Pearson Edexcel

Mark Scheme (Results)

October 2023

Pearson Edexcel International Advanced Level In Biology (WBI14)
Paper 01 Unit 4: Energy, Environment, Microbiology and Immunity

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Question number	Answer	Mark
1(a)	The only correct answer is **C** *A is incorrect as photolysis takes place on the thylakoid membranes and P is a ribosome* *B is incorrect as photolysis takes place on the thylakoid membranes and R is the stroma* *D is incorrect as photolysis takes place on the thylakoid membranes and V is DNA*	**(1)**

Question number	Answer	Mark
1(b)	The only correct answer is **D** *A is incorrect as DNA contains genes and P is a ribosome* *B is incorrect as DNA contains genes and Q is a starch grain* *C is incorrect as DNA contains genes and S is DNA thylakoid*	**(1)**

Question number	Answer	Mark
1(c)	The only correct answer is **C** *A is incorrect as hydrogen ions accumulate in the thylakoids and Q is a starch grain* *B is incorrect as hydrogen ions accumulate in the thylakoids and R is the stroma* *D is incorrect as hydrogen ions accumulate in the thylakoids and V is DNA*	**(1)**

Question number	Answer	Mark
1(d)(i)	The only correct answer is **C** *A is incorrect as T, U and W are all made of phospholipids* *B is incorrect as T, U and W are all made of phospholipids* *D is incorrect as T, U and W are all made of phospholipids*	**(1)**

Question number	Answer	Mark
1(d)(ii)	The only correct answer is **A** ***B** is incorrect as phospholipids are* made of a glycerol attached to two fatty acids and one phosphate group ***C** is incorrect as phospholipids are* made of a glycerol attached to two fatty acids and one phosphate group ***D** is incorrect as phospholipids are* made of a glycerol attached to two fatty acids and one phosphate group	**(1)**

Question number	Answer	Additional guidance	Mark
1(e)	• (0.0085 cm =) 85 (μm) (1) • 7.3 (μm) (1) OR • length in cm calculated (1) • 7.3 (μm) (1)	Bald answer of 7.3 = 2 marks Bald answer of 85 (μm) = 1 mark Bald answer with the values (7.2649572 / 0.00072649572) correctly rounded but not to 2 sig figs = 1 mark Bald answer to 2 sig figs but wrong order of magnitude = 1 mark	**(2)**

Question number	Answer	Additional guidance	Mark
2(a)(i)	• pain and swelling / pain and loss of function / swelling and loss of function (1)	**ACCEPT** hurts / tender / aches / throbbing / dolor oedema / blistering	**(1)**

Question number	Answer	Additional guidance	Mark
2(a)(ii)	An explanation that includes two of the following points: • because (an increase in / high) {temperature / heat} speeds up {enzyme / lysozyme} activity (1) • pathogens destroyed faster by {phagocytes / lysozymes / neutrophils / macrophages} (1) • (high) {temperature / heat} denatures enzymes (of pathogens) so pathogens {destroyed / inhibited / cannot reproduce} (1)	**ACCEPT** destroyed by phagocytosis faster increases the immune response **ACCEPT** infected cells damaged **DO NOT ACCEPT** viruses killed	**(2)**

Question number	Answer	Additional guidance	Mark
2(b)	A description that includes two of the following points: • interferons are secreted by infected cells (1) • they are anti-viral proteins (1) • preventing {viral replication / synthesis of viral proteins / spread of virus} (1) • involved in activation of {macrophages / T killer cells} (1)	**ACCEPT** prevent viruses {entering / binding to} cells **ACCEPT** activation of cell-mediated response	**(2)**

Question number	Answer	Additional guidance	Mark
2(c)	An answer that includes *three* of the following **with the similarity:** **Similarities:** • concentration of antibody rises (and falls) in both (1) **Differences:** • antibody concentration rise {sooner / immediately} following the second infection (1) • antibody concentration rise higher following the second infection (1) • antibody concentration rise faster following the second infection (1)		**(3)**

Question number	Answer	Additional guidance	Mark
3(a)	• 8.5×10^5 (1)		(1)

Question number	Answer	Additional guidance	Mark
3(b)	An explanation that includes the following points: • (no increase in number of bacteria) because the cells had to {adjust to new environment / warm up / synthesise new enzymes} (1) • (increase in number of bacteria) as {conditions are suitable / nutrients available / pH appropriate / oxygen levels appropriate / appropriate temperature} (1)		(2)

Question number	Answer	Additional guidance	Mark
3(c)(i)	A description that includes the following points: • use serial dilutions (1) • sample {added to agar and spread / spread over agar / used to create a lawn of bacteria (on agar)} (1)	**ACCEPT** description of serial dilutions e.g. dilute several times, / add bacteria to water and repeat	(2)

Question number	Answer	Additional guidance	Mark
3(c)(ii)	An explanation that includes three of the following points: • {optical methods / turbidity} measure {total cell counts / dead and alive cells} (1) • dilution plating measure (numbers of) living bacteria (1) • therefore in the optical method number of cells stayed the same as no new cells being produced (1) • therefore in the dilution plating number of cells stayed the same as number of new cells equals cells dying **OR** therefore in the dilution plating number of cells fell as were dying (1)		**(3)**

Question number	Answer	Additional guidance	Mark
4(a)	• whole number in range of 55 to 70 (%) (1)		**(1)**

Question number	Answer	Additional guidance	Mark
4(b)(i)	A description that includes two of the following points: • {same types of / all (types) / the five types} bacteria (found in gut) in {babies fed with both milks / all babies} (1) • babies fed with breast milk had a {higher proportion of Bifidobacterium and Bacteroides / lower proportion of Enterococcus, Streptococcus and Veillonella} (1) • Bifidobacterium is the highest in babies fed with both types of milk (1)		**(2)**

Question number	Answer	Additional guidance	Mark
4(b)(ii)	An explanation that includes the following points: • to prevent the growth of pathogenic bacteria / so pathogenic bacteria cannot survive (1) • gut flora compete with other bacteria for {space / nutrients} **OR** gut flora produce {toxins / lactic acid} (1)		**(2)**

Question number	Answer	Additional guidance	Mark
4(c)	An explanation that includes three of the following points: • oligosaccharides {provide an alternative to antibiotics that the bacteria are resistant to / can be used on resistant bacteria} (1) • using oligosaccharides removes the selection pressure (1) • oligosaccharides {will have fewer side effects / will not destroy the gut bacteria} (1) • oligosaccharides will increase the gut bacteria which {can then outcompete / will reduce the number of} the {GBS / resistant bacteria} (1)	**ACCEPT** bacteria are not resistant to oligosaccharides **ACCEPT** description e.g. reduces the use of antibiotics so number of resistant bacteria does not increase	**(3)**

Question number	Answer	Additional guidance	Mark
5(a)	• 3.2×10^7 / 3.18×10^7 (1)		**(1)**

Question number	Answer	Mark
5(b)(i)	The only correct answer is **A** **B** *is incorrect because glycosidic bonds are in carbohydrate molecules* ***C*** *is incorrect because hydrogen bonds are between water molecules* ***D*** *is incorrect because there are no ionic bonds in water*	**(1)**

Question number	Answer	Mark
5(b)(ii)	The only correct answer is **B** **A** *is incorrect because ATP does not store hydrogen* ***C*** *is incorrect because plants and seaweeds do not store glycogen* ***D*** *is incorrect because RUBISCO is not a fuel*	**(1)**

Question number	Answer	Mark
5(b)(iii)	The only correct answer is **C** **A** *is incorrect because carbon dioxide and hydrogen combine during the light-independent reactions and oxygen is released during the light-dependent reactions* ***B*** *is incorrect because carbon dioxide and hydrogen combine during the light-independent reactions and oxygen is released during the light-dependent reactions* ***D*** *is incorrect because carbon dioxide and hydrogen combine during the light-independent reactions and oxygen is released during the light-dependent reactions*	**(1)**

Question number	Answer	Additional guidance	Mark
*5(c)	**Indicative content:** **Diagram 1:** • seaweed taking up space of other organisms • {fish / sea mammals} could get caught up in wires • could prevent {fishing / water sports / water activities / shipping} **Diagram 2:** • seaweed could reduce {food / habitat} of water animals • seaweed could compete with other (wild) aquatic plants for light • could provide labour for local population • increasing the economy of the area • increase in carbon dioxide removed from {atmosphere / water} / reduces greenhouse effect • machinery used to {grow / harvest} seaweed might disturb other organisms • causing them to {move away / be stressed} • interrupting food chain • presence of seaweed might provide {food source / habitat} for different species • which would compete with current species • interrupting food chain • increase biodiversity • machinery used to {transport /process} seaweed will burn fossil fuels **Other ideas:** • maybe other organisms brought into area on the seaweed • which would compete with other species for {food / habitat} • could bring in diseases • that could weaken or kill other species • will Europe have high enough {temperature / light levels} to sustain growth	**Level 1: Simple comments about aspects** 1 mark = one relevant comment 2 marks = simple comments relating to at least three aspects **Level 2: discussion about aspects linked to at least one diagram / idea** 3 marks = at least one aspect discussed in more detail 4 marks = at least two aspects discussed in more detail **Level 3: detailed discussion about aspects from both diagrams** 5 marks = at least three aspects discussed in more detail 6 marks = at least four aspects discussed in more detail which includes an idea not included in the diagram	**(6)**

Question number	Answer	Mark
6(a)(i)	The only correct answer is C **A** *is incorrect because the base is not attached to the phosphate group* ***B*** *is incorrect because the phosphate group is not attached to the base* ***D*** *is incorrect because the phosphate group and base are not attached to adjacent carbons*	**(1)**

Question number	Answer	Additional guidance	Mark
6(a)(ii)	• phosphodiester (bond / link) (1)		**(1)**

Question number	Answer	Additional guidance	Mark
6(b)(i)	An explanation that includes the following points: • as temperature increases the {rate of enzyme reactions / length of lizards} increases (1) • due to more {frequent collisions / energetic collisions} between enzymes and substrates (1) • credit a named enzyme-controlled reaction that would contribute to faster growth (1)	**ACCEPT** as rate of enzyme reactions increase the length of lizards increases increases enzyme activity **ACCEPT** due to more enzyme substrate complexes forming due to increase in kinetic energy increase in {metabolic reactions / metabolism} e.g. DNA synthesis, mitosis, protein synthesis, respiration, cell division	**(3)**

Question number	Answer	Additional guidance	Mark
6(b)(ii)	A description that includes two of the following points: • at 46 mm there is no change in the abundance of lizards (1) • as the length of the lizard increases above 46 mm there is decrease in the abundance of lizards (1) • lizards {between 44.5 and 46 mm / less than 46 mm} in length increased in abundance (1) • the length of the lizard affects its {chance of survival / abundance} (1)	**ACCEPT** shorter lizards (are more likely to) have a greater chance of survival / converse lizards of 44.5 mm (are more likely to) have greatest chance of survival	**(2)**

Question number	Answer	Additional guidance	Mark
6(b)(iii)	An explanation that includes three of the following points: • because the cells in the longer lizards would have divided more (1) • and every time a cell divides DNA synthesis takes place (1) • {shorter telomeres / damaged chromosomes} cause cell death (1) • so the longer lizards are in lower abundance / lizards die before they can grow any longer (1)	**ACCEPT** number of cell divisions increases with growth	**(3)**

Question number	Answer	Additional guidance	Mark
7(a)	An answer that includes the following points: • active immunotherapy {stimulates the immune system / causes an immune response / uses (cancer) antigens} (1) • so memory cells generated (1)	**ACCEPT** description of what is stimulated e.g. B cells, antibody production	**(2)**

Question number	Answer	Additional guidance	Mark
7(b)(i)	An explanation that includes the following points: • because a mutation causes a change in the {DNA / base} sequence (1) • and this can result in a {change in the / new} {amino acid sequence / primary structure} (1)	**ACCEPT** change in genetic code change in one base **ACCEPT** (poly) peptide change in one amino acid	**(2)**

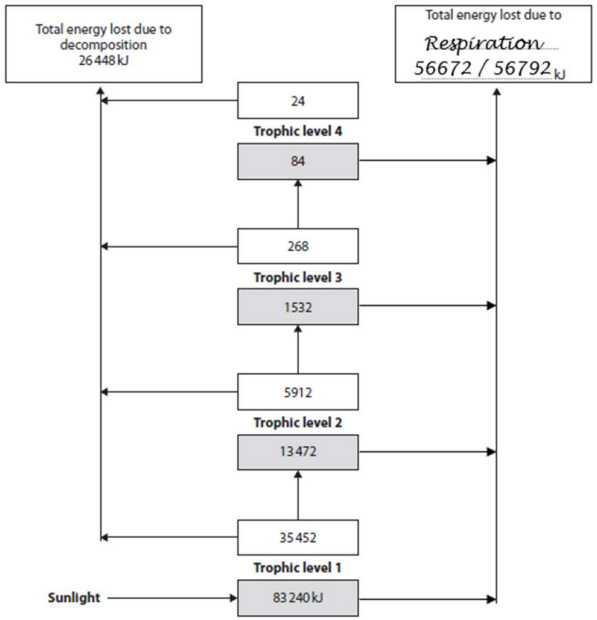
Question number	Answer	Additional guidance	Mark
7(b)(ii)	An explanation that includes four of the following points: • the mRNA results in the production of the neoantigens (1) • the body will recognise these neoantigens as foreign (1) • therefore macrophages will {engulf the neoantigens / express neoantigens on surface} (1) • and macrophages present the neoantigens to {T helper / CD4} cells (1) • which will then release cytokines to stimulate {an immune response / humoral response / cell-mediated immunity / B cells / T killer cells} (1)	**ACCEPT** mRNA translated (into neoantigens) **ACCEPT** present on surface / express on MHC **ACCEPT** macrophages become APC {to T_h cells / and T helper cells bind to {macrophage / neoantigen / MHC} **ACCEPT** chemicals for cytokines	**(4)**

Question number	Answer	Additional guidance	Mark
7(c)	An explanation that includes the following points: • because the antibodies will {bind to the neoantigens / form an antigen antibody complex} (1) • and therefore the cancer cells will be destroyed faster by the {macrophages / phagocytes} (1) **OR** • antibodies binding cancer cells together (1) • and therefore the cancer cells will be {destroyed faster by the macrophages / prevented from spreading} (1)	**ACCEPT** opsonisation (of cancer cells) **ACCEPT** engulfed by macrophages faster **ACCEPT** agglutination (of cancer cells) **ACCEPT** engulfed by {macrophages / phagocytes} faster	**(2)**

Question number	Answer	Additional guidance	Mark
7(d)	An explanation that includes the following points: • because large number (T helper cells) are needed to activate {B cells / T killer cells} (1) • because genetically identical cells will not be rejected (1)	**IGNORE** pathogens throughout **ACCEPT** large number (T killer cells) are needed to destroy cancer cells effects of {HI / CMI} e.g. more antibody produced **ACCEPT** need to be specific to the (cancer cell) antigens	**(2)**

Question number	Answer	Additional guidance	Mark
7(e)	An answer that includes two of the following points: • must not be {pathogenic / cause disease / cause cancer} (1) • must {be specific to / target} the {cancer cells / neoantigens} (1) • must be able to destroy the cancer cells (1)	**ACCEPT** can bind to cancer cells / can enter cancer cells / only affect cancer cells / do not affect healthy cells	**(2)**

Question number	Answer	Additional guidance	Mark
8(a)(i)	An answer that includes the following points: • 35 452 and 83 240 (1) • 43 / 42.6 / 42.59 (%) (1)	Bald answer of {43 / 42.6 / 42.59} = 2 marks Bald answer containing {too many dps / incorrect rounding with acceptable number of dps} = 1 mark	**(2)**

Question number	Answer	Additional guidance	Mark
8(a)(ii)	An answer that includes the following points: • (total energy lost to) respiration / heat (energy) (1) • (total energy lost to) 56 672 / 56 792 (1) • four arrows each coming out of a different grey box pointing to the vertical RH arrow (1)		**(3)**

Question number	Answer	Additional guidance	Mark
8(a)(iii)	An explanation that includes three of the following points: • because enzymes are needed to breakdown dead organisms (1) • so that the (products of) digested molecules are soluble (1) • so that the (digested) molecules can be {taken up / used} by microorganisms (1) • so that the dissolved molecules can soak into the ground (1) • important in {recycling / carbon cycle} (1)	**ACCEPT** named molecule e.g. cellulose **ACCEPT** named molecule e.g. glucose	**(3)**

Question number	Answer	Additional guidance	Mark
8(b)	An explanation that includes the following points: • (overall) {TLN / trophic level number} has increased (with time) (1) • because the (proportion of) meat in the diet has increased (1) • greatest increase in meat in diet was after 1983 (1) • people are eating less than 50 % meat (throughout the time period) (1) • because the TLN is low (1)	**ACCEPT** proportion of plants has decreased **ACCEPT** people are eating more than 50 % plants (in their diet) people eating more plants than animals / less meat than plants} **ACCEPT** below {3 / 2.5}	**(3)**

Question number	Answer	Additional guidance	Mark
9(a)(i)	• 380 and 210 / 170 / 380 and 215 / 165 (1) • 11.3 (if 210 used) / 11.0 (if 215 used) (1)	**DO NOT ACCEPT** 11.00 / 11.30 Bald answer of {11.0 / 11.3} = 2 marks Bald answer with incorrect number of sig figs = 1 mark Bald answer of {170 / 165} = 1 mark	**(2)**

Question number	Answer	Additional guidance	Mark
9(a)(ii)	• answer in the range of 468 to 470.7 to max one dp (1)		**(1)**

Question number	Answer	Additional guidance	Mark
9(a)(iii)	An answer that includes the following points: • (graph / line / plastic production shows a) non-linear increase (1)	**ACCEPT** exponential rate (of increase) is not the same fluctuates increasing gradient	**(1)**

Question number	Answer	Additional guidance	Mark
9(b)(i)	A description that includes two of the following points: • (the probability of death increases as the number of pieces of plastic increases in a) {S / sigmoidal} (shape) (1) • there is a critical number of pieces of plastic above which the probability of death increases sharply (1) • probability of death is zero when number of pieces of plastic is very low (1)	**ACCEPT** description e.g. shallow increase then a sharp increase and then a shallow increase but non-linear positive correlation **ACCEPT** above a certain number of pieces . . . . . . **ACCEPT** rapid increase **ACCEPT** below a certain number of pieces of plastic the probability is zero	**(2)**

Question number	Answer	Additional guidance	Mark
9(b)(ii)	A description that includes two of the following points: • cause of death of the turtles not known (1) • therefore {no direct evidence that the plastic did cause the death of the turtles / correlation not causation} (1) • the size of the plastic was not taken into account (1) • {species / size} of turtle not known (1) • no indication of timescale of plastic inside turtle (1) • no values given on the graph (1)	**ACCEPT** other factors may have caused death **ACCEPT** mass / type **ACCEPT** age of turtle	**(2)**

Question number	Answer	Additional guidance	Mark
*9(c)	**Graph 1:** • fewer mangoes are diseased (D) • so they will be more edible / less wastage • so more food to go round • increase profits of mango-producing countries **Graph 2:** • less mass is loss than no packaging / (slightly) more mass lost than plastic (D) • which is probably due to dehydration of the mango • therefore fruit will be more succulent • and add water to the diet • important in arid countries **Table:** • decomposes relatively quickly (D) • therefore biodegradable • will not be any plastics to go into the sea / land fill sites • so less damage to wild life • less interruption to food chain • contributes to carbon cycle **Other ideas:** • sustainable / carbon neutral • more banana plants grown reducing carbon dioxide levels • maybe less toxic • production of plastic results in burning of fossil fuels • plastics not always available to countries producing mangos • using plastic adds more to cost of mangos • plastics are expensive	**Level 1: simple** 1 mark = data in {one graph / table} described 2 marks = data in {both graphs / one graph and table} described **OR** one advantage described **Level 2:** advantages described 3 marks = one advantage discussed in detail **OR** two advantages described 4 marks = two advantages discussed in detail **OR** three advantages described **Level 3:** extended discussion 5 marks = three advantages discussed in detail **OR** four advantages described 6 marks = as for 5 marks but covers 3 sections	**(6)**

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