	FOR OFFICIAL USE					
	National Qualificat 2021 ASSE	ions ESSMENT R	ESOl	JRCE	Mark	
X807/76/01					B [.] Pa	iology aper 2
Duration — 2 hours 20 mi	nutes			*	X 8 0 7 7	601*
Fill in these boxes and rea	ad what is printe	d below.				
Full name of centre			Town			
Forename(s)	Sur	name			Number	of seat
Date of birth						
Day Month	Year	Scottish can	didate	e number		

Attempt ALL questions.

You may use a calculator.

Questions 4 and 16 contain a choice.

Write your answers clearly in the spaces provided in this booklet. Additional space for answers and rough work is provided at the end of this booklet. If you use this space you must clearly identify the question number you are attempting. Any rough work must be written in this booklet. Score through your rough work when you have written your final copy.

Use blue or black ink.

Before leaving the examination room you must give this booklet to the Invigilator; if you do not, you may lose all the marks for this paper.









1. (continued)

(c) The polymerase chain reaction (PCR) amplifies specific sequences of DNA.

The graph shows the changes in temperature during this process.

В С С В Α A Α 100 90 temperature (°C) 80 70 60 50 9 2 3 5 8 0 1 4 6 7 10 time (minutes) (i) Describe the events that occur during stage A and stage B. 2 Stage A _ Stage B ____ (ii) An original sample of DNA contained 100 copies of the target sequence. Calculate how long it would take to produce at least 25 000 copies of this sequence. 1 Space for calculation minutes (d) State one practical application of PCR. 1



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2. Anole lizards are found on islands in the Atlantic ocean. The leg length and surface area of the feet of these lizards affect their ability to cling to branches during windy conditions.

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A study was carried out to investigate the effect of a hurricane on characteristics of one species of anole lizard on two islands.

Scientists measured the foot surface area and leg length of lizards on both islands before and after a hurricane.

The results are shown in the table.

Charactoristic	Lizard population on Island 1		Lizard population on Island 2	
Characteristic	Before hurricane	After hurricane	Before hurricane	After hurricane
Average foot surface area (mm²)	16.0	16.9	14.6	16.1
Average leg length (mm)	22.0	20.3	25.6	22.4



2	(tinued)	MARKS	DO N WRITE THI MARC
L .	(a)	Calculate the percentage decrease in the average leg length of the lizard population on Island 2 after the hurricane. Space for calculation	1	
	(b)	Using the information given, explain how natural selection due to hurricanes could result in an increase in foot surface area of future generations of this species.	2	
	(c)	The populations of lizard isolated on two islands could become different species as a result of natural selection. (i) Name the type of speciation that would occur.	1	
		(ii) What evidence would confirm that speciation had occurred?	1	
		[Turn over		
				I

. The	e diagram shows a stage in aerobic respiration occurring in eukaryotic ls.	MARKS	DO NOT WRITE IN THIS MARGIN
	H H H H H H H H H H H H H H H H H H H		
(a)	Name this stage and state its exact location in eukaryotic cells.	2	
	Exact location	_	
(b)	Name enzyme X and substance Y.	2	
(c)	Y Describe the role of electrons in this stage and how this leads to the production of ATP.	2	
		_	
		_	

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			MARKS	DO NOT WRITE IN THIS MARGIN
4.	Atte	empt either A or B. Write your answer in the space below.		
	Α	Write notes on the process of glycolysis in respiration.	4	
	OR			
	В	Write notes on plasmids as vectors in recombinant DNA technology.	4	
	You	may use labelled diagrams where appropriate.		

[Turn over



- MARKS DO NOT WRITE IN THIS MARGIN
- 5. An investigation was carried out into the effect of exposure to low temperature on human body temperature.

Two volunteers, A and B, were immersed in ice baths over an 8 minute period. Body temperatures were measured every 2 minutes.

The results are shown in the table.

	Body temp	erature (°C)
Time of exposure (minutes)	Volunteer A	Volunteer B
0	37.2	37.1
2	36.9	36.9
4	36.4	36.8
6	35.8	36.8
8	35.2	36.7

 (a) (i) Calculate the average decrease in body temperature per minute for Volunteer A during the investigation.

Space for calculation

____°C/min

(ii) Using evidence from the results, suggest why the reliability of the results would be improved if more volunteers were included in the investigation.





5.	(continu	ied)	MARKS	DO NOT WRITE IN THIS MARGIN
	(b) (i) Give an example of a corrective response to a decrease in body temperature and explain how it helps to regulate body temperature.	2	
		Explanation	_	
	(ii) Human body temperature is usually maintained at 37 °C. Apart from optimal enzyme activity, give one reason for the importance of thermoregulation to maintain metabolism.	1	
		[Turn ove	 ?r	





_____%



 6. (b) (continued)
 (ii) The population of polar bears is likely to decrease if the overall trend in the graph continues.
 1

 Suggest a reason for this.
 1

 (c) Other than hibernation, name one way that animals survive adverse conditions.
 1

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7. Cancer is a disease in which cell division is uncontrolled. Some anticancer drugs inhibit protein synthesis.

An experiment was carried out to compare the effect of two drugs, Y and Z, on protein synthesis in human cells.

Two different human cell cultures, HeLa and HL-60, were incubated with drugs Y and Z in liquid growth media at 35 °C.



A range of concentrations of each drug were used and protein synthesis was measured.

The results are shown in the table.

Drug concentration	Protein synthesis (% of control)			
(nM)	Drug Y	Drug Z		
0 (Control)	100	100		
10	100	85		
50	56	35		
75	32	14		
100	7	0		

- (a) (i) Name a piece of apparatus that could be used to maintain the temperature at 35 °C.
 - (ii) Give **one** variable, not already mentioned, that should be kept constant so that a valid conclusion can be drawn on the effect of drug Y on protein synthesis on HeLa cells.









(b) (i) Using the information given, suggest why there is a rapid increase in asparagine concentration between 3 and 4 hours. 2	(b) (i) Using the information gi in asparagine concentra	iven, suggest why there is a rapid increase tion between 3 and 4 hours. 2
 (ii) Explain the changes in the viable cell count between 7 and 10 hours. (c) (i) State why <i>E. coli</i> requires the amino acid asparagine for growth. (ii) Bacteria require other complex molecules apart from amino acids for biosynthesis. Name another complex molecule that could be added to the 		
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growth medium. 1	(ii) Bacteria require other c for biosynthesis.Name another complex growth medium.	omplex molecules apart from amino acids molecule that could be added to the 1



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9. Some plants have nodules in their roots that contain bacteria, which use the enzyme nitrogenase to produce compounds required for the synthesis of amino acids.

In an investigation, nitrogenase activity was measured at different concentrations of its substrate, nitrous oxide, in the presence and absence of two inhibitors P and Q.

Nitrogenase activity (units) Concentration of nitrous oxide No inhibitor Inhibitor P Inhibitor Q $(moll^{-1})$ 0 0 0 0 3 5 13 4 10 25 17 11 15 36 26 14 20 36 35 14 25 36 36 14

The results are shown in the table.

 (a) (i) In the presence of inhibitor P, calculate how many times greater the nitrogenase activity is at a nitrous oxide concentration of 15 moll⁻¹ compared to 5 moll⁻¹.

Space for calculation

_____ times greater

(ii) Name the type of inhibition shown by Q and use evidence from the table to justify your answer.

Type of inhibition _____

Justification _____



Г					MARKS	DO NOT WRITE IN THIS MARGIN
	9.	(cont	tinue	d)		
		Meta	bolic	pathways can be regulated by feedback inhibition.		
		(b)	(i)	Describe feedback inhibition of a metabolic pathway.	2	
					-	
					-	
			(ii)	Suggest one advantage to a cell of using feedback inhibition.	- 1	
					-	
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L				* X 8 0 7 7 6 0 1 1 7 *		•

10. In coastal ecosystems different species of seaweed are found at different depths of seawater.

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The diagram shows the depth to which some different colours of light penetrate seawater.



The table shows the seaweed species present at different depths of seawater.

Depth (m)	Seaweed species present
0-5	A. mirabilis
15-20	D. anceps
20-25	H. grandifolius and D. menziesii

- (a) Name a pigment that absorbs mainly red and blue light.
- (b) *H. grandifolius* has higher levels of carotenoids in its cells than *A. mirabilis*.
 - (i) Describe the role of carotenoids.





THIS An investigation was carried out to determine the effect of radiation on 11. germination of seeds of the crop plants maize, okra and groundnut. Five hundred seeds of each crop plant were exposed to different levels of radiation. They were then placed in dishes containing wet filter paper and left for five days to germinate. Control dishes were set up for each type of seed. The percentage germination for each was calculated and the results are shown in the graph. 100 Key - maize 90 -- okra germination (%) 80 groundnut 70 60 50 40 100 200 300 400 500 600 700 800 900 1000 0 radiation level (Gy) (a) (i) Using values from the graph, describe the changes in the percentage germination of okra as the radiation level increased. 2 (ii) State the percentage germination of maize in the control dish. 1 %



1

11. (continued)

(b) The germinated seedlings were grown for eight weeks. The total dry mass of each crop was measured. The average dry mass per plant was calculated for each crop.

Radiation	Average dry mass per plant (g)				
level (Gy)	maize	okra	groundnut		
0	40	32	24		
150	36	30	23		
300	35	27	22		
500	27	23	21		
700	22	18	17		
900	17	10	14		
1000	10	9	13		

The results are shown in the table.

(i) Using information from the table, suggest which crop is least affected by the radiation and justify your answer.

Crop _____ Justification _____

(ii) **Using information in the graph and table**, calculate the total dry mass of maize eight weeks after the 500 seeds were exposed to 500 units of radiation.

Space for calculation

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MARKS DO NOT WRITE IN THIS MARGIN Selective herbicides are often used in sprays to control perennial weeds such 12. as dandelions growing in areas of grass. Dandelion Grass many seeds flower narrow leaves flower broad leaves long tap root (storage organ) (a) Using information from the diagram (i) explain why dandelions could be incorrectly identified as annual weeds. 1 (ii) suggest why a selective herbicide would have a greater effect on dandelions than on grass. 1



12. (continued)

(b) A field trial was carried out to investigate the effectiveness of a selective herbicide to control dandelions in eight grass plots as shown.

A	A	A	A
В	В	В	В

Key A – untreated

B – treated with herbicide spray

Suggest an improvement to the design of this field trial and justify your answer.

Improvement _____

Justification _____

[Turn over

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- **13.** Related meerkats (*Suricata suricatta*) live in large social groups. Some act as lookouts and make alarm calls when a predator is detected.
 - (a) Explain why the behaviour of the lookouts could be described as altruistic.
 - (b) State why behaviour, which appears to be altruistic, is more common in related animals.
 - (c) The table shows information on the number of meerkats acting as lookouts and the predation success of hawks on a population of meerkats.

Number of meerkat lookouts	Predation success of hawks (%)
1	56
3	45
5	23
8	10
10	8
12	8

Using values from the table, describe the changes in predation success of hawks as the number of meerkat lookouts increases.

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(con	tinue	ed)	MARKS	DO NOT WRITE IN THIS MARGIN
(d)	(i)	Meerkats live in social hierarchies.		
		Name a type of behaviour that is often shown by dominant members of a social group.	1	
	(ii)	Give an advantage of being in a social hierarchy.	1	

13.

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14. A study was carried out to compare the populations of some species of invertebrates on two different chicken farms, A and B. On Farm A chickens were free range, while on Farm B chickens were farmed intensively.

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The results of the study are shown in the table.

	Average population of invertebrates (per m ²)		
Invertebrate species	Farm A	Farm B	
D. gallinae	3	127	
H. affinis	8	5	
H. rufipes	5	0	
L. pilicornis	6	3	
C. impunctatus	59	56	

- (a) State which farm has the greater invertebrate species richness and justify your answer.
- (b) Mites (*D. gallinae*) and chickens have a symbiotic relationship in which the mites feed on the chicken's blood.
 - (i) Name this type of symbiotic relationship.
 - (ii) State the term used to describe the chicken in this relationship.
 - (iii) Mites are spread by direct contact.Use the information given to support this statement.

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14.	(cor	ntinued)	MARKS	DO NOT WRITE IN THIS MARGIN
	(c)	Intensively farmed chickens show abnormally low levels of activity. State the term used to describe this behaviour.	1	
	(d)	State an advantage to humans of intensive farming.	1 	
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Duc	to a growing population areas of rainforest in Brazil have been cleared	MARKS
for	food production. This has led to habitat fragmentation.	
Bio deg	diversity in isolated fragments is decreasing as the edges of the fragments rade.	
(a)	Explain why biodiversity in isolated fragments decreases as the size of the fragment gets smaller.	2
		-
(b)	Jaguars (<i>Panthera onca</i>) are native to rainforest in Brazil. Their population has decreased as a result of habitat fragmentation. It has been proposed that linking isolated fragments of rainforest by planting trees will increase the jaguar population size.	
	 Give a reason why reproductive rates of jaguars in isolated fragments are low. 	1
	(ii) State the term used to describe areas of land that connect isolated fragments.	- 1
	(iii) Explain why linking habitat fragments may result in an increase in the jaguar population.	- 1
(c)	Areas of cleared rainforest can be used for cattle farming or crop	-
	production. Suggest why less habitat would have to be cleared if it was only used for crop production.	
		-
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16.	6. Attempt either A or B. Write your answer in the space below and on pages 30 and 31.				DO NOT WRITE IN THIS MARGIN
	Α	Write	e notes on		
		(i)	stem cells	4	
		(ii)	uses of stem cells.	4	
	OR				
	B Write notes on				
		(i)	single gene mutations	5	
		(ii)	effects of single gene mutations on proteins synthesised.	3	
	You may use labelled diagrams where appropriate.				



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MARKS DO NOT WRITE IN THIS MARGIN

SPACE FOR ANSWERS



MARKS WRITE IN THIS MARGIN

SPACE FOR ANSWERS

[END OF QUESTION PAPER]

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ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

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Additional graph paper for question 7 (c)





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ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK



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ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK



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