Neap:

Trial Examination 2013

VCE Biology Units 3 & 4

Written Examination

Suggested Solutions

SECTION A: MULTIPLE-CHOICE QUESTIONS

1	A	B	**C**	D
2	A	B	C	**D**
3	A	B	**C**	D
4	**A**	B	C	D
5	A	B	C	**D**
6	A	B	**C**	D
7	A	**B**	C	D
8	**A**	B	C	D
9	A	B	C	**D**
10	A	B	**C**	D
11	A	B	C	**D**
12	**A**	B	C	D
13	A	B	**C**	D
14	A	B	**C**	D

15	A	**B**	C	D
16	**A**	B	C	D
17	**A**	B	C	D
18	**A**	B	C	D
19	A	B	C	**D**
20	A	**B**	C	D
21	**A**	B	C	D
22	A	B	C	**D**
23	A	B	**C**	D
24	**A**	B	C	D
25	A	B	**C**	D
26	A	**B**	C	D
27	A	B	**C**	D
28	**A**	B	C	D

29	A	**B**	C	D
30	A	B	**C**	D
31	A	**B**	C	D
32	A	B	C	**D**
33	A	B	**C**	D
34	A	B	C	**D**
35	A	**B**	C	D
36	A	**B**	C	D
37	A	B	C	**D**
38	**A**	B	C	D
39	**A**	B	C	D
40	A	**B**	C	D

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SECTION A: MULTIPLE-CHOICE QUESTIONS

Question 1 C

Ribose is a five-carbon carbohydrate, which is one of the three parts of a nucleotide (in DNA it is deoxyribose). Amino acids are the monomers of proteins and fatty acids are the main part of fats.

Question 2 D

The primary structure of a functional protein is the amino acid sequence (which is coded for by the DNA). The amino acids coil and sheet due to their interactions with each other. The shaping of the polypeptide (α-helices and β-sheets) is referred to as the secondary structure. The final shape of the protein is brought about by chemical bonds such as disulphide that holds together the polypeptide in a final 3D shape (tertiary structure). The functional protein often requires several polypeptides to cluster together (quaternary structure). The ATPase has many working parts (polypeptides) making it a quaternary protein.

Question 3 C

ATP is formed by combining an inorganic phosphate (P_i) and ADP. This reaction requires an input of energy because ATP is more energy rich than the substrates (P_i and ADP). This energy can come from a variety of catabolic (exergonic) reactions that, as they proceed, provide the energy for anabolic (energy requiring) reactions such as ATP synthesis.

Question 4 A

The biomacromolecule is called DNA. DNA is a double helix and the two polynucleotide chains are held together by complementary base pairing. They are an attraction force between two complementary nucleotides (between H and N or H and O).

Question 5 D

The endosymbiotic theory suggests that ancestral aerobic bacteria and ancestral cyanobacteria may have been consumed (endocytosis) by ancestral eukaryotic cells. These structures provided a survival advantage to the consumer (efficient production of ATP as well as production of glucose) and the consumed bacteria were provided protection. One piece of evidence to support this theory is that there is DNA in both mitochondria and chloroplasts. This DNA (virtually) works independently to the nuclear DNA.

Question 6 C

Protein synthesis involves a series of steps that starts with the transcription of the DNA template. Pre-mRNA is formed in eukaryotic cells and then introns are spliced out, leaving behind exons (with stabilising factors at each end) that make up the mRNA. The mRNA then moves through the ribosome in groups of three nucleotides (codons), and in the process of translation, amino acids are joined to make a protein.

Question 7 B

The independent variable in a well-designed experiment is the factor that is deliberately changed. All other factors need to be the same (concentrations of enzyme, substrate) so that the factor being measured (dependant variable) can be used to make valid conclusions.

Question 8 A

There is a lower amount of starch digestion at 50°C because the area of no starch is at a minimum compared to the other plates. It is reasonable to conclude that at this high temperature the amylase is denatured and was not able to digest the starch. The amylase is working at its most efficient at 40°C and is converting the starch to simple sugars (not the other way round). At low temperatures, the rate of collisions between the enzyme and substrate is reduced (not denatured) and there is clearly some activity at 10°C.

Question 9 D

Non-competitive inhibitors are chemicals that bind to enzymes away from the active site. This leads to a change in the shape of the active site thus preventing the enzyme from functioning normally. This can be brought about naturally with allosteric inhibition where a product can act as a non-competitive inhibitor of an enzyme that led to its production. This can be used in a therapeutic way through the administration of drugs that act as non-competitive inhibitors of enzymes that are catalysing reactions causing disease.

Question 10 C

The reactions of photosynthesis can be divided into two main parts. The first part occurs within the grana, inside the thylakoid membranes. This is where the light energy is trapped in the chlorophyll and is used (partly) to activate an enzyme that splits water (light-dependent reaction). The H ions move through an ATPase enzyme into the stroma of the chloroplast providing energy and excess H ions to make ATP and NADPH. The ATP and NADPH become part of the light-independent reaction (Calvin cycle). This is when carbon dioxide and other substrates combine to form glucose.

Question 11 D

The question is investigating enzyme inhibition as a way of controlling the speed of certain biochemical pathways. In the context of the question, a lower concentration of product would lead to an increase in enzyme activity for it to be a feedback mechanism. Option **D** refers to the competitive inhibition of a non-substrate (product), which must have a shape similar to the active site. Its presence in high concentrations will mean there are less active sites available, thus slowing down the action of the enzyme.

Question 12 A

Pheromones are signalling molecules secreted from one member of a species that travel through the air (or water) away from that individual. Another member of the same species may come in contact with the pheromone (inhale, taste) and respond to it. The response would be triggered as a result of the pheromone binding to a receptor within the organism. The response could be a behavioural change such as a male dog's response to smelling a female dog on heat.

Question 13 C

Depolarisation at a particular point along an axon is triggered by sodium channels opening. The resting axon has more sodium ions on the outside of the axon compared to the inside of the axon. As a result, the open sodium channels allow the sodium ions to diffuse into the cytosol making the cytosol more positive (depolarisation phase). To restore the resting potential, potassium channels then open and finally a sodium/potassium protein pump restores the ion balance (repolarisation phase).

Question 14 C

The sequence of events that leads to a message passing across a synapse is as follows: The action potential moving along the nerve initially triggers calcium-gated channels to open, which allows calcium ions to move into the axon at their ends. This promotes the exocytosis of vesicles that contain neurotransmitters and these are secreted from the pre-synaptic side of the synapse. Once there the neurotransmitters diffuse across the synapse and bind to receptors on the post-synaptic side of the synapse (dendrite, muscle, gland). This allows the signal to pass from one cell to another without them touching.

Question 15 B

Protein hormones bind to receptors on the surface of cell membranes because they cannot pass through the membrane. Once this interaction occurs, a cascade of intracellular events occurs. G proteins are mobilised within the membrane leading to an enzyme (adenylyl cyclase) to convert ATP into cyclic AMP. Cyclic AMP is a second messenger that has a role of activating particular enzymes specific to that particular cell (for example activating an enzyme to convert glycogen into glucose).

Question 16 A

As a result of the analysis it can be concluded that the factor causing the disease was not cellular (test 1 negative) and did not contain DNA (test 2 negative). Tests 3 and 4 show that the infective agent is a protein and so a prion is the likely cause.

Question 17 A

The body has three main lines of defense. The first are the barriers (for example, skin) and secretions (for example, acidity) which reduce the chances of pathogens entering into the internal environment. The second is a body response to the pathogen that is the same regardless of the pathogen (for example, phagocytosis). The third is a tailor-made response that produces long lasting memory (for example, B cells).

Question 18 A

An allergic response is the result of prior exposure to an allergen that results in mast cells being coated with a specific antibody against the allergen. Mast cells are an important aspect of body defense, however, the allergic response can be life threatening. If the allergen comes in contact with the individual who is allergic to it, the allergen (*X*) bind to antibodies (*Y*) on the surface of the mast cell. The mast cell secretes histamine (*Z*) which causes blood vessels to vasodilate. This is meant to eradicate the allergen but it can cause life-threatening symptoms.

Question 19 D

An antigen on the surface of an APC (antigen presenting cell) or the pathogen comes in contact with a B cell that carries the complementary match to the antigen. There is, in a human body, literally only one of these B cells present. Once this contact is established, the end result is for that B cell to clone into cells that are then programmed to produce many specific antibodies (1000/sec/cell). These cells are called plasma cells.

Question 20 B

Memory cells are left behind after an initial exposure to a particular antigen (whether in a vaccine or on the surface of a pathogen). On subsequent exposures to the pathogen, these memory cells can quickly clone into plasma cells and act specifically against the pathogen by manufacturing antibodies. This means it is eradicated before it causes disease.

Question 21 A

The antibodies obtained from the colostrum are obtained naturally. The mother has produced these antibodies as a result of being exposed to a variety of pathogens over time. These antibodies are able to bind to antigens on the pathogens the baby is exposed to and this provides temporary immunity (passive) until the baby's immune system begins to mature.

Question 22 D

Gametes have a haploid set of chromosomes. This means that one member of each pair of chromosomes is found in a gamete. Since there are two sex chromosomes in most diploid cells, only one of these would be found in each gamete.

Question 23 C

The mosquito has a diploid number of 6 and a haploid number of 3. When the mosquito's diploid cells undergo meiosis, the first division is when the pairs of chromosomes are separated from each other. The second division is where the chromatids are separated away from each other. Options **A** and **D** represent cells in the first meiotic division and option **B** could only be during the second stage of meiosis but the diploid number of the original cell would have to be 12.

Question 24 A

If both black parent rabbits produce both black and white offspring, the white phenotype must be inherited in a recessive fashion. This means both black parents would need to be heterozygous and the chance of them conceiving a white offspring would be 25%. Each time a rabbit is conceived, the chance of a white allele combination (homozygous) remains 25%. There is no information about gender in the question so a conclusion about the location of the gene cannot be made.

Question 25 C

The easiest method to use in solving this question is to list all the possible genotypes each scenario would produce. For **A** and **B**, there could only be three phenotypes and for **D** there would be more than four phenotypes (ten in fact). Option **C** is the correct answer because this can provide type A, B, AB and O.

Question 26 B

The easiest way to solve this question is to construct a punnet square.

Gametes	VT	Vt	vT	vt
Vt	VVTt	VVtt	VvTt	Vvtt

All offspring have at least one 'V' allele, resulting in all violet flowers. One half of the offspring have the genotype Tt (tall) and the other half have the genotype tt (short). Since the answer is asking for a phenotypic ratio, we need to know what the plants look like rather than listing the genotypes. Option **A** is a correct genotypic ratio but option **B** is the answer.

Question 27 C

The stem of the question states that the faulty allele is shorter than the normal allele. This means it would travel further in the gel and so profile 1, 2 and 3 all show a band that has moved further in the gel. The normal allele is longer in comparison to the faulty allele and so it would not move as far in the gel. Profile 1, 3 and 4 all show a band that has not moved far in the gel. A heterozygous individual would need to have both alleles present and since there are only two alleles present, profile 3 is the answer.

Question 28 A

To produce a recombinant plasmid, biotechnologists would need to start with a sample of unmanipulated plasmids that restriction enzymes would be added to. The same would be done with the target DNA so as to generate complementary sticky ends. Both the plasmid and target DNA would then be added together with ligase so that the recombinant plasmid would be formed. The biotechnologists would then need to purify it.

Question 29 B

A PCR cycle is repeated many times to generate copies of target sections of DNA. A temperature of about 90°C is involved in step 1 which breaks the hydrogen bonds holding the original DNA strand together. The sample is then cooled to about 50°C where primers are then able to anneal (stick) onto complementary sections of each DNA strand. Finally the sample is warmed to about 70°C and the taq polymerase enzyme works to replicate each strand using the primer as an anchor for the enzyme. This completes one cycle and it then begins again.

Question 30 C

There was initially one strand and after the first cycle there were two strands. After two cycles there were four strands. After three, there were 8. After four, there were 16. After five cycles there were 32 strands.

Question 31 B

The data provides supporting evidence of a link between nuclear radiation and translocations but it cannot conclusively be represented as the cause of the translocation because there could be other factors as well. However, the link seems pretty convincing. The control group tested would need to be the same approximate age group of the surviving naval personnel, otherwise there could be too many variables to make any conclusions. Adding up the number of participants in total, it is apparent there are about 100, not 200. Clearly more of the veterans had 10 or more translocations per 1000 cells.

Question 32 D

Stability of gene pools mainly occurs if populations are large (small random changes influence gene pools significantly in small populations). However, if there is a change in the environment, then certain phenotypes may be more suited and natural selection may occur, regardless of the size of the population. If the environment is stable, it is unlikely there is any selective advantage for any phenotypes, ensuring stability.

Question 33 C

When population sizes are very small, as would be the case with a group of endangered panthers, any deaths of individuals can drastically effect the gene pool within the group. In this case, an allele conferring resistance to a virus is lost because that family of panthers may have been the only ones possessing it. This is an example of genetic drift.

Question 34 D

Any group of animals (or plants) that have been bred for particular reasons, are produced as a result of artificial selection. In this case, cats show dramatic variations in size and body hair, unlikely to exist is a group of wild cats such as lions.

Question 35 B

A change in environment does not cause mutations. This is a Lamarkian comment. The way bacterial resistance would develop, would be that the use of antibiotics has eradicated most bacteria. Those surviving possibly have some sort of genetic resistance, making the resistance a pre-existing mutation. New antibiotics would work in the same way as current ones in that they will kill most bacteria but not all.

Question 36 B

Organisms that have a similar phenotype but have very different ancestry display convergent evolution. The shark and dolphin are classified into different orders and evolved at different times. Due to the similar environmental pressures (particularly for the dolphin which is a mammal) they have evolved similar phenotypes.

Question 37 D

To solve this question, the number of nucleotide differences between individual 1 and 2 is indicative of how long ago they had a common ancestor. There are four differences and so there was a common ancestor 4000 years ago. Occasionally, there could be a mutation that mutates back and so appears to be a match but in fact should be two differences (2000 years). This is why many individuals would usually be tested.

Question 38 A

The *Homo* genus is credited with a huge advance in cultural (and technological) evolution. This is due primarily to an increase in cranial capacity, which enables them to problem-solve at a higher level. All Primates have opposable thumbs and all Hominins stood upright. The fossil record shows the *Homo* line was much taller than the *Australopithecines.*

Question 39 A

A donor (the black and white cow) provides a differentiated diploid cell (*T*). This is fused (*U*) with an ova (*Z*) which has been enucleated (*Y*). The resulting embryo (V) is implanted into a surrogate (*W*) and she gives birth to a clone (*X*) which should have a high milk yield like the original donor.

Question 40 B

The phenotype is a combination of the inherited genes and the environment and so it is untrue to say that their phenotype is the same. The clones have a better milk yield but they are all genetically the same and if a disease swept through the herd they would probably not have any genetic resistance to it. The herd would not necessarily look the same because features such as the location of black and white patches could be determined by environmental factors as well as genetic factors.

SECTION B: SHORT-ANSWER QUESTIONS

Question 1 (6 marks)

a. i. Contractile vacuole is able to contract at different rates to remove excess water. When in freshwater, there would be a tendency for the *euglena* to absorb water (osmosis). To prevent them swelling up and bursting, the vacuole will contract more rapidly. 1 mark

ii.

Structure (A to E)	Name of structure	How structure suits an animal-like existence
E	flagellum	Move towards food
D	mitochondria	Provide energy (ATP) to enable flagellum to move

2 marks

Note: Correct name of structure and demonstrating usefulness to an animal way of life is acceptable

b. i. $1.5 \pm 0.2\%$ 1 mark

ii. At low light intensity the glucose levels are dropping suggesting the glucose is being absorbed by the *euglena*. This is consistent with the definition of a heterotroph, and is an animal-like feature. 1 mark

iii. As light intensity increases, the carbon dioxide levels in the solution drop showing that carbon dioxide is a substrate for photosynthesis. 1 mark

Question 2 (6 marks)

a. $C_6H_{12}O_6 + 6O_2 + 38ADP + 38P_i \rightarrow 6CO_2 + 6H_2O + 38ATP$ 2 marks

Note: 1 mark for inputs and 1 mark for outputs

b. Pyruvate kinase is a protein. 1 mark

Pyruvate kinase has an active site that is complementary to phosphoenolpyruvate (substrate), which fits into the active site on the enzyme and is converted to pyruvate. 1 mark

c. Pyruvate is at a crossroad of metabolism because the availability of oxygen dictates whether the pyruvate will be broken down aerobically or anaerobically. 1 mark

If oxygen is available the pyruvate moves into the mitochondria. If oxygen is not available the pyruvate is broken down further in the cytosol. 1 mark

Question 3 (9 marks)

a. Aerobic generates 36–38 ATP molecules whereas anaerobic generates 2 ATP molecules 1 mark

b. i. Negative feedback is where the response works in the opposite direction to the stimulus. 1 mark

The response (more RBC) carries more oxygen that is working in the opposite direction to the original stimulus (reduced oxygen in blood). 1 mark

ii. bone marrow (from the same cell line) 1 mark

c. Get twenty dishes of muscle cells and divide them into five groups of four dishes. The first four dishes do not add testosterone to them. This is the control that can be compared to the other groups. 1 mark

The remaining three groups of muscle cell dishes will have increasing levels of testosterone given to them. This is the variable being tested. 1 mark

The data generated (mass of cell lines after the experiment) can then be used to make a conclusion. All conditions such as temperature, pH and levels of other nutrients must be kept constant otherwise valid conclusions about the effect of the variable cannot be made. 1 mark

Note: A diagram could earn 3 marks so long as it is well labelled and descriptions of the assessed areas are clear.

d. Testosterone is a lipid hormone and so binds to intercellular receptors whereas EPO is a protein hormone and binds to receptors on the cell surface. 1 mark

The action of testosterone is to activate genes and is longer lasting than EPO which activates enzymes which is shorter lasting. 1 mark

Question 4 (7 marks)

a. **i.** *Any two of the following:*

- temperature
- pH
- water availability
- type of seeds
- amount of seeds 1 mark

ii. an increase in GA (mg/l) increases percentage germination 1 mark

b. *For example:*
auxin 1 mark

Auxin accumulates on the shaded side of coleoptiles and promotes growth in that region.
The result is the tip of the plant bends towards the light source. 1 mark

Note: Auxin could also be discussed in relation to geotropism and apical dominance
There are many hormones and many courses of action these hormones have. This gives students an opportunity to show their knowledge.

c. **i.** GA binds to a receptor on the surface of the cell membrane. The GA has a complementary shape to the receptor. 1 mark

This external message is processed by the cell and a gene is activated that leads to the production of α-amylase , which is then secreted by exocytosis. 1 mark

ii. Signal amplification is where one message leads to an amplified response. This response, in turn becomes a message for a larger response again. In this case, the GA binds to the receptor activating several cAMP signals. This means the DNA activator could be active for longer. More mRNA could result leading to a very large amount of α-amylase . 1 mark

Question 5 (7 marks)

a. A virus is a protein shell with a nucleic acid core. 1 mark

b. **i.** For women, of the 15 000 cases of these type of cancer, about 13 000–14 000 are caused by HPV. For men, of the 10 000 cases of these types of cancer about 6500 are HPV related.

So, it is more likely women who suffer these types of cancer develop it due to being infected with HPV. 1 mark

ii. Of all the cancers attributable to HPV (about 20 000) about 17 000 of them are caused by these strains. Considering there are thirty strains of HPV pathogenic to humans, it is logical to vaccinate against these four. 1 mark

c. Antigens from each HPV type 6, 11, 16 and 18. 1 mark

d. Antigen for HPV-16 is recognised as non-self by the body's immune system (B cells).. 1 mark

The correct B cell clones into a large number of plasma cells, which secrete many antibodies against the antigen 1 mark

After the antigen is removed, the plasma cells drop in numbers and left behind are memory cells that can act fast if subsequent exposure to the antigen occurs (presumably on the surface of HPV-16). 1 mark

Question 6 (7 marks)

a. D B E A C 1 mark

b. Mitosis is part of the cell cycle. The cell cycle describes the steps a cell undergoes from being produced to forming two new cells. 1 mark

This involves the existence of the cell where chromosomes are not visible (interphase) but as a result of the G1, S and G2 phases, DNA replicates and condenses to form chromosomes that can then go through the process of mitosis. 1 mark

c. The p53 mutation may not stop mitosis. This means more cells will form where they would not normally be found, leading to cancer. 1 mark

d. **i.** Healthy cells (A) are constant AND cancer cells (B) are increasing. 1 mark

ii. Healthy cells are also killed with the chemotherapy, however, they regenerate back to normal levels after each treatment 1 mark

The cancer cells decrease in numbers after each treatment until after four treatments they are all removed. 1 mark

Question 7 (5 marks)

a. Codons are groups of three mRNA nucleotides. 1 mark

There are four different types of RNA nucleotides and so there are sixty-four different three-letter sequence combinations of nucleotides. 1 mark

b. mRNA AAU GGU UUU UGG GUU 1 mark

DNA (template) TTACCAAAAACCCAA 1 mark

DNA (complementary) AATGGTTTTTGGGTT 1 mark

Note: There are many other codon combinations students could use.

Question 8 (5 marks)

a. **i.** aaX^CY (must use letters provided) 1 mark

ii. The genes are independently inherited because they are on different chromosomes. The gene for colourblindness is on the X chromosome whereas the gene for albinism is on an autosome. 1 mark

b. Phenotype Father (non-albino, normal vision) Mother (non-albino, normal vision)

Genotype AaX^CY AaX^CX^c 1 mark

Gametes $(AX^C \ AY \ aX^C \ aY)$ $(AX^C \ AX^c \ aX^C \ aX^c)$

	AX^C	**AX^c**	**aX^C**	**aX^c**
AX^C	AAX^CX^C	AAX^CX^c	AaX^CX^C	AaX^CX^c
AY	AAX^CY	AAX^cY	AaX^CY	AaX^cY
aX^C	AaX^CX^C	AaX^CX^c	aaX^CX^C	aaX^CX^c
aY	AaX^CY	AaX^cY	aaX^C Y	aaX^cY

1 mark

Note: working out does not need to be in the form of a punnet square however, there needs to be some effort at working out an answer.

Probability of a son who is colour-blind and not albino (aaX^cY) is highlighted in the pedigree. Many students will say $\frac{1}{16}$; however we are after the probability of a son who is colourblind and not albino. The probability of this is $\frac{1}{8}$ because there are only 8 potential genotypes for a son in the pedigree.

1 mark

Question 9 (9 marks)

a. **i.** The pattern of inheritance is autosomal recessive: 1 mark

- Recessive because I-1 of I-2 are unaffected
- Autosomal because if it were sex-linked, the father of II-1 would also express the trait. 1mark

ii. II-3 has a $\frac{2}{3}$ chance of being heterozygous; however the genotype of II-2 could be homozygous dominant or heterozygous but it cannot be concluded either way. 1 mark

Children have less than a $\frac{2}{3}$ chance of inheriting a faulty allele from II-3 (his genotype could be HH or Hh or Hh and so it is more likely a 'H' will be passed on). 1 mark

Note: For the second mark students should be able to argue that it is less than a $\frac{2}{3}$ chance.

b. Homozygous sickle cell: survival estimate 0.75 ± 0.02

Homozygous normal: survival estimate 0.80 ± 0.02

Heterozygous: survival estimate 0.85 ± 0.02 1 mark

Heterozygous individuals are 10% more likely to survive than sickle children and 5% more likely to survive than homozygous normal children 1 mark

(or using data from graph to make a comparison)

c. Within a given East African population there is variation in the genotype with respect to sickle cell anaemia. 1 mark

Malaria provides an environmental condition that suits the individuals heterozygous to sickle cell anaemia more than the other variations and therefore, they are more likely to survive to have children. 1 mark

As sickle cell is a heritable trait, it would be expected that the East African sickle cell gene pool would increase in the proportion of the recessive alleles. 1 mark

Question 10 (9 marks)

a. i. Hominin: *Homo sapiens* and any of their bipedal ancestors. 1 mark

ii. *Homo habilis* existed from 1.6–2.3 million years ago and *Australopithecus boisei* from 1.2–2 million years ago. This means they co-existed from 1.6–2 million years ago.

Answer: 400 000 years (± 50 000 years) 1 mark

b. Fossils may not have been found yet. 1 mark

They have been out-competed by hominins such as *Orrorin tugensis* and so became extinct. 1 mark

c. Divergent evolution is where similarly related organisms have a different common ancestor and develop different phenotypes due to different environments. 1 mark

Homo sapiens and *Homo neanderthalensis* have the same generic name and are similarly related. They are classified as different species and so would have unique features. It also seems that other hominins (*erectus, ergastor*) existed prior to either and so they would be good candidates for the common ancestor. 1 mark

Note: This is a constantly changing field. The student answer must make reference to the diagram, not other information.

d. i. radioisotopic dating 1 mark

The half-life of the isotope being tested; for example potassium-40 has a half-life of 1.3 billion years. Compare the amount of K-40 in 'fresh' rock and compare it to how much K-40 is in rock layers containing the fossil and this will give a measure of the age of the layer containing the fossil. 1 mark

Note: Students could gain full marks without giving a specific example however, they could not gain full marks if their example was carbon dating (only useful for 50 000 years max).

ii. Investigate previously discovered fossils that have been dated at a similar time and use them as a guide, or compare the bone fragment to both groups and see which group is most compatible in terms of shape and size. 1 mark

