



HUMAN BIOLOGY

ATAR course examination 2016

Marking Key

Marking keys are an explicit statement about what the examining panel expect of candidates when they respond to particular examination items. They help ensure a consistent interpretation of the criteria that guide the awarding of marks.

Section One: Multiple-choice

30% (30 Marks)

Question	Answer
1	b
2	d
3	b
4	a
5	a
6	d
7	c
8	b
9	c
10	a
11	d
12	c
13	b
14	b
15	a
16	d
17	c
18	c
19	b
20	b
21	d
22	c
23	a
24	c
25	a
26	a
27	c
28	d
29	b
30	d

Section Two: Short answer

50% (105 Marks)

Question 31

(11 marks)

- (a) Complete the table below, outlining the anatomical differences between quadrupedal and bipedal primates. (8 marks)

Description			Marks
Anatomical characteristic	Quadrupedal primates	Bipedal primates	1–8
<i>Curvature of the vertebral column</i>	C-shaped/single curvature	S-shaped/double curvature	
<i>Pelvis</i>	Long and narrow/at an angle to the vertebral column	Short and broad/aligned with the vertebral column	
<i>Presence of a carrying angle of the femur</i>	Absent/vertical femur/straight	Present/converge inwards from hip to knee	
<i>Arches in the foot</i>	Longitudinal arch/one arch	Transverse and longitudinal arches/two arches	
Total			8

- (b) (i) What is the meaning of the term prognathism? (1 mark)

Description	Marks
Forward-jutting/protruding jaw	1
Total	1

- (ii) Prognathism is said to be reduced in higher-order primates. Although not the cause of the change, reduced prognathism does provide an advantage for bipedal primates. State what the advantage is. (1 mark)

Description	Marks
Any one of:	1
Helps the skull balance on top of the vertebral column	
Reduction in neck muscles to support skull	
Total	1

- (iii) Suggest a possible cause for the reduction of prognathism in higher-order primates. (1 mark)

Description	Marks
Any one of:	1
Reduction in teeth size	
Reduction in number of teeth	
Reduction in importance of smell	
Increased importance of sight (stereoscopic vision)	
Change in diet	
Development of a chin	
Development of speech	
Total	1

Question 32

(11 marks)

- (a) Identify the type of receptor labelled Y. (1 mark)

Description	Marks
Nociceptor/pain receptor/pain/touch	1
Total	1

- (b) Receptors W, X and Z are all located in the upper region of the dermis, but receptor Y is located in the epidermis. Explain why it is important that receptor Y is located in a different position. (3 marks)

Description	Marks
Closer to the surface of the skin	1
detects change more quickly/triggers a faster response to stimuli/detect light touch	1
Protective device/helps prevent damage	1
Total	3

- (c) Some of the receptors shown in the diagram are involved in triggering reflexes. Name a type of stimulus that would trigger a reflex. (1 mark)

Description	Marks
Any one of:	1
Pain	
Heat/very hot	
Intense light (eye)/sound (hear)	
Irritation to mucosa (sneezing or coughing reflex)	
Irritation to cornea (blinking reflex)	
Any specific example of a reflex stimuli	
Total	1

- (d) Using the labels in the diagram, identify the following correctly. (2 marks)

Description	Marks
Afferent neuron – B	1
Interneuron - A	1
Total	2

- (e) State what is found within the structure labelled C. (1 mark)

Description	Marks
Cell bodies	1
Total	1

- (f) Outline **three** important functional properties that are associated with all spinal reflexes. (3 marks)

Description	Marks
Any three of:	1-3
The reflex is involuntary/without conscious thought	
It is rapid/only involves a small number of neurons/short pathway	
Requires a stimulus/not spontaneous	
It is stereotyped/occurs the same way every time	
Total	3

Question 33

(14 marks)

- (a) What type of therapy was used by the scientists in this experiment? (1 mark)

Description	Marks
Gene (therapy)	1
Total	1

- (b) What is the purpose of injecting the DNA into the rat's body? (1 mark)

Description	Marks
To replace a faulty gene	1
Total	1

- (c) Describe a control group that could be used for this experiment. (2 marks)

Description	Marks
Diabetic rats	1
Received a placebo/injection without the DNA/injection without the active ingredient/no treatment	1
Total	2

- (d) State **one** factor involving blood glucose levels in rats that the scientists would have to determine before they began the experiment. (1 mark)

Description	Marks
Any one of:	1
Normal blood glucose levels in healthy rats.	
Levels of glucose in the diabetic rats before treatment	
Total	1

- (e) If the insulin-producing cells created by this DNA sequence were functioning in the same way as insulin that is normally produced in the body, what is the stimulus being received that ensures optimal levels of glucose are maintained? (1 mark)

Description	Marks
Increased/high blood glucose concentration	1
Total	1

- (f) List **two** further steps that scientists would have to take before people with Type 1 diabetes would be able to have access to this therapy? (2 marks)

Description	Marks
Any two of:	1–2
Clinical trials/trials on humans	
Knowledge of side effects/or a specific example of a possible side effect	
Approval by authorities	
Remove prohibitive costs/be in financial reach of people	
Total	2

- (g) Why is insulin **not** produced in people with Type 1 diabetes? (2 marks)

Description	Marks
An autoimmune response is occurring/cells attacked by self-antigens	1
Affects Beta cells/islet cells/pancreatic cells	1
Total	2

- (h) Describe **two** processes controlled by insulin that ensure the maintenance of blood glucose levels. Include the locations in the body where each process occurs. (4 marks)

Description	Marks	
<i>1 mark for describing the process and 1 mark for location Naming process not a mark – must describe it</i>		
Any two of:		
Conversion of glucose to glycogen	In the liver/muscles	1–4
Conversion of glucose to lipids/fats	In adipose tissue	
Increased uptake of glucose	Body cells	
Increased rate of protein synthesis	Body cells	
Conversion of glucose to amino acids	In the liver/muscle	
Total	4	

Question 34

(14 marks)

- (a) Identify and describe the type of immunity an infant will gain when injected with the Pertussis vaccine. (4 marks)

Description	Marks
Active immunity	1
Body makes own antibodies	1
Artificial immunity	1
Required medical invention/pathogen injected/antigens injected	1
Total	4

- (b) (i) State the name of the cells identified as X and Y in the diagram. (2 marks)

Description	Marks
X – B cell/B lymphocyte	1
Y – Plasma cell	1
Total	2

- (ii) Describe the role of a helper T-cell, as shown in the diagram. (3 marks)

Description	Marks
Binds to antigen	1
Secretes cytokines	1
Activates/sensitises/presents the B-lymphocyte	1
Total	3

- (iii) Outline **three** ways in which the antibodies produced by cell Y can fight a bacterial infection. (3 marks)

Description	Marks
Any three of:	1–3
Agglutination/clumping together of the pathogen	
Make more easily consumed by phagocytes/enhance phagocytosis	
Neutralisation of toxins/combine with toxins	
Coat bacteria	
Dissolve organisms/bacteria/pathogen	
Make membranes more permeable/punches holes in membrane/causes leakage of contents	
Make soluble substance insoluble/form a precipitate	
Total	3

- (c) Whether infants are vaccinated against Pertussis or exposed to the Pertussis bacterium and suffer the effects of the disease, they should be immune to contracting the infection again. Explain why. (2 marks)

Description	Marks
Both produce memory cells	1
Antibodies produced a lot quicker when reinfected/antibodies fight infection before symptoms appear/more antibodies produced than first exposure/antibodies last longer	1
Total	2

Question 35

(11 marks)

- (a) Is cortisol a water-soluble or lipid-soluble hormone? (1 mark)

Description	Marks
Lipid	1
Total	1

- (b) Describe the mode of action of a steroid hormone such as cortisol when it reaches a target cell. Include in your answer how the hormone enters the cell and brings about an effect. (4 marks)

Description	Marks
Diffuses across the cell membrane/enters the cell	1
Hormone attaches to receptor in cytoplasm/hormone-receptor complex formed in cytoplasm	1
(Complex) enters the nucleus	1
(Complex binds to DNA) activation of genes/transcription of mRNA/protein synthesis occurs/alters gene expression	1
Total	4

- (c) (i) Which lobe of the pituitary gland would the tumour have affected? (1 mark)

Description	Marks
Anterior	1
Total	1

- (ii) Which pituitary hormone would have had its secretion altered by the tumour? (1 mark)

Description	Marks
ACTH/adrenocorticotrophic hormone	1
Total	1

- (d) Treatment for Cushing's syndrome may require the removal of part of the pituitary gland or adrenal gland. Removing the affected endocrine gland may eliminate the high levels of cortisol; however, it can create other problems. Identify **one** such problem. (1 mark)

Description	Marks
Any one of:	1
Reduced amounts of other hormones produced by these structures/any specific example of a hormone that would be affected by removal of the adrenal glands or pituitary gland e.g. low TSH/LH/FSH/GH/PRL/MSH	
Excessively low cortisol levels	
Any specific problem caused by low cortisol e.g. fatigue/anxiety/depression	
Total	1

- (e) (i) What is a synthetic hormone? (1 mark)

Description	Marks
Any one of:	1
Laboratory hormone/man made hormone/artificially made	
Uses non-human hormones (made from other organism/plant/animal)	
Total	1

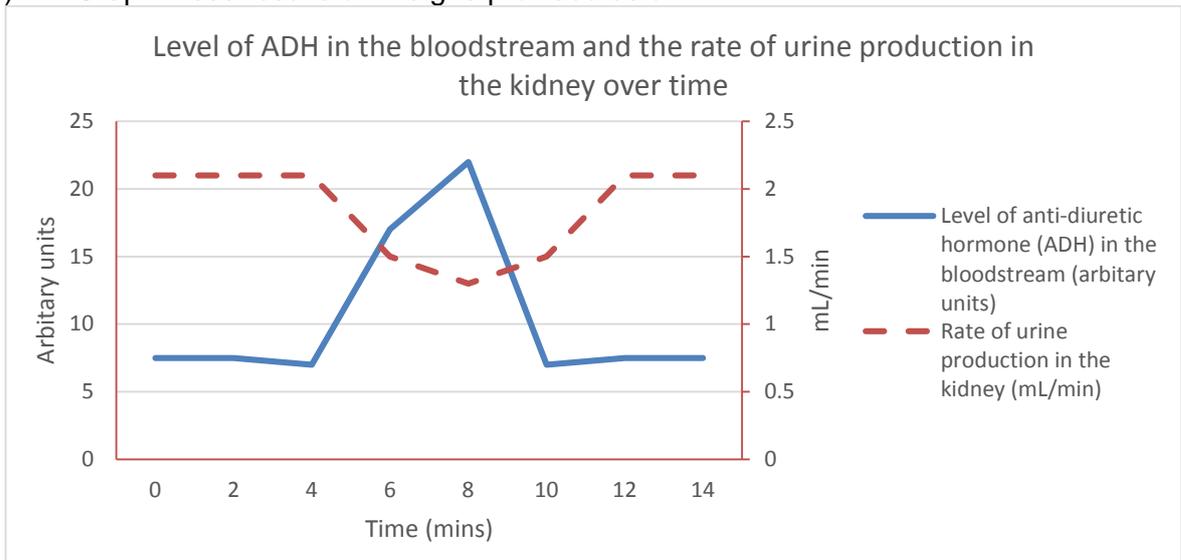
- (ii) Sometimes synthetic hormones produce side-effects that hormones produced normally by the body do not. Explain why. (2 marks)

Description	Marks
Not identical to normal (human) hormones/have slight differences in molecular structure/can be 'supernatural'	1
Any one of:	1
Body reacts to the differences/causes different effects on the body	
Can be difficult to administer correct dose for individuals	
Total	2

Question 36

(10 marks)

(a) Graph these results on the grid provided below.



(5 marks)

Description	Marks
<i>Maximum of 3 marks for a bar graph</i>	
Correctly constructs axes using appropriate scale (urine production and level of ADH on Y axis, Time on X axis)	1
Correctly plots points and joins points to form a line (ruler)	1
Labelling of axes with correct name and unit	1
Identifies lines using key/labels	1
Title appropriate with both independent and dependent variables included (independent = time; dependent = urine production and ADH levels)	1
Total	5

(b) From the graph, determine the level of ADH in the bloodstream after seven minutes.

(1 mark)

Description	Marks
19.5 (allow 19-20)	1
Total	1

(c) (i) Does an increase in ADH levels in the bloodstream increase or decrease the rate of urine production? (1 mark)

Description	Marks
Decreases	1
Total	1

(ii) Describe the process that causes the change in the rate of urine production you have stated in part (c)(i). (3 marks)

Description	Marks
ADH makes the walls of the nephron tubule/collecting duct/distal convoluted tubule permeable to water	1
Higher water concentration/lower osmotic pressure in nephron tubule than medulla/surrounding fluid/bloodstream	1
More water is reabsorbed back into the bloodstream	1
Total	3

Question 37

(12 marks)

- (a) Complete the table by identifying which labels A, B, C, D and/or E match the statements below. (4 marks)

Description		Marks
Statement	Labels	1-4
Oldest group of tools	D	
Tools made only by <i>Homo sapiens</i>	B and E	
Tools made only of stone or rock	A, C and D	
Classified as Mousterian tool culture	C	
Total		4

- (b) Name and describe an absolute dating method that could be used to date the tools labelled D. (4 marks)

Description	Marks
Potassium-argon dating/K-Ar dating	1
Any three of:	1-3
Based on decay of potassium-40 to calcium and argon	
Potassium-40 has a half-life of 1.25-1.3 billion years	
Ratio of potassium-40 to argon-40 determines age	
Dates rocks/volcanic rock	
Must be older than 100000 (to 200000) years	Total

- (c) The tools labelled E show a great variety in size and shape. Suggest **two** ways in which the hominid who made these tools might have used them and what that tool culture implies about the way they lived. (4 marks)

Description	Marks	
<i>1 mark for stating use of the tool and 1 mark for what that implies about lifestyle</i>		
Any two of:	1-4	
Needles for sewing		Wore clothes
Weapons for hunting		Meat eating
Barbed spears/arrowheads attached to wood		Spear hunting
Harpoons		Fishing
Ornamental pieces/carvings on tools		Made art/figurines/jewellery/story telling/ritual beliefs
Burin tools used to make other tools	Use of alternate tool materials (bone, ivory, antler)	
Total		4

Question 38

(11 marks)

- (a) People who have both alleles for the sickle-cell have the disease sickle-cell anaemia. What is sickle-cell anaemia? (2 marks)

Description	Marks
Any two of:	1–2
A mutated form of haemoglobin	
Distorts the red blood cells into a crescent shape/reduce surface area of red blood cells	
Reduces oxygen carrying capacity of red blood cells	
Lethal/fatal	
Total	2

- (b) People who carry only one sickle-cell allele are said to have the sickle-cell trait. State **one** disadvantage sickle-cell trait has for people with this condition. (1 mark)

Description	Marks
Any one of:	1
May cause breathing problems when exercising/at high altitudes/when scuba diving/when oxygen is in low supply	
(Rare problems such as) urinary tract infections/heat stroke/blood in urine/blood in the eye/renal failure	
If reproduce with another sickle-cell trait individual, could have offspring with sickle-cell anaemia	
Total	1

- (c) The sickle-cell trait has an advantage for people living in malaria-prone areas due to a selectively advantageous mutation. Explain what is meant by a selectively advantageous mutation. (3 marks)

Description	Marks
A change in DNA	1
Provides a survival advantage (to a particular genotype)	1
Under particular environmental conditions/selective pressure	1
Total	3

- (d) (i) Describe how the link between the sickle-cell allele and malaria can lead to changes in the allele frequencies in a population. (4 marks)

Description	Marks
Malaria reduces reproduction of normal cell individuals	1
Sickle-cell allele selected for/favoured	1
Carriers of sickle cell reproduce at greater rates	1
Sickle cell trait allele combinations increase/allele frequency of sickle cell increases	1
Total	4

- (ii) What term is used to describe the process given in part (d)(i)? (1 mark)

Description	Marks
Natural selection	1
Total	1

Question 39

(11 marks)

- (a) Outline the event that occurs in each of the three steps involved in PCR. (3 marks)

Description	Marks
Denaturing – separates complimentary base pairs/DNA strands separate/heating separates the DNA	1
Annealing – adding a primer (small single strand of DNA) to bind to complementary base sequences	1
Extension – DNA polymerase makes a copy of DNA strands through repeated series	1
Total	3

- (b) Why is conducting PCR a necessary step in analysing fossil samples? (1 mark)

Description	Marks
Any one of:	1
To amplify minute samples of DNA to testable amounts/to provide testable amounts of DNA	
Fossil DNA is often in minute quantities	
Total	1

- (c) (i) What information obtained by gel electrophoresis is shown by a gel plate? (1 mark)

Description	Marks
DNA profile/DNA fingerprint/DNA (or RNA/proteins) present in a sample	1
Total	1

- (ii) By comparing the fossil sample on the gel plate with those of already identified samples the fossil can be classified. What would be the classification of the fossil sample? (1 mark)

Description	Marks
<i>Homo neanderthalensis</i>	1
Total	1

- (d) Describe how scientists can use comparative protein analysis to discover evolutionary relationships between organisms. (3 marks)

Description	Marks
Every protein (in the body) has a specific number of amino acids	1
Any one of:	1
Amino acids are arranged in a particular sequence	
Differences in the DNA sequence give rise to different amino acid sequencing	1
Similarity of amino acid sequence is evidence of close evolutionary relationship	
Total	3

- (e) Could comparative protein analysis be used on the hominid femur bone that was tested by gel electrophoresis? Justify your answer. (2 marks)

Description	Marks
Yes	1
Any one of: Haemoglobin can be used	1
Blood cells found in fossil bones	
or	
No	1
Any one of: No protein left age/condition of bone	1
Total	2

Section Three: Extended answer

20% (40 Marks)

Question 40

(20 marks)

- (a) Explain how the nervous and endocrine systems maintain the body's internal temperature when it is in danger of falling below the tolerance limits. Ensure your answer includes **two** nervous mechanisms and **one** endocrine mechanism. (14 marks)

Description	Marks
General	
Thermoreceptors in hypothalamus detect decrease in internal temperature	1
Endocrine	
<i>Thyroid</i>	1-6
Any six of:	
Hypothalamus releases releasing factor(TSHRF)	
Stimulates anterior pituitary	
Anterior pituitary releases thyroid stimulating hormone (TSH)/Stimulates thyroid gland	
Produces thyroxine/thyroxine secreted into blood	
Secreted into blood	
Increased metabolic rate	
Increased heat production	
or	
<i>Adrenal medulla</i>	
Hypothalamus sends impulses via sympathetic nerves	
To adrenal medulla	
Produces adrenaline/noradrenaline	
Secreted into blood	
Increases metabolic rate	
Increased heat production	
Nervous	
<i>Shivering</i>	1-7
Hypothalamus sends impulses to parts of brain controlling muscle tone/hypothalamus sends impulses to cerebellum/hypothalamus sends impulses to medulla	
Transmission by somatic nerves/to skeletal muscle	
Shivering/fast rhythmic muscle contraction	
Increased heat production	
<i>Vasoconstriction</i>	
Hypothalamus sends impulses via sympathetic nerves	
Vasoconstriction of skin arterioles/skin blood vessels constrict/reduce diameter	
Reduced heat loss	
Total	

- (b) Thermoregulation can also be assisted by behavioural mechanisms. Identify **three** behaviours that lower internal temperature when it is in danger of rising above tolerance limits and outline how each of these assist in maintaining internal temperature. (6 marks)

Description		Marks
<i>1 mark for identifying the behaviour and 1 mark for outlining how it lowers temperature</i> Any three of:		
Decreased activity	Reduces heat gain through metabolic processes/muscle contractions	1–6
Increased water intake/eating foods high in water content	Assists with process of heat loss via sweating	
Staying cool/being in a shaded area	Reduces heat gain through radiation from the sun	
Fanning/method of moving cool air across the body/increase surface area exposed	Increases heat loss by convection/improves evaporation	
Cool shower/swim/contact with cool surface	Increases heat loss by conduction	
Removing clothing	Improves heat loss by radiation/convection/evaporation	
Total		6

Question 41

(20 marks)

- (a) Outline
- four**
- methods by which pathogens are transmitted. (4 marks)

Description	Marks
<i>Can answer by outlining method or providing a specific example (don't need both)</i> Any four of:	
Direct contact with another person/or describe by using a specific example e.g. conjunctivitis	1–4
Indirect contact when damaged/broken skin is in contact with soil/water/objects/or describe by using a specific example e.g. tetanus	
Airborne/Indirect contact through the air/droplets from sneezing/or using a specific example e.g. flu	
Contaminated food and drinks due to lack of hygiene/lack of refrigeration/or describe by using a specific example e.g. e coli	
Transfer of body fluids/or using a specific example e.g. via blood/semen/saliva	
Vectors which carry pathogens/or describe by using a specific example e.g. mosquito carrying malaria	
Total	

- (b) Identify features of the skin and the respiratory tract that are external defence mechanisms and outline how they provide defence against pathogens. (8 marks)

Description	Marks	
<i>1 mark for identifying the structure and 1 mark for outlining how it provides defence</i> <i>Any four of: (but must have at least one from skin and one from respiratory tract).</i>		
Skin		
Physical barrier	Prevents entry of pathogens	1–4
Sebaceous glands secrete sebum	Prevents cracking of skin/antibacterial properties	
Sweat glands produce lysozyme	Destroys bacteria/pathogens	
Commensal/useful/harmless bacteria on skin surface	Compete with pathogens	
Respiratory tract		
Hairs in nostrils	Slow air movement/trap larger particles	1–4
Lysozyme in nasal cavity	Destroys pathogens	
Mucous lining airways	Traps pathogens	
Cilia lining the upper respiratory tract	Move pathogens (with mucous) upwards	
Sneezing	Removes trapped pathogens	
Total	8	

- (c) Describe the social, cultural and economic factors that influence whether or not parents choose to have their children immunised. (8 marks)

Description	Marks
<i>Can be for or against, at least one social/cultural and one economic factor must be included in the answer</i>	
Social/Cultural	1–8
<i>For</i>	
Helping to create herd immunity/social responsibility to protect everyone from communicable disease	
Following the health advice of government/health professionals	
“Peer pressure” to vaccinate like everyone else does	
Negative side effects considered very rare	
Historically always done in families/cultural groups	
<i>Against</i>	
Perceived health concerns/side effects with vaccine	
Negative side effects to previous vaccines	
Lack of availability of vaccine/large distance to travel to obtain vaccine	
Parents forget/don't see the importance of vaccinating	
Ethical/religious objection to medical interventions	
Conflict in some countries prevents immunisation	
Economic	
<i>For</i>	
Immunisation bonus paid to participants	
Reduced health care cost for treating the sick	
No loss of family tax benefits	
<i>Against</i>	
Cost of visiting a doctor to obtain/cost of the vaccine	
Cost prohibitive for some governments/other priorities for government	
Total	8

Question 42

(20 marks)

- (a) Explain why archaeologists initially had difficulty in deciding to which species the hominid specimen belonged. Describe **three** features of the post-cranial skeleton and **five** features of the skull evident in the specimen that allowed them to distinguish it as *Homo neanderthalensis* rather than *Homo sapiens*. (10 marks)

Description	Marks
Classifying	
Any two of:	1–2
Both lived at the same time/both existed 60 000 years ago	
Both lived in the same location	
Very close on the ancestral tree/share a recent common ancestor	
<i>Neanderthalensis</i> features compared to <i>Homo sapiens</i> – NB. Some candidates may write it in the reverse as features <i>Neanderthalensis</i> lacks when being compared. This can be awarded if it is clearly stated.	
Post Cranial	
Any three of:	1–3
Generally shorter/limb bones shorter	
More robust skeletons/limb bones thicker	
Larger joints in the limbs	
Wider pelvis	
Longer clavicle/wider shoulders	
Barrel rib cage	
Bowed femur	
Larger heel bone	
Skull	
Any five of:	1–5
Brain size was larger than the average modern human brain/averaged 1500 cubic centimetres.	
Skull was low/flat/elongated	
Back of the skull had a bulge/occipital bun present	
Depression (the suprainiac fossa) at back of skull (for the attachment of strong neck muscles)	
Crest on the mastoid process (behind the ear opening)	
More prognathic/protruding face	
Thicker brow ridge	
Jaws were larger/more robust	
Larger teeth	
Teeth have a gap called the retromolar space, behind the third molars (wisdom teeth) at the back of the jaw	
Lack of a chin	
No groove on canine teeth	
Larger openings at front of mandible (mental foramen – for blood supply)	
Skull retained less juvenile features/not neotenized	
Total	10

- (b) Explain why the fossil record is important in providing evidence for evolution. Describe the factors that can affect fossil formation and explain why it is difficult to locate fossil specimens. (10 marks)

Description	Marks
Fossil record	
Establishes evolutionary links between species/shows common ancestry	1
Any one of:	1
Provides evidence of which organisms lived on Earth in the past	
Provides examples of organisms which may now be extinct	
Provides examples of transitional organisms between species	
Fossil formation	
Any four of:	1-4
Organisms need to be protected from decay by micro-organisms	
Scavenging of organisms prevents fossilisation	
Need to be buried rapidly	
Requires a lack of oxygen/low pH & no oxygen/alkaline soils	
Need to be left undisturbed for a long time	
Most fossils only created from hard (bone/teeth) parts/soft body parts often destroyed	
Difficult to find	
Any four of:	1-4
Fossils may have been destroyed by earth movements/erosion/weathering	
Fossils may have been destroyed by human activity	
Fossils may not be recognised/people don't realise what they find is a fossil	
Archaeologists may be looking in the wrong place	
May be buried too deep to find/located in a place unable to be excavated	
Total	10

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