low sample size/too few repeats; Statistical test not carried out; Not representative

1. The maggots used for the investigation should be as similar as possible. Describe two ways in which the maggots should be similar

Same (previous) treatment e.g. environment/feeding;

Same size/age;

Same species

1. Which aspect of size did you choose to measure? Explain why.

Length of root as its longest/ total length as not always easy to distinguish root and shoot/shoot length as it was less easily damaged/root because straightest/less tangled/strongest

1. Describe how you selected the seedlings you measured.

Unbiased random. e.g. Grid lines drawn on base of Petri dish/seedlings numbered /seedlings lined up (on bench); Use random numbers/systematic method (for choosing seedlings)

1. Explain the reason for selecting the seedlings in this way.

Able to use statistics/removes bias/representative sample

1. Give one problem that you encountered in obtaining accurate measurements. Explain how you overcame this problem.

Seedling curled/not straight/tangled/brittle; Use piece of cotton/stretch out/ straighten against ruler/measure broken pieces; Difficult to see start/end of radicle; Measure whole length; Seedlings difficult to see; Put it on black paper/ use a magnifying glass

1. A representative sample is required. This can be achieved by determination of the running mean of a sample. Suggest how.

Look for number of samples where mean does not change/changes little/mean shows less fluctuation

***ALL TASK 2 QUESTIONS:***

All task two questions will always be:

1. State your null hypothesis
2. Give your choice of statistical test
3. Give the reason for your choice of statistical test
4. Calculate the test statistic
5. Interpret the test statistic in relation to your null hypothesis. Use the words probability and chance in your answer.

Mark scheme answers as an example form each type of test:

**SPEARMAN RANK EXAMPLE:**

1. State your null hypothesis:

There is no (rank) correlation between the number of turns the maggot makes and the time it takes to move off the filter paper

1. Give your choice of statistical test:

Spearman rank

1. Give the reason for your choice:

Looking for associations between (different) measurements (from the same sample)

5. Interpret the test statistic in relation to your null hypothesis. Use the words probability and chance in your answer.

Calculated value **greater than** critical value reject null hypothesis; ≤0.05 probability that the correlation in results occurred by chance/>0.95 probability that the correlation in results did not occur by chance;

OR

Calculated value **less than** critical value accept null hypothesis; >0.05 probability that the correlation in results occurred by chance/≤0.95 probability that the correlation in results did not occur by chance

**STANDARD ERROR AND 95% CONFIDENCE LIMITS EXAMPLE:**

1. State your null hypothesis:

There is no difference in the rate of photosynthesis with green/coloured light and white light

2. Give your choice of statistical test:

Standard error and 95% confidence limits

3. Give the reason for your choice:

Looking for differences between mean values/comparing means

5. Interpret the test statistic in relation to your null hypothesis. Use the words probability and chance in your answer.

If student’s ranges **overlap**: Probability **greater than** 0.05/5% that differences in results are due to chance; Accept null hypothesis

OR

If student’s ranges **do not overlap**: Probability **less than** 0.05/5% that differences in results are due to chance; Reject null hypothesis

**CHI SQUARED EXAMPLE:**

2. Give your choice of statistical test:

Chi squared

3. Give the reason for your choice:

Categorical/frequency data/direction of turn/right and left are categories – not taking measurements

5. Interpret the test statistic in relation to your null hypothesis. Use the words probability and chance in your answer.

If the calculated value of χ2 is **less than** the critical value; >0.05 probability (5% probability) that the difference between expected and observed results occurred by chance/≤0.95 probability that the difference between expected and observed results did not occur by chance**.**  Accept the null hypothesis.

OR

If the calculated value of χ2 is **greater than** the critical value; ≤0.05 (5%) probability that there is a statistically significant difference between the expected and observed results/>0.95 probability that the difference between the expected and observed results did not occur by chance; Reject the null hypothesis.

***ALL TASK 3 QUESTIONS:***

1. All the maggots should have been kept in the same environmental conditions before the investigation. Give two environmental conditions that should have been kept the same.

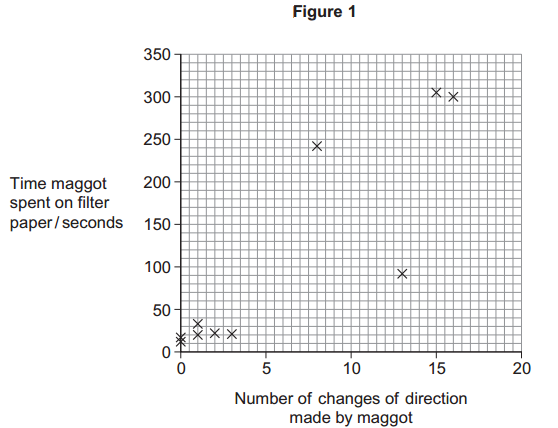
Light intensity; Temperature; Humidity; Food source

1. The behaviour shown by the maggots in Task 1 and Task 2 was a kinesis. What is a kinesis?

A non-directional response to a stimulus; Results in changed rate of movement/turning; Keeps an organism in a favourable environment/until organism is in a more favourable environment

1. How could you calculate the rate of movement of a maggot in mm s–1?

Draw a line along the path of the maggot and measure this distance; Divide distance moved by maggot in mm by time in seconds

A student carried out the same investigation as you did in Task 2. He plotted his data as shown in Figure 1.

1. Why did the student draw this type of graph?

To see if there was an association/relationship/correlation between the two variables; Two continuous variables

1. Other than environmental factors, suggest two reasons why maggots showed variation in the number of times they changed direction during the investigation

Genetic (variation); (Differences in) age/size/mass; (Different) starting orientation; (Different) sex

1. The student proposed the hypothesis that ‘by changing direction more often, a maggot stays in a favourable environment’. Do his results support the hypothesis? Explain your answer

Yes (because) Positive correlation; More turns does mean the maggot stays in the

same area for longer;

No (because) No statistics; Don’t know if the trend is significant/not due to

chance; No evidence here of whether this is linked to conditions being favourable

1. When measuring the mean percentage damage to maize plants, 60 plants from each test plot were selected at random and examined. Describe how the maize plants could be selected at random

Set up tape measures on two sides of the plot/make grid of plot; Use random number table/calculator/generator; To generate coordinates;

1. In the test plot, bare ground was left between the maize and the grass species. Suggest an explanation why.

To prevent competition between the maize and the grass; For light/nutrients/water; OR Idea of limits movement of pest (between grass and maize); Only eating/damaging grass

1. The legume plants have nodules containing nitrogen-fixing bacteria on their roots. Explain how nitrogen-fixing bacteria could increase the growth of the maize.

Nitrogen-fixing bacteria convert nitrogen (in the air) into ammonium compounds (in the soil); These ammonium compounds are converted into nitrates/nitrification occurs; Maize uses nitrates (in soil) for amino acid/protein/ATP/nucleotide production

1. It was essential to include a control experiment in this investigation. Explain why.

Any difference is due to the treatments/push-pull

1. Describe the results of the control experiment.

More food eaten without pesticide (than food with pesticide); (Standard error) bars overlap so no

significant difference

1. Name the type of behaviour the insects showed in response to the hormone.

Taxis

1. The scientists concluded that the push-pull stimuli would improve control of the insect

pest. How do these data support this conclusion?

More food with pesticide eaten when push-pull used; No overlap of standard error bars so (suggests) significant difference; (So) likely to result in death of more insects

1. The scientists’ investigations were aimed at developing an integrated system of pest control. What is meant by an integrated system of pest control?

Keeping pest below economic injury level/controlling pest population rather than eradicating it; Using a combination of pest control strategies with at least two examples eg biological, chemical, mechanical

1. A journalist read about the use of push-pull stimuli and wrote an article entitled ‘The days of chemical pesticide use are numbered!’ Evaluate this statement.

Agree (because) Resource A shows successful control of pest (without use of pesticide); Disagree (because) Only shown for one pest on one crop; May not be a plant to use as pull stimulus/push stimulus; Resource A shows no comparison for pesticide use; Resource B still uses chemical pesticide to destroy the insect; Push-pull likely to reduce chemical pesticide use not to eliminate it

1. In step 2, you were told to use the same piece of aquatic plant throughout your Task 2 investigation. Explain why.

Same concentration of chlorophyll/same number of chloroplasts/same number of leaves/same surface area

1. For how long did you decide to count bubbles? Explain why you chose this length of time.

Long enough to minimise effect of miscounting; Short enough to maintain accurate counting; Time to allow sufficient repeats to be carried out

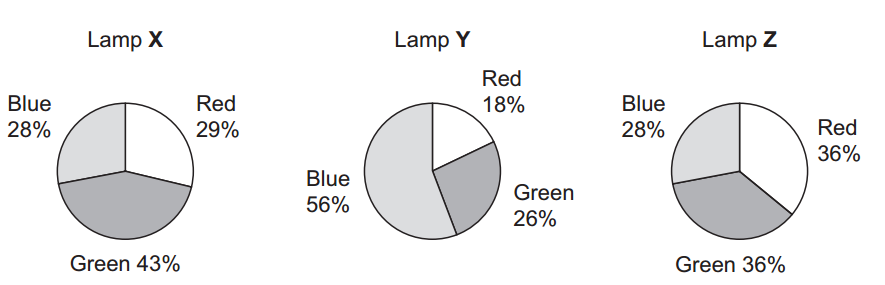
1. How many repeat counts did you take in each colour of light? Give two reasons why you did this number of repeat counts.

Enough for statistical test; Enough for more representative mean; Limited by time available; Reduce the effect of anomalies on the mean

1. The student kept fish and aquatic plants in an aquarium. Suggest two reasons why it would be important to include aquatic plants when keeping fish in an aquarium.

Shelter for fish eg to reduce stress / avoid predators; Food source for plant eating fish; Oxygen production for fish respiration; Remove CO2 produced from fish respiration / remove CO2 so water does not become acidic; Remove nitrogenous waste/namedexample from fish

1. The student wanted to buy new lamps for his aquarium to make sure the aquatic plants would carry out photosynthesis rapidly. He found information about the proportions of different colours of light produced by three types of lamp, X, Y and Z.



The student used this information and his results from Figure 5 to choose the lamp to light his aquarium. He chose lamp Z. Suggest why he chose lamp Z

Highest proportion of red light – this produced fastest photosynthesis

1. Other than the proportion of light of different colours, give one feature of a lamp that could affect the rate of photosynthesis of the aquatic plants

Light intensity/energy; Heat given off

1. A student carried out an experiment using the technique for photosynthesis where there is an aquatic plant in a test tube with water and a pipe with a syringe connected.

What is the syringe used for?

To draw bubble(s) onto scale (for measuring); To draw solution in to tube; To remove bubbles to enable repeat (reading)

1. Using this apparatus, the student obtained a more accurate measurement of the volume of gas produced than by counting bubbles. Explain why

Volume of gas measured/calculated / volume of bubbles not measured; Description of how to calculate volume of gas - 𝜋𝑟2 × length where 𝑟 = radius of bore of tube; Avoids problem of bubbles being differing sizes; Avoids problem of miscounting number of bubbles

1. In leaves at the top of trees in a forest, carbon dioxide is often the limiting factor for photosynthesis. Use your knowledge of photosynthesis to suggest and explain one reason why.

Light not limiting/lots of light (as no shading); Light-dependent reaction not

limiting/fast; OR Temperature not limiting/Warm (as no shading); Fast reactions of enzymes in lightindependent reaction; OR High use of CO2; Light-independent reaction is Limiting

1. The ecologist collected shade leaves at random from a branch. Suggest a method he could have used to collect shade leaves at random from a branch.

Number leaves on the branch; Use random number table/calculator/pick numbers from bag to determine which leaf to pick OR Collect large number of leaves; Pick out of bag with some idea of randomness

1. The ecologist concluded that there is a significant difference between the amounts of chlorophyll b in sun leaves and shade leaves of beech trees. Do you agree with this conclusion?

No. No stats test carried out; Standard error/95% confidence

interval calculation identified; Yes No overlap shown by the standard deviations; Ranges around mean stated

1. Each type of chlorophyll is produced by a specific enzyme-controlled pathway. Use this information to suggest how the same beech tree can produce more chlorophyll b in some leaf cells than others.

In shade leaves: Greater amount of enzyme/enzyme activity (for

production of chlorophyll b); Greater gene expression/transcription of the gene/more mRNA produced/gene switched on; Greater translation; Enzyme/substrate is light sensitive– faster rate of reaction with lower light

1. It is an advantage to beech trees to produce more chlorophyll b in the shade leaves. Suggest and explain why

(Some of the) light that passes through is absorbed by chlorophyll b; This is light of around 500 and/or around 640

1. What sample size did you use in your investigation? Give two reasons why you used this sample size.

Large enough for statistical test; The larger the sample the more representative of the population it will be; Not so many that insufficient time

1. Did you use a maggot more than once in your investigation? Give a reason for your answer.

No. Prevents learning/reduces stress on maggots

1. What is a taxis?

Directional response to stimulus

1. Describe how you could try to ensure that the response of the maggots in your investigation was not a taxis in response to light. Explain your answer.

Method to keep light source nondirectional e.g. lamp above/keep in dark; So that it is not possible to show a directional response/reduces light as a variable/keeps light uniform

1. Maggots detect the presence of food by its scent. Describe how you could use the maze to investigate whether maggots detect the scent of raw meat.

Use T part of maze only/place maggot in stem of T; Put food at one end of Tshape; Analyse data statistically/use large number of maggots; Repeat with food on the other side of T

1. Can you conclude that woodlice show turn alternation behaviour when the distance between the forced turn and the second turn was 10 cm? Explain your answer.

No. Equal numbers/50% turn each way; (Would expect this) by chance/at random

1. The student suggested that the difference in turning behaviour of the woodlice in her investigation was due to the distance between the first and second turn. Her friend suggested that it was due to the time taken to get from the first to the second turn and not the distance. Suggest how you could investigate which of these two possibilities is more likely

Keep distance same; Increase time/delay woodlice/decrease speed of woodlice (Increase time) between forced and second turns

1. The woodlice were left for 15 minutes before their movement was recorded. Give two reasons for this.

Time to establish humidity to that required/time for substance to absorb water; So that behaviour typical of humidity; Woodlice no longer affected by handling

1. The points in Figure 5 do not all fall on the curve. Suggest why.

It is a line of best fit; 2 Variation in woodlice/a named difference in woodlice; 3 Variation in environmental conditions/change in a named environmental condition

1. Woodlice in Group B had a greater percentage loss in mean mass during the investigation than woodlice in Group A. Explain why.

(More mass loss) linked to losing more water; 2 Gills (more) exposed to air/covered (less) by other woodlice; 3 Greater surface area (exposed); 4 (Not clumped) so lower humidity (around each woodlouse); 5 So greater evaporation/diffusion (of water)

1. It would be useful to give the loss in mean mass as a percentage in this investigation.

Explain why

Initial masses different

1. The movement of the woodlice in low relative humidity is an advantage to their survival. Explain how.

Low humidity results in more woodlice moving; So increased movement increased chance of leaving dry/unfavourable environment; So reduce water loss/reduce evaporation

1. You were provided with 0.2 mol dm–3 sodium chloride and distilled water. Describe how you would use these to make up 10 cm3 of a solution of concentration 0.15 mol dm–3. 7

7.5 cm3 sodium chloride and 2.5 cm3 distilled water;

1. How did you decide how many lettuce seeds to use in each Petri dish?

Sufficient to get enough data for statistical test; Not too many so they are crowded/become tangled/difficult to count;

1. How did you arrange the lettuce seeds in each Petri dish? Why did you choose this arrangement?

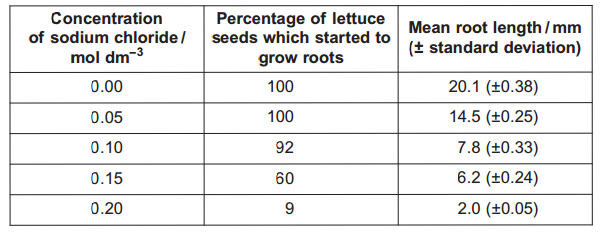
maintain distance so they do not compete with each other

1. The Petri dishes should have been covered to prevent evaporation. Why is it important to prevent evaporation in this investigation?

Evaporation would lead to loss of water; This would increase concentration of salt solution / decrease water potential of salt solution

1. You used 5 cm3 of sodium chloride solution in your investigation. Suggest why it was important that the solution did not completely cover the seeds.

It would decrease oxygen availability; Would stop respiration/would inhibit respiration; Could encourage fungal growth/growth of mould

1. A student carried out a similar investigation to yours. The table shows her results.

Describe what these data show.

As NaCl concentration increases the percentage (of seeds growing roots) and (mean) root length decrease; Percentage (of seeds growing roots) decreases above 0.05 (mmol dm-3 ); Root length falls uniformly up to 0.10 (mmol dm-3 ) then falls less steeply after 0.10 (mmol dm-3 ); No overlap of SD / SD decreases as concentration (of NaCl) increases; At 0.05 (mmol dm-3 ) all seedlings are growing (roots) but have shorter (mean) root length

1. Suggest an explanation for the effect of sodium chloride concentration on the germination of seeds.

Increased sodium chloride concentration decreases water potential/makes water potential more negative outside seeds/in surrounding solution; Seeds take up less water; By osmosis; Reduces enzyme activity/named enzyme activity

1. Lettuce is classified in the same family as dandelions. Dandelions commonly grow on roadside verges and may accidentally be sprayed with salt when salt is added to the road in winter. Describe how you could use a transect to investigate whether the distribution of dandelions changed with increased distance from the road.

Lay tape/rope at right angle/perpendicular to road; Take samples at regular/stated intervals; Using a quadrat; Count numbers/percentage cover of dandelions; Use several transects;

1. Explain why the lettuce growers measured germination as a percentage

So that they could compare different numbers of seedlings

1. Suggest how you could determine the dry mass of a sample of plant material.

Heat at 100 C / heat to temp to evaporate water; Weigh and heat until no further change in mass

1. What is the advantage of using dry mass and not fresh mass to compare the yield of plants?

Amount of water present will vary; This will affect fresh mass / will not affect dry mass