From Organoids to Gastruloids (June 2019 Paper 3 Scientific Article): Edexcel SNAB A Level Biology Exam Question

11 questions · 31 marks · about 37 minutes. Answer in the spaces, then check the mark schemes at the end.

Question 1 · A level Paper 3 · June 2019 · Q8(a) · 2 marks

8 The scientific article you have studied is adapted from *The Biologist*.

Use the information from the scientific article and your own knowledge to answer the following questions.

(a) State the meaning of the term stem cell (paragraph 1).

(2)

Question 2 · A level Paper 3 · June 2019 · Q8(b) · 3 marks

(b) Describe how a 'single fertilised egg' can produce many different cell types (paragraph 2).

(3)

Question 3 · A level Paper 3 · June 2019 · Q8(c) · 1 mark

(c) Name the property shown by 'spontaneously beating regions' in cardiac muscle (paragraph 15).

(1)

Question 4 · A level Paper 3 · June 2019 · Q8(d) · 3 marks

(d) Mice used in research have a number of limitations (paragraph 6). Mice that are homozygous for a recessive trait are rare in the population, but can be produced in genetic crosses.

Explain how genetic crosses could be used to generate a mouse line expressing a recessive trait.

(3)

Question 5 · A level Paper 3 · June 2019 · Q8(e) · 3 marks

(e) Retinoic acid affects the expression of genes in embryonic stem cells (ESCs) leading to the development of neural tissues (paragraph 11).

Explain how chemicals such as retinoic acid could affect gene expression.

(3)

Question 6 · A level Paper 3 · June 2019 · Q8(f) · 3 marks

(f) The Zika virus can cause microcephaly. This condition is a result of brain tissue not developing in the foetus (paragraphs 20 and 21).

Explain how the Zika virus can cause microcephaly.

(3)

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Question 7 · A level Paper 3 · June 2019 · Q8(g) · 4 marks

(g) Tissue rejection can occur in organs transplanted from other individuals (paragraph 22).

Explain how the immune system is involved in tissue rejection.

(4)

Question 8 · A level Paper 3 · June 2019 · Q8(h) · 5 marks

(h) Human cells can be grown in monolayers using tissue culture (Figure 1).

Devise a procedure to investigate the effect of temperature on the growth rate of a monolayer of human cells.

(5)

Question 9 · A level Paper 3 · June 2019 · Q8(i) · 2 marks

(i) Describe how a gastruloid differs from an organoid (paragraphs 21, 26 and 28).

(2)

Question 10 · A level Paper 3 · June 2019 · Q8(j) · 2 marks

(j) Describe two ethical issues concerning the use of human embryonic stem cells in research (paragraph 32).

(2)

Question 11 · A level Paper 3 · June 2019 · Q8(k) · 3 marks

(k) Explain the advantages of using iPSCs compared to ESCs for the production of transplant material (paragraphs 33 and 34).

(3)

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Mark schemes

Question 1 · A level Paper 3 · June 2019 · Q8(a) · 2 marks

Question Number	Answer
8(a)	An answer the makes reference to the following: • cells capable of unlimited division (1) • (they are undifferentiated) cells that can give rise to specialised cells (1)

Additional guidance	Mark
ALLOW cell capable of self-renewal / cell that does not have a Hayflick limit	**(2)**

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Question 2 · A level Paper 3 · June 2019 · Q8(b) · 3 marks

Question Number	Answer
8(b)	A description that makes reference to three of the following: • mitosis gives rise to new cells (1) • different (sets of) genes are {activated / switched on} (in different cells) (1) • different proteins synthesised which determine {structure / function } of the cell (1) • resulting in differentiation (1)

Additional guidance	Mark
IGNORE meiosis ALLOW genes {deactivated / switched off / genes expressed / differential gene expression}	**(3)**

Question 3 · A level Paper 3 · June 2019 · Q8(c) · 1 mark

Question Number	Answer	Additional guidance	Mark
8(c)	myogenic		**(1)**

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Question 4 · A level Paper 3 · June 2019 · Q8(d) · 3 marks

Question Number	Answer
8(d)	An explanation that makes reference to three of the following: • {screen / produce} a (large) population of mice (1) • cross (two) heterozygous mice (1) • select the homozygous recessive mice (1) • and breed from these for subsequent generations (1)

Additional guidance	Mark
ALLOW labelled genetic diagrams ALLOW carriers for heterozygous ALLOW breed for select ALLOW select mice expressing the recessive trait	**(3)**

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Question 5 · A level Paper 3 · June 2019 · Q8(e) · 3 marks

Question Number	Answer
8(e)	An explanation that makes reference to the following: • (retinoic acid / chemicals) acts as a transcription factor (1) • (transcription factors) bind to regulator regions of DNA (1) • allowing {the production of mRNA / transcription} (1)

Additional guidance	Mark
ALLOW converse for each marking point ALLOW activates a transcription factor / acts as a repressor / acts as an enhancer / unwinds DNA from histones ALLOW bind to promotor / polymerase binding site on genes IGNORE translation	**(3)**

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Question 6 · A level Paper 3 · June 2019 · Q8(f) · 3 marks

Question Number	Answer
8(f)	An explanation that makes reference to three of the following: • virus binds to receptors on (neural) cells (1) • { virus / genetic material } is taken into the cell (1) • virus replicates (1) • causing (neural) cells to {die / burst} / inhibiting replication of (neural) cells / spreads to other (neural) cells (1)

Additional guidance	Mark
(It must be clear that the answer refers to either neural cells or brain cells to gain the first or last marking point) IGNORE viral DNA / RNA replicated IGNORE virus reproduces	**(3)**

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Question 7 · A level Paper 3 · June 2019 · Q8(g) · 4 marks

Question Number	Answer
8(g)	An explanation that makes reference to four of the following: • (donated) { proteins / cells / tissues / organs} act as antigens (1) • (which are) presented by {macrophages / phagocytic cells / antigen presenting cells} (1) • (leading to) activation of T helper cells (1) • (leading to) activation of {T killer cells / cytotoxic T cells / B cells / plasma cells to produce antibodies} (1) • (resulting in) destruction of the transplanted tissue (1)

Additional guidance	Mark
ALLOW { proteins / cells / tissues / organs} are recognised as being foreign ALLOW cells { destroyed / marked for destruction }	**(4)**

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Question 8 · A level Paper 3 · June 2019 · Q8(h) · 5 marks

Question Number	Answer
8(h)	An answer the makes reference to five of the following: • description of how temperature will be controlled (1) • identification of another appropriate abiotic factor to control (1) • provide nutrients (for cells) (1) • use of aseptic technique (to prevent contamination of cell culture) (1) • culture for a stated period of time (1) • description of method of measuring growth (1)

Additional guidance	Mark
e.g. set temperatures using a {water bath / incubator} e.g. pH / humidity/ carbon dioxide concentration / oxygen concentration ALLOW description of aseptic technique ALLOW times greater than 2 hours ALLOW culture at each temperature for the same period of time ALLOW e.g. measure {mass / number / area} of cells at beginning and end of culture	**(5)**

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Question 9 · A level Paper 3 · June 2019 · Q8(i) · 2 marks

Question Number	Answer
8(i)	An answer the makes reference to two of the following: • gastruloids show { a greater extent of differentiation / more types of cell } (1) • (only) gastruloids develop (three) germ layers (1) • the cells in gastruloids are organised {along an axis / with left – right patterning } (1)

Additional guidance	Mark
ALLOW converse statements ALLOW stem cells in the gastruloid {are pluripotent / can give rise to more cell types ALLOW gastruloids are more like an embryo / organoids are only a single organ ALLOW gastruloids have a node	**(2)**

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Question 10 · A level Paper 3 · June 2019 · Q8(j) · 2 marks

Question Number	Answer
8(j)	A description that makes reference to two of the following: • embryonic stem cells have the potential to develop into a human being (1) • embryo is unable to give consent (1) • potential benefits of using embryonic stem cells outweigh the disadvantages (1)

Additional guidance	Mark
ALLOW harvesting embryonic stem cells destroys {embryos / potential life}	**(2)**

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Question 11 · A level Paper 3 · June 2019 · Q8(k) · 3 marks

Question Number	Answer
8(k)	An explanation that makes reference to three of the following: • iPSCs avoid {ethical issue / example of an ethical issue } associated with use of embryos (1) • (transplant material from) iPSCs will be { genetically identical / have the same antigens } (1) • iPSCs can be collected when needed / no need to produce embryos to collect iPSC (1) • iPSCs have less potential to {proliferate / form cancers } (1)

Additional guidance	Mark
ALLOW iPSCs are obtained from the patient ALLOW iPSCs will not trigger an immune response	**(3)**

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