
Specimen answer 3

June 14 BIOL5 10b

10 Write an essay on one of the following topics.

EITHER

10 (a) How cells and organisms carry out exchanges with their external environment to maintain their internal environment.

[25 marks]

OR

10 (b) How energy is transferred within and between organisms.

[25 marks]

If you want to make a plan write it here.

10 b) How energy is transferred within and between organisms

Plan:

- ecosystems energy loss
- nitrogen cycle
- carbon cycle
- ATP
- digestion
- Pacinian corpuscle
- photosynthesis
↓
light chemical
- rod cells, cone cells



Energy is transferred between organisms in a number of different ways. Energy transfer is vital for ^{the} survival of organisms and for them to carry out specialised processes such as active transport, muscle contraction etc and regulation of body temperature.

Energy cannot be created or destroyed ⁱⁿ it is transformed from one type to another.

The sun is vital for survival on Earth for many organisms. The sun provides energy in the form of both heat and light. Photosynthetic organisms such as plants contain leaves with lots of chloroplasts ^{which} are full of pigments such as chlorophyll A, B. Light energy strikes ~~these~~ chlorophyll molecules where it excites electrons to a higher energy level. They pass down a series of electron carriers in redox reactions and the energy is ^{used} to combine ADP with P_i to form ATP. This is called photophosphorylation. Photolysis of water by light splits water into protons, electrons and oxygen, this produces reduced NADP. CO_2 enters through stomata and the enzyme Rubisco catalyses the formation ^{of} 2 molecules of G3P from CO_2 and RUBP.

Turn over ►

PG3P is ~~can~~ reduced $\rightarrow$ to TP by reduced NADP and energy from ATP. TP can be regenerated to form RUBP and can also be converted to useful organic substances such as glucose. In photosynthesis, light energy from sun is converted to chemical energy in the form of glucose which then passes along food chain.

At each trophic level, there is a loss of energy between organisms and their environment. Firstly, not all light energy that strikes chlorophyll molecule is of the right wavelength and not all light energy strikes chlorophyll molecule, so energy is lost between the sun and producers. Energy is also lost between consumers as not all of the organism is eaten, for example the roots in plants or bones of animal. Not all of organism can be digested, for example cellulose in plants, and ^{energy is lost as the} it is excreted, lost in faeces. Energy is also lost between an organism and its environment due to respiration and maintenance of body temperature but also during movement. Energy is transferred between consumers, producers and their

environment in many ways, and energy is converted into a number of different forms.

In carbon cycle, when organisms die, saprobionts release enzymes that break down organic matter. They absorb products of digestion by diffusion, then when they respire, they release CO_2 into the atmosphere. Energy is also transferred when fossil fuels are burnt as they release CO_2 and methane.

In Nitrogen cycle, nitrogen fixing bacteria convert nitrogen gas from atmosphere into nitrogens. In process of ammonification,

Saprobionts release enzymes that break down nitrogen containing compounds such as urea into ammonium ions, this is an example of energy transfer. Nitrifying bacteria can then oxidise ammonium ions to nitrite ions then nitrate ions, which can be absorbed by plants, and nitrate nitrogen is used by plants for protein synthesis.

In living organisms, there are receptors on cell surface membranes such as the Pacinian corpuscle. The Pacinian corpuscle converts mechanical energy into electrical energy. In a Pacinian corpuscle pressure

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It causes sodium ion channels to stretch and change shape. This causes sodium ions to enter causing depolarisation and creation of an action potential, which is then transported along sensory neurones to the CNS. Other receptors include rod cells and cone cells which also act as transducers. They Rod cells display ^{when} detect in black white, while cone cells display in full colour. Several rod cells are connected to one bipolar neurone, therefore they have poor visual acuity compared to cone cells where each cone cell is connected to one neurone. Rod and cone cells are sensitive to light and are photoreceptors that convert light energy into nervous, electrical impulses, which then pass to optic nerve.

ATP, adenosine triphosphate, is produced in both the stroma and cristae by ~~of~~ light oxidative phosphorylation and photophosphorylation. ATP is an immediate energy source, that cannot be stored and is broken down by a single one step reaction. The energy transfer when an ATP molecule is hydrolysed, is used in many processes.

including active transport and muscle contraction. Hydrolysis of ATP transfers energy which is vital in muscle contraction for the 'powerstroke' movement and the crossing over of actin, myosin filaments but is also very important in the detachment of actin myosin cross bridges.

There is a transfer of energy in digestion as polymers in food which are insoluble and cannot be directly absorbed into the blood and assimilated, are broken down into monosaccharides. Proteases break down proteins into amino acids, carbohydrases break down polysaccharides into monosaccharides such as glucose. These products can then be absorbed into the blood where they can be used by body.

Chemical energy in glucose can be converted into heat energy or other forms of energy during respiration. This can be used by the body to maintain regular body temperature and a constant internal environment (homeostasis).

In conclusion, the transfer of energy from one form to another is vital.

Turn over ►



for the ~~suicid~~ survival of organisms

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Senior examiner annotations				
#	Item	Page	Mark/symbol	Annotation
1	10	1	0	Plan viewed, no creditable material.
2	10	2	0	Introduction. Do not view as irrelevant material.
3	10	2	0	P - Idea of light energy to chemical energy.
4	10	2	0	P - Correct reference to photolysis and using energy from ATP and reduced NADP to form glucose in light-independent reaction.
5	10	3	0	Et - Correct references to loss of energy between trophic levels and the different ways in which this occurs.
6	10	4	0	Irrelevant material about nutrient cycles.
7	10	4	0	Sr - Pacinian corpuscle converting mechanical energy into electrical energy.
8	10	5	0	Sr - Correct reference to the functioning of light receptors transferring light energy into electrical energy.
9	10	6	0	Correct material about chemical energy from ATP being converted into movement energy and used in active transport. The error in referring to both the stroma and the cristae as the site of ATP production is not a significant error so does not negate.
10	10	6	0	Mc - Noted as a topic however insufficient material.
11	10	6	0	D - Glucose produced as a result of digestion can then be converted into other energy forms eg heat to maintain body temp.
12	10	7	0	Following theme using examples (holistic) - directly addressing theme. One irrelevant passage but, on balance, offset by content. Nothing detailed beyond specification. Extended abstract - awarded 22 marks.