Mark Scheme (Results)

Summer 2017

Pearson Edexcel GCE
In Biology Spec A (9BN0) Paper 03
General and Practical Applications in Biology

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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	Additional Guidance	Mark
1(a)	A description that makes reference to the following: • Advantage – being sustainable / {can decompose / is biodegradable} **(1)** • Disadvantage – less strong / {can decompose/ is biodegradable } **(1)**	Biodegradable / can decompose must be qualified if given as both an advantage and a disadvantage ALLOW renewable or more plants can be grown	**(2)**

Question Number	Answer	Additional Guidance	Mark
1(b)	An answer that makes reference to the following: • the (pulling) force the fibre can withstand before breaking **(1)**	ALLOW mass or weight instead of force	**(1)**

Question Number	Answer	Additional Guidance	Mark
1(c)	An answer that makes reference to four of the following: • pieces of rope of same length and {width / diameter } **(1)** • (stored at) a range of temperatures above and below 18°C **(1)** • humidity at 60% / ropes stored for same period of time **(1)** • {masses / force / weights} applied until rope breaks **(1)** • calculate change in tensile strength **(1)**		**(4)**

Question Number	Answer	Additional Guidance	Mark
1(d)	An answer that makes reference the following: • sclerenchyma (fibres) on the outer side of the {vascular bundle / phloem} **(1)** • xylem (vessels) on the {inner side / inside} of the vascular bundle **(1)**	ALLOW correctly labelled diagram ALLOW sclerenchyma outside vascular bundle ALLOW xylem in the vascular bundle	**(2)**

Question Number	Answer	Additional Guidance	Mark
2(a)	A description that makes reference to the following: • women requiring {pain relief / surgical intervention} (when they gave birth) **(1)** • condition of mothers **(1)**	e.g. same age / same number of babies / no pre-existing pain medication / same gestation period	**(2)**

Question Number	Answer	Additional Guidance	Mark
2(b)	An explanation that makes reference to the following: • {control / placebo} **(1)** • to allow a comparison with {A and B / the other groups} **(1)**		**(2)**

Question Number	Answer	Additional Guidance	Mark
2(c)	An answer that makes reference to the following: • TENS provides pain relief **(1)** • high frequency {most effective / more effective than low frequency} **(1)** • quantified difference between before TENS and after TENS to show that A was the largest **(1)** • there was overlap between the {low frequency TENS / B} and {TENS with no pulses / placebo / control / C} **(1)**	ALLOW TENS is effective {4.8 / 65.8%} pain relief reduction for group A but only {2.8 /38.4% for group B} / {2.3 / 37.7% for group C}	**(4)**

Question Number	Answer	Additional Guidance	Mark
2(d)	A description that makes reference to four of the following: • (repeated stimulus) decreases {sensitivity / permeability} of pre-synaptic membrane / calcium channels not opening **(1)** • so {fewer / no} Ca^{2+} ions move into pre-synaptic neurone **(1)** • so {fewer / no} vesicles {move towards / fuse with} (pre-synaptic) membrane **(1)** • so {less / no} neurotransmitter {released / can diffuse across gap} **(1)** • {action potential / depolarisation} less likely to occur in post-synaptic neurone **(1)**	ALLOW calcium channels less or not responsive	**(4)**

Question Number	Acceptable Answer	Additional Guidance	Mark
3(a)(i)	An answer that makes reference to the following: • as heart rate increases, so does incidence of {both conditions / CHD and cancer } **(1)** • relationship between heart rate and CHD quantified **(1)** • relationship between heart rate and cancer quantified **(1)** • greater increase in incidence of cancer with increased heart rate **(1)** • at a heart rate >99bpm there is a reduction in incidence of both conditions / plateaus / little difference **(1)**	ALLOW converse e.g. 1.95x increase up to 99 bpm / 1.88x increase at >99 e.g. 4.0x increase up to 99 bpm / 3.8x increase at >99 ALLOW converse	**(5)**

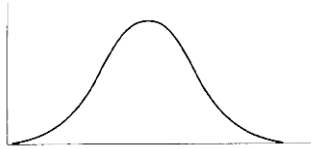
Question Number	Answer	Additional Guidance	Mark
3(a)(ii)	An answer that makes reference to the following: • mid heart beat rate is more common in the (general) population / heart rate is normally distributed in the population **(1)** • fewer people available at low and high heart rate because of other health risks **(1)**	ALLOW high and low heart rates are less common	**(2)**

Question Number	Answer	Additional Guidance	Mark
3(a)(iii)	An answer that makes reference to two of the following: • still (statistically) a large sample size **(1)** • wide range of heart rates considered **(1)** • percentage incidence used (rather than number) **(1)**		**(2)**

Question Number	Answer	Additional Guidance	Mark
3(b)	A description that makes reference to three of the following: • {nucleus / nuclear envelope / nucleous} breaks down **(1)** • spindle (fibres) formed **(1)** • {chromosomes / chromatids} condense **(1)** • Centrioles migrate to (opposite) poles of the cell **(1)**	IGNORE chromatin ALLOW become visible ALLOW opposite ends	**(3)**

Question Number	Answer	Additional Guidance	Mark
4(a)(i)	• correct answer to four significant figures **(1)**	Example of calculation 6.44 ÷ 10 = 0.644 (mm)	**(1)**

Question Number	Answer	Additional Guidance	Mark
4(a)(ii)	An explanation that makes reference to the following: • divide change in mean length by time **(1)** • comparison between the rate for 3% and 5% **(1)**	ALLOW (growth) rate = change in mean length ÷ time ALLOW grow faster in 5%	**(2)**

Question Number	Answer	Additional Guidance	Mark
4(b)(i)	• (symmetrical) bell-shaped curve drawn **(1)**		**(1)**

Question Number	Answer	Additional Guidance	Mark
4(b)(ii)	• specimen 7 = 1.277 **AND** $\Sigma x_1^2 = 12.198$ **(1)**		**(1)**

Question Number	Answer	Additional Guidance	Mark
4(b)(iii)	• Top line of formula correctly calculated **(1)** • correct answer to two significance figures **(1)**	Example of calculation 9.055 – 9.006 = 0.0054 / 0.00544 / 5.4 x 10^{-3}	**(2)**

Question Number	Answer	Additional Guidance	Mark
4(b)(iv)	• top line of formula correctly calculated **(1)** • bottom line of formula correctly calculated **(1)** • correct answer to between three and five significant figures **(1)**	Example of calculation 0.153 0.0336 (0R 0.0337 if 0.00544 used) = 4.55 (OR 4.54 if 0.00544 used) ALLOW answer between 4.5510 and 4.5540 Correct answer with no working gains full marks	**(3)**

Question Number	Answer	Additional Guidance	Mark
4(b)(v)	An explanation that makes reference to the following: • there was a significant difference between {the 3% and the 5% salt solution / groups} **(1)** • at the 5% significance level **(1)**	IGNORE significant correlation / significant relationship ALLOW 95% probability there is a difference e.g. '5% chance that the difference is due to chance' or with 95% certainty' IGNORE p = 0.05	**(2)**

Question Number	Answer	Additional Guidance	Mark
5(a)	An answer that makes reference to the following: • thylakoid membrane / grana / granum **(1)**	ALLOW phonetic spelling ALLOW lamella	**(1)**

Question Number	Answer	Additional Guidance	Mark
5(b)	An answer that makes reference to five of the following: • variable {heights / altitude} **(1)** • {collecting / growing} plants for each sample **(1)** • standardising plant material to be analysed **(1)** • other abiotic factors taken into account **(1)** • method of extraction of pigment **(1)** • method to measure pigment **(1)**	 ALLOW reference to plant material in place of plants e.g. same mass / same part of plant e.g. humidity, wind speed, soil moisture, soil pH e.g. use of solvent e.g. use of colorimeter	**(5)**

Question Number	Answer	Additional Guidance	Mark
5(c)(i)	An answer that makes reference to the following: <u>Similarities:</u> • exposure to UV-B for 20 mins decreases both (mean chlorophyll and flavonoid content) **(1)** <u>Differences:</u> • (longer than 20 min) exposure to UV-B causes chlorophyll to decrease and flavonoid to increase **(1)** • greater change in flavonoid content **(1)**		**(3)**

Question Number	Answer	Additional Guidance	Mark
5(c)(ii)	An answer that makes reference to five the following: • higher altitude more flavonoids synthesised **(1)** • DNA protected from UV-B **(1)** • reduced risk of mutations (so more growth) **(1)** • reduced chlorophyll (due to more UV-B) **(1)** • reduced photosynthesis (so less growth) **(1)** • reduced enzyme activity (so less growth) **(1)**	ALLOW converse statements ALLOW greater expression of the flavonoid gene at higher altitude	**(5)**

Question Number	Answer	Additional Guidance	Mark
6(a)	• width of X to Y ÷ magnification **(1)** • correct answer with appropriate units **(1)**	<u>Example of calculation</u> 50(mm) ÷ 5 000 000 / 5(cm) ÷ 5 000 000 10 nm / 0.01 μm	**(2)**

Question Number	Answer
6(b)	Answers will be credited according to candidates' deployment of knowledge and understanding of material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. Comparisons between phospholipid bilayer and proteins in the cell surface membrane: • judgement about the relative importance of the phospholipid bilayer and the proteins within that bilayer Use of data: • most proteins in the cell are associated with the cell membrane • whilst quantities of phospholipid are the same the proteins have more functions Importance of proteins in the cell surface membrane: • immune response e.g. as antigens and therefore body defence, antibodies, MHC proteins • receptors e.g. receptor proteins on tip of sperm allowing acrosome reaction when encounters zona, for neurotransmitters • regulation e.g. with regards to hormones such insulin • signal / transcription e.g. transcription factors, secondary messengers • transport e.g. active transport, as channel proteins allowing facilitated diffusion, as {voltage-gated / eq} channels for the nerve impulse / resting potential or / and role of Na^+-K^+ pump Importance of phospholipid bilayer in some of: • the role of fluidity and structure of cell the membrane • inhibiting polar substances moving across due to having a hydrophobic component • having both hydrophilic and hydrophobic components which leads to the separation of the aqueous contents of the cell from its aqueous external surroundings • allowing diffusion of gases directly across it • myelin sheath / nerve impulse

Level	Marks	Descriptor	Additional guidance
0		No awardable content	
1	1-3	An explanation may be attempted but with limited interpretation or analysis of the scientific information 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.	Discussion of one type of membrane protein linked to its role May have lots of irrelevant information
2	4-6	An explanation will be given with occasional evidence of analysis, interpretation and/or evaluation of **more than one** piece of scientific information. The explanation shows some linkages and lines of scientific reasoning with some structure.	Discussion of more than one membrane protein linking them to their function Also discussing the role of phospholipids
3	7-9	An explanation is made which is supported throughout by sustained application of relevant evidence of analysis, interpretation and/or evaluation of **several** pieces of scientific information. The explanation shows a well-developed and sustained line of scientific reasoning which is clear and logically structured.	Good discussion of role of proteins and phospholipids – reaching a judgement Linking role of proteins and phospholipids Number of specific examples of membrane proteins Very little if any irrelevant information

Question Number	Answer	Additional Guidance	Mark
7(a)	An explanation that makes reference to three of the following: • methane is a greenhouse gas **(1)** • greenhouse gases {absorb / trap} {heat / infra red / long wave} energy **(1)** • (anaerobic oxidation of methane results in) less methane in the atmosphere **(1)** • (the breakdown of methane) could {reduce the greenhouse effect / result in less heat being trapped / reduce global warming} **(1)**		**(3)**

Question Number	Answer	Additional Guidance	Mark
7(b)	An answer that makes reference to two of the following: • only one cell as opposed to potentially many **(1)** • no nucleus present **(1)** • no membrane-bound organelles present / absence of named membrane-bound organelle other than nucleus **(1)**	ALLOW DNA not associated with histones ALLOW example e.g. no mitochondrion	**(2)**

Question Number	Answer	Additional Guidance	Mark
7(c)	An answer that makes reference to the following: • transfer carbon from an {inorganic source / CO_2} into organic compound **(1)** • that becomes part of the mass of that organism **(1)**	ALLOW correct named organic compound e.g. cellulose / protein ALLOW description of light independent reactions of photosynthesis ALLOW part of biomass	**(2)**

Question Number	Answer	Additional Guidance	Mark
7(d)	An explanation that makes reference to four of the following: • final acceptor of electrons (and H^+) (in the electron transport chain) **(1)** • {to allow / in} oxidative phosphorylation **(1)** • ATP is synthesised **(1)** • (presence of oxygen) allows oxidation of (reduced) NAD **(1)**	ALLOW coenzyme / FAD ALLOW converse	**(4)**

Question Number	Answer	Additional Guidance	Mark
7(e)	An explanation that makes reference to three of the following: • unfolding due to breaking of bonds **(1)** • change in {tertiary structure / 3D shape} / enzyme denatured **(1)** • leading to a change in the shape of the active site **(1)** • substrate no longer able to bind to {enzyme / active site} **(1)**	ALLOW breaking of hydrogen or ionic bonds ALLOW not complementary / not fitting / enzyme substrate complex not formed	**(3)**

Question Number	Answer	Additional Guidance	Mark
7(f)	An answer that makes reference to the following: • all the {DNA / exons and introns} **(1)**	DO NOT ALLOW 'all the genes in the DNA' / 'all the DNA in the genes'	**(1)**

Question Number	Answer	Additional Guidance	Mark
7(g)	An explanation that makes reference to five of the following: • as a result of a mutation **(1)** • (cyanobacteria) produce proteins containing the amino acid cysteine **(1)** • (cysteine rich proteins) produce {heat stable enzymes / proteins resistant to unfolding} **(1)** • other adaptations such as {enzymes with large hydrophobic cores / simpler protein folds / amino acids that do not bond to metal ions } **(1)** • high temperatures act as a selection pressure **(1)** • allowing them to {survive / replicate} and pass advantageous allele to next generation **(1)**	ALLOW 'pass alleles for heat tolerance to next generation'	**(5)**

Question Number	Answer	Additional Guidance	Mark
7(h)	A description that makes reference to two of the following: • (70S) ribosome **(1)** • larger and smaller subunits **(1)** • containing protein and rRNA **(1)**		**(2)**

Question Number	Answer	Additional Guidance	Mark
7(i)	An explanation that makes reference to three of the following: • antibiotics reduce the number of other (species of) bacteria **(1)** • antibiotics that attack cell walls {cause lysis / are bactericidal } **(1)** • antibiotics that attack protein synthesis (machinery) {prevent growth / are bacteriostatic} **(1)** • this reduces interspecific competition from other bacteria for limited resources **(1)**	ALLOW attack ribosomes	**(3)**

Question Number	Answer	Additional Guidance	Mark
7(j)	An answer that makes reference to the following: • pyruvate has 3 carbons compared to 2 carbons in acetyl **(1)**		**(1)**

Question Number	Answer	Additional Guidance	Mark
7(k)	An answer that makes reference to four of the following: <u>Similarities</u> • to avoid adverse environmental conditions **(1)** • formation of resistant {outer coating / capsule} **(1)** • reduce metabolic activity **(1)** <u>Differences</u> • sporulation and no sporulation **(1)** • different reasons for entering dormancy **(1)** • (only) genetic material is in a protective capsule in Bacillus **(1)**	e.g. mycobacterium enters dormancy to avoid immune response and Bacillus to survive lack of resources	**(4)**

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