Mark Scheme (Results)

January 2025

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

Question number	Answer	Mark
1(a)	The only correct answer is **C**	
	A *is incorrect because Box J is GPP, Box K is R and Box L is NPP* B *is incorrect because Box J is GPP, Box K is R and Box L is NPP* D *is incorrect because Box J is GPP, Box K is R and Box L is NPP*	**(1)**

Question number	Answer	Mark
1(b)	The only correct answer is D	
	A *is incorrect because the units are energy per area per time = kJ m^{-2} yr^{-1}* B *is incorrect because the units are energy per area per time = kJ m^{-2} yr^{-1}* C *is incorrect because the units are energy per area per time = kJ m^{-2} yr^{-1}*	**(1)**

Question number	Answer	Additional guidance	Mark
1(c)(i)	• 3 625 / 3 625.0		(1)

Question number	Answer	Mark
1(c)(ii)	The only correct answer is C **A** *is incorrect because roots do not contain chlorophyll* **B** *is incorrect because leaves do not contain glycogen* **D** *is incorrect because leaves do not contain glycogen*	(1)

Question number	Answer	Additional guidance	Mark
1(d)	• organisms <u>interacting</u> with each other and their {environment / habitat} (1)	**ACCEPT** species / biotic factors / community **ACCEPT** abiotic factors / non-living environment	(1)

Question number	Answer	Mark
2(a)	The only correct answer is **D** **A** *is incorrect because chromatography separates out solutes* **B** *is incorrect because dendrochronology studies tree rings* **C** *is incorrect because evolution looks at speciation*	**(1)**

Question number	Answer	Additional guidance	Mark
2(b)	An explanation that includes four of the following points: • because body <u>temperature</u> drops (with increasing time after death) (1) • (body temperature falls) as {the air temperature is low(er) / the body is no longer producing heat (from metabolism) / metabolism stops} (1) • time of death can be calculated if ambient temperature and change in body temperature known (1) • {muscle stiffens / rigor mortis} and (then) relaxes (again) (1) • stiffens because (levels of) ATP decrease (with time) (1) • {relaxes / stiffening decreases} because {bacteria / microorganisms / enzymes} {digest / breakdown} the muscle (1)	**ACCEPT** increases **ACCEPT** respiration stops **NB** must match change in body temperature if given **ACCEPT** use of calibration curve **Piece together** **ACCEPT** smaller muscles stiffen first {extent / degree} of stiffness can be used	**(4)**

Question number	Answer	Additional guidance	Mark
3(a)(i)	• 7.5 / 8 / 8.3 / 9 / 9.4 (1)		(1)

Question number	Answer	Additional guidance	Mark
3(a)(ii)	An answer that includes the following points: • an oscillating curve with both peaks higher than corresponding peaks on the lynx line (1) • an oscillating line that is displaced from the lynx line (1)		(2)

Question number	Answer	Additional guidance	Mark
3(a)(iii)	An explanation that includes three of the following points: • (number of) lynx decrease (as they die) due to starvation (when the number of hares decrease) (1) • (number of) {hares / lynx} increase when {hares / lynx} are born / reproduce / mating} (1) • (number of) hares decrease as they are {hunted / killed / eaten / predated} by <u>more</u> lynx (1) • changes in numbers are staggered as it takes time for {starvation / births / hunting} (1)	**ACCEPT** description of starvation i.e. the idea that death would result from a lack of {energy / nutrients / food} **ACCEPT** birth rate greater than death rate **ACCEPT** die if there was a lack of plant food for hare die from disease when there are high numbers	(3)

Question number	Answer	Additional guidance	Mark
3(b)	An answer that includes two of the following points: • (the numbers of) prey are influenced by {their food source / other (types of) predators} (1) • a predator may have more than one prey (species) (1) • the numbers of predators are influenced by their predators (1) • other named factors affect the number of organisms (1)	e.g. habitat loss, disease, natural disasters, lack of water, migration, global warming, climate change, temperature change	**(2)**

Question number	Answer	Mark
4(a)(i)	The only correct answer is **C** **A** *is incorrect because light-dependent reaction takes place on the thylakoid membranes which is T and the light-independent reactions in the stroma which is R* **B** *is incorrect because light-dependent reaction takes place on the thylakoid membranes which is T and the light-independent reactions in the stroma which is R* **D** *is incorrect because light-dependent reaction takes place on the thylakoid membranes which is T and the light-independent reactions in the stroma which is R*	(1)

Question number	Answer	Mark
4(a)(ii)	The only correct answer is **C** **A** *is incorrect because hydrogen ions accumulate in the thylakoid space which is S* **B** *is incorrect because hydrogen ions accumulate in the thylakoid space which is S* **D** *is incorrect because hydrogen ions accumulate in the thylakoid space which is S*	(1)

Question number	Answer	Additional guidance	Mark
4(a)(iii)	An answer that includes the following points: • chloroplast measured as 9.6cm and converted to 96 000 µm (1) • value divided by 16 000 (1) • 108 / 112 / 113 (1)	**ACCEPT** 4.8 cm converted to 48 000 µm ecf for measurement of 9.5 cm or 9.7 cm to max 2 marks ecf for using diameter not radius	(3)

Question number	Answer	Additional guidance	Mark
4(a)(iv)	An explanation that includes the following points: • so that {more light <u>absorbed</u> / more chlorophylls are present} (1) • to generate {lots of / more} ATP / reduced NADP) / so that lots of glucose can be synthesised / more biomass produced} (1)	**ACCEPT** more for lots more {(photosynthetic) pigments / PSs / electron carrier proteins / ATP synthase} **ACCEPT** more for lots GALP for glucose	(2)

Question number	Answer	Additional guidance	Mark
4(b)(ii)	An answer that includes the following points: • (two cycles requires) (6 + 12) 18 ATP and (6 + 6) 12 NADPH (1) • 1.5 : 1 (1)	**ACCEPT** 9 : 6 etc but not 6 : 9 etc values shown for one cycle or more	(2)

Question number	Answer	Mark
4(b)(i)	The only correct answer is **D** *A is incorrect because ADP is not hydrolysed and energy is not released* *B is incorrect because ADP is not hydrolysed* *C is incorrect because energy is not released*	(1)

Question number	Answer	Additional guidance	Mark
4(b)(iii)	An explanation that includes the following points: • because {it is used to regenerate RuBP / (otherwise) the cell will run out of RuBP} (1) • (with no RuBP) no {carbon fixation / (Calvin) cycle / light independent stages} will occur (1)	**IGNORE** any numbers given **ACCEPT** used to make {glycerol / amino acid / nucleotides} stand alone **ACCEPT** description of carbon fixation (regeneration of RuBP) for next cycle of carbon fixation	(2)

Question number	Answer	Additional guidance	Mark
5(a)	An explanation that includes the following points: • (pollen grains from) cereal crops {begin to appear / (start to) increase} when humans {farmed / grew} cereal crops (1) • {increase in (pollen from) cereal crops / (pollen from) beans start to appear} when more {humans to feed / food needed} (1) • the (pollen grains from) trees decreases as more {land is being farmed / more trees cut down for buildings} (1)	**NB ACCEPT** name of plant instead of pollen throughout **ACCEPT** other uses of trees / wood	(3)

Question number	Answer	Mark
5(b)(i)	The only correct answer is B A *is incorrect because the maximum value is 16 and the minimum value is 8 so the difference is 8* C *is incorrect because the maximum value is 16 and the minimum value is 8 so the difference is 8* D *is incorrect because the maximum value is 16 and the minimum value is 8 so the difference is 8*	**(1)**

Question number	Answer	Additional guidance	Mark
5(b)(ii)	An explanation that includes five of the following points: • (body was preserved) as {conditions / named condition} (in bog) were not suitable for {<u>decomposition</u> / <u>decay</u>} to take place (1) • (cold temperatures meant that) (microbial) enzymes were working slowly (1) • {(low) pH / acid conditions} not suitable for {bacteria to survive / bacteria to grow / (microbial) enzymes to function / enzymes denature} (1) • water-logged bog meant that {oxygen levels were (very) low / conditions were anaerobic} (1) • so not enough {energy released / ATP produced} by respiration (for the microorganisms) (1) • bog protected body from {insects / animals / scavengers} (1)	**ACCEPT** {bacteria / fungi / decomposers} for microorganisms **ACCEPT** slow **IGNORE** denature **DO NOT ACCEPT** enzymes killed **ACCEPT** specified reason e.g. waterlogging prevented maggots from being there	**(5)**

Question number	Answer	Additional guidance	Mark

6(a)	An answer that includes the following points:
	
	• a {chemical / substance / drug / medicine} that {kills / inhibits the growth of} {bacteria / microorganisms / pathogens} (1)
		ACCEPT inhibits the reproduction of microorganisms
		            chemical that is bacteriostatic / bactericidal
		DO NOT ACCEPT confusion with antigens / antibodies
		            viruses
			(1)

Question number	Answer	Mark
6(b)	The only correct answer is **C** **A** *is incorrect because ((10 – 1.27) ÷ 1.27) × 100 = 687.40157* **B** *is incorrect because ((10 – 1.27) ÷ 1.27) × 100 = 687.40157* **D** *is incorrect because ((10 – 1.27) ÷ 1.27) × 100 = 687.40157*	**(1)**

Question number	Answer	Additional guidance	Mark
6(c)	An explanation that includes two of the following points: • bacteria will not be resistant to {this / new} drug (1) • so we will be able to **treat** {antibiotic-resistant bacteria / (bacterial) diseases / (bacterial) infections} (1) • if the new drug is not an antibiotic, bacteria may not develop resistance (1)	**ACCEPT** pathogens throughout **DO NOT ACCEPT** viruses **ACCEPT** to win the evolutionary race current drugs are less effective **IGNORE** bacteria are becoming resistant to current antibiotics **ACCEPT** so fewer people will die from bacterial infections if we do not have a new drug, we will not be able to treat bacterial infections	(2)

Question number	Answer	Additional guidance	Mark
6(d)	An answer that includes the following points: • drug {disrupted / increased permeability of} {membrane / wall / peptidoglycan} (1) • so antibiotic could {access / affect} their {target sites / named target sites} / so antibiotic can enter cell (1)	**ACCEPT** acts as a channel protein e.g. peptidoglycan, ribosomes, enzymes, cell wall, murein **ACCEPT** less antibiotic needed to disrupt {cell wall / peptidoglycan} as drug has done this	(2)

Question number	Answer	Additional guidance	Mark
6(e)(i)	A description that includes two of the following points: • (overall) all three antibiotics decrease the species richness (1) • effect of all three antibiotics is (nearly) the same in the first 3 days (1) • antibiotic C {decreases species richness the most / destroys most bacteria / is the most effective at killing bacteria (overall / after 3 days)} (1)	**ACCEPT** it / number of species / richness **ACCEPT** antibiotics only show different effects after 3 days **ACCEPT** converse for antibiotic A	(2)

Question number	Answer	Additional guidance	Mark
6(e)(ii)	An explanation that includes three of the following points: • {antibiotic / C} may act {faster / at lower doses} (1) • therefore the {species richness / gut flora} may not {decrease / be affected} as much (1) • credit appropriate comment linking species richness to health (1) • patient may recover sooner from their infection (1)	**ACCEPT** C can be taken for fewer days e.g. gut flora will be able to compete with pathogens for {space / nutrients} less damage to gut flora will aid digestion **ACCEPT** fewer side effects	(3)

Question number	Answer	Additional guidance	Mark
7(a)	(carbon dioxide) burning (fossil) fuels / farming animals / burning trees / burning plastics / vehicle emissions **and** farming rice / paddy fields / farming ruminants / farming named ruminant e.g. cattle / landfill sites / fossil fuel production / coal mining / burning biomass / burning biofuels / burning plastics / mismanagement of sewage / draining of peat bogs (1)	**NB** answers must be different for the mark to be awarded **ACCEPT** burning {coal / oil / natural gas / peat} **ACCEPT** livestock for farming	**(1)**

Question number	Answer	Additional guidance	Mark
7(b)	A description that includes three of the following points: • greenhouse gases {accumulate / increase / more released / in excess} in the (upper) atmosphere (1) • allow {UV / short wavelength / visible} light {through / to reach Earth's surface} (1) • but {prevent the exit of / trap / absorb} {IR (radiation) / long wavelength light / heat (energy)} (1) • causing the Earth's {atmosphere / surface} to {heat up / increase in temperature (1)	**ACCEPT** named greenhouse gas **ACCEPT** reflect (back) / re-emit	**(3)**

Question number	Answer	Additional guidance	Mark
7(c)	• value between 1.10 and 1.40 up to 2 decimal places (1)		(1)

Question number	Answer	Additional guidance	Mark
7(d)(i)	• 9.5 (1)		(1)

Question number	Answer	Additional guidance	Mark
7(d)(ii)	An answer that includes three of the following points: • tackling the release of nitrous oxide is urgent as it has {a (very) high / the highest} WP (1) • the issue with carbon dioxide production is it has a long-term effect (1) • reducing methane because as it has a (fairly) high WP (1) • tackle nitrous oxide first, carbon dioxide second, methane third / all gases should be tackled as they all affect climate change (1)	**ACCEPT** carbon dioxide would be a more long-term solution as the {WP is low / it remains in the atmosphere for years} **ACCEPT** methane has least effect as intermediate WP and lasts 12 years	(3)

Question number	Answer	Additional guidance	Mark
7(e)(i)	An explanation that includes two of the following points: • the higher the turbidity the more {cells / bacteria / growth of bacteria} present (1) • use lines of best fit (1) • compare the gradients of the two lines (1) **OR** • the higher the turbidity the more {cells / bacteria / growth of bacteria} present (1) • compare the mean rate of change in turbidity (1) • using {the values at 1 and 14 days / y = m x + c} (1)	**IGNORE** doubling time / GRC **ACCEPT** lines of best fit shown on the graph **ACCEPT** B has steeper gradient (so higher growth rate)	**(2)**

Question number	Answer	Additional guidance	Mark

7(e)(ii)	• {energy / carbon} is not enough to sustain the metabolic requirements of the bacteria
	
	   OR
	
	• concentration outside cell is too low for (facilitated) diffusion of methane (into the cell)
	
	   OR
	
	• bacteria are not able to actively transport methane (into the cell) (1)
		ACCEPT named use e.g. cell division, protein synthesis, reproduction
		
		IGNORE growth / biomass
			(1)

Question number	Answer	Additional guidance	Mark
7(e)(iii)	An explanation that includes the following points: • because {nitrous oxide / carbon dioxide / other greenhouse gases (than methane) / greenhouse gases} may be produced (by the bacteria) (1) • {nitrous oxide / carbon dioxide} could cause more {climate change / global warming} than the reduction in methane would reduce (1)	ACCEPT more greenhouse gases maybe produced than (methane) absorbed {nitrous oxide / carbon dioxide} contribute to acid rain	(2)

Question number	Answer	Additional guidance	Mark
8(a)	An answer that includes the following points: • (generally) more cases in men (than in women) (1) • most cases in the {21 to 30 year olds / 11 to 40 / 50 year olds} (overall / men and women) (1)	**ACCEPT** risk / chance **ACCEPT** 71 to 80 is only age group where there are more cases in women than men **ACCEPT** fewest cases in (91 to 100 year olds / over 60s}	(2)

Question number	Answer	Additional guidance	Mark
8(b)(i)	A description that includes the following points: • rice powder without the subunit (1) • at the same {concentrations / masses / doses} (1) • same {appearance / texture / colour} / looks like the vaccine (1)	**ACCEPT** rice from {normal / non-genetically modified} plant rice without the {vaccine / drug} **ACCEPT** at the three different {concentrations / masses} / at 1,3 and 6 g	(2)

Question number	Answer	Additional guidance	Mark
8(b)(ii)	• because {only one with significant difference (above placebo) / fewer error bars overlapping (1)	**ACCEPT** SD for error bars error bars not overlapping after {6 / 8} weeks	(1)

Question number	Answer	Additional guidance	Mark
8(b)(iii)	An explanation that includes two of the following points: • antibodies are {specific / complementary} to one <u>antigen</u> (1) • therefore the other toxins must have {a similar shape / same antigens / same subunits} (to the cholera subunit) (1) • other molecules in rice powder have similar shape to the toxins of other bacteria (1) • rice powder contaminated with {other bacteria (that produce the toxins) / the toxins} (1)		(2)

Question number	Answer	Additional guidance	Mark
8(b)(iv)	An answer that includes three of the following points: Similarities: • both have {A, B, C and D (and others) / all (four) types of bacteria} (1) • both have A as the most abundant (1) Differences: • non-responders have greater percentage of the bacteria that have been named / responders have greater percentage of the 'other' types of bacteria (1) • non-responders have lower percentage of {B / C / D / B, C and D} than responders (1)	**DO NOT PIECE TOGETHER** **ACCEPT** A, B, C and D converse **ACCEPT** higher percentage of A converse	**(3)**

Question number	Answer	Additional guidance	Mark
8(b)(v)	An answer that includes two of the following points: • other factors (could be causing the difference) (1) • it may be one of the 'other' bacteria (causing the difference) (1) • cannot identify which (named) bacteria is the cause / it could be a combination of the types of bacteria (1)	**ACCEPT** named factor e.g. age, sex, diet, named dietary component, alcohol consumption, immune status, smoking, other medications, exercise, other infectious diseases, no timescale, genetics **IGNORE** sample size, abundance, lifestyle **ACCEPT** only (a few / 4) types of bacteria counted 'other' types not specified	(2)

Question number	Answer	Mark
*9(a)	**Infection with retrovirus:** • virus attached to cell {membrane / receptors} • {virus / viral RNA} entered host cell • DNA copy of the viral RNA made • using reverse transcriptase • viral DNA copy inserted into the host cell {genome / DNA} • using integrase **Conservation of ERVs and passing ERVs down from generation to generation:** • ERVs present as {provirus / incorporated DNA} in the cells / in latency • because the ERVs replicate when the {DNA / cell} replicates • no gene products made / any gene products were harmless / no viruses made • virus infected {cells that produce gametes / gametes / early embryo} • on fertilisation the ERVs were present in the zygote • therefore ERVs passed onto the child • as the embryo cells divided by mitosis the new cells acquire the ERVs • by semiconservative replication • resulting in all body cells possessing ERVs • gametes from the offspring will each possess one copy of an ERV • this was repeated over thousands of generations • no negative selection pressure • no gene products due to epigenetic modification • preventing gene expression • by DNA methylation / RNA silencing (for example)	(6)

			Additional guidance
Level 0	0	No awardable content	
Level 1	1-2	An explanation may be attempted but with limited interpretation or analysis of the scientific information and with a focus on mainly just one piece of scientific information. The explanation will contain basic information, with some attempt made to link knowledge and understanding to the given context.	Simple description 1 mark = one relevant comment 2 marks = one simple explanation for one section (2 or 3 points made)
Level 2	3-4	An explanation will be given, with occasional evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The explanation shows some linkages and lines of scientific reasoning, with some structure.	Some explanation 3 marks = one detailed explanation for one section (4 or more comments made) **OR** two simple explanations, one for each section 4 marks = one simple explanation for one section and one detailed explanation for the other section
Level 3	5-6	An explanation is made that is supported throughout by sustained application of relevant evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The explanation shows a well-developed and sustained line of scientific reasoning, which is clear and logically structured.	Extended explanation 5 marks = two detailed explanations, one for each section 6 marks = two detailed explanations, one for each section, including an understanding that the ERVs had to be present in the gametes to be passed on to the zygote at fertilisation to be present in the next generation

Question number	Answer	Additional guidance	Mark
9(b)	An explanation that includes three of the following points: • (epigenetic modification) prevents gene expression (1) • by {DNA methylation / histone modification} (1) • therefore transcription and (then) translation cannot occur (if gene is silenced) (1)	**ACCEPT** genes are {silenced / switched off / deactivated **ACCEPT** other examples of epigenetic modifications e.g. repressor proteins, histone methylation, histone deacetylation **DO NOT ACCEPT** post-transcriptional modification **ACCEPT** description **ACCEPT** {RNA polymerase / transcription factors} prevented from binding to the DNA	(3)

Question number	Answer	Additional guidance	Mark

9(c)	An explanation that includes five of the following points:
	
	• (development of) cancer will stimulate a secondary immune response (1)
	
	   AND ANY FOUR FROM:
	
	• because an immune response (to the envelope proteins / by the vaccine) was stimulated (1)
	
	• memory cells produced (1)
	
	• antibodies will be produced by plasma cells (1)
	
	• that will opsonise the cancer cells / so that macrophages can {engulf / destroy} them (faster) / antibodies will be produced faster (1)
	
	• T killer cells will release {perforins / chemicals / enzymes} destroying cancer cells (sooner) (1)
		ACCEPT description e.g. <u>memory cells</u> produce a faster response
		DO NOT ACCEPT infection with cancer cells
		
		ACCEPT a description of macrophages as APCs to T helper cells
		        active immunity / humoral response / cell mediated response
		
		DO NOT ACCEPT by B cells
		
		ACCEPT agglutination
		
		DO NOT ACCEPT antibodies destroy cancer cells
			(5)