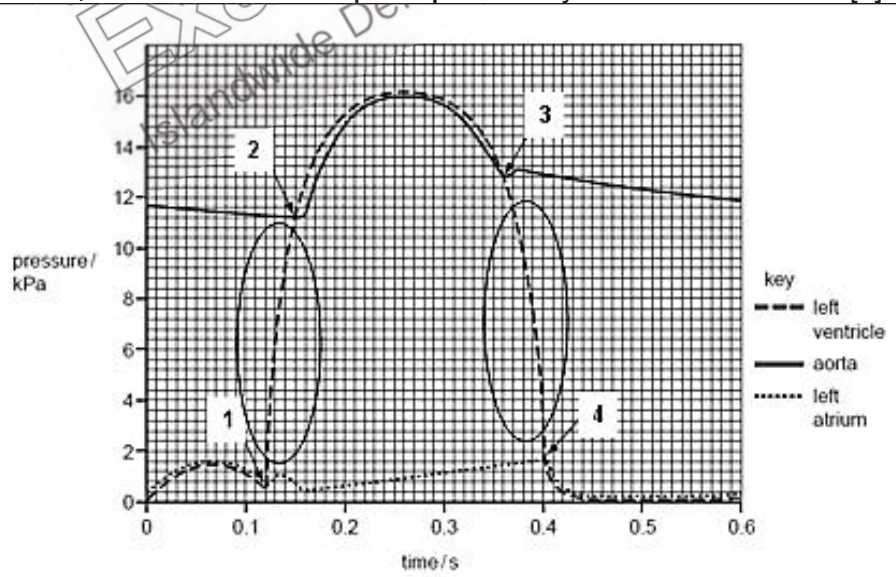
2020 Marking Scheme for 4E Pure Biology Prelim

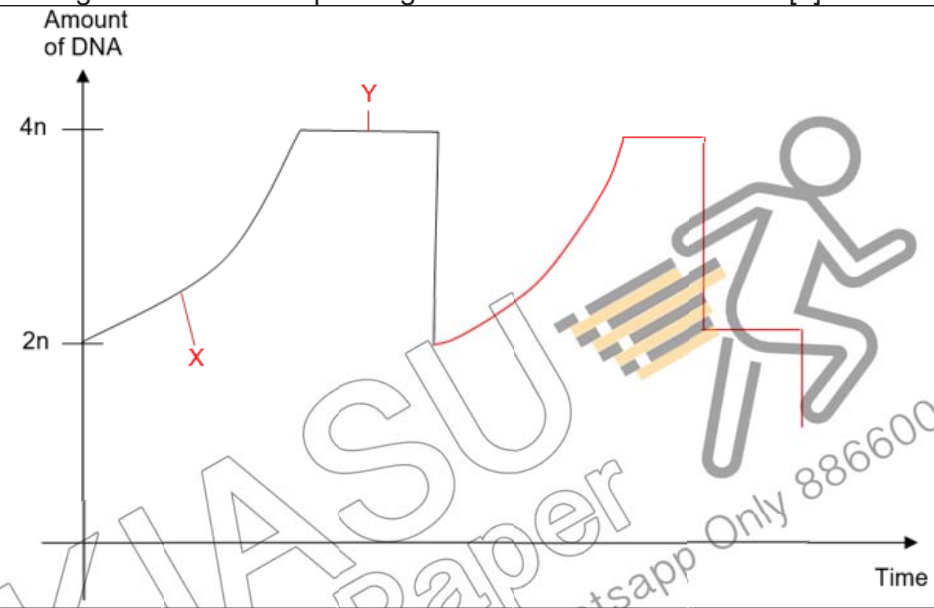
Paper 1

1. A	2. D	3. B	4. C	5. D
6. D	7. B	8. C	9. B	10. C
11. D	12. B	13. B	14. A	15. C
16. C	17. C	18. B	19. A	20. D
21. D	22. A	23. A	24. A	25. C
26. A	27. B	28. A	29. D	30. B
31. B	32. C	33. D	34. B	35. D
36. A	37. C	38. D	39. C	40. B

Paper 2

Qn	Marking Scheme	Remarks
1a	presence of chloroplast ; present of a large vacuole ; presence of a cell wall ;	Any 1
1b	freshwater pond has a higher water potential than the cell sap of *Spirogyra*; [1] water molecules will enter the vacuole of *Spirogyra* cells via osmosis through the partially permeable cell surface membrane ; [1] cell will swell and expand, and eventually burst as there is no cell wall to prevent bursting ; [1]	3
2a	Place the test tube in a water bath to maintain a constant temperature	1
2bi	- enzyme: trypsin - optimum pH: 9.0	Both correct, 1m
2bii	pancreatic juice / pancreas / pancreatic glands	1
2c	- the enzymes were completely denatured at acidic pH values of pH 5 and 6, protein substrates were unable to bind to the enzyme active sites and thus, cannot form enzyme-substrate complex [1] - reaction cannot occur and the length of the egg white remains the same [1]	2
3a	The hole in the median septum will cause the oxygenated blood in the left side of the heart to mix with the deoxygenated blood in the right side of the heart. [1] This will result in less oxygen transported in the blood around the body. [1] Hence, he will be unable to participate in any strenuous activities. [1]	3
3bi		Each circle: 1m [2]
3bii	60 s / 0.8 s = 75 heart beats per minute	1
4ai	Insects	1
4aii	Presence of large petals; or	Any 1

<table>
<tr><td></td><td>Stigma is small and compact / does not protrude out of the flower</td><td></td></tr>
<tr><td>4b</td><td>Pollen grains from the anthers could have fallen on the stigma of the flower [1]
Allowing self-pollination to occur [1]</td><td>2</td></tr>
<tr><td>4c</td><td>Offspring may inherited beneficial qualities from both parents;
More genetic variation which increases the chance of the species surviving changes in the environment;
Offspring may express desirable traits from both parents;
Reduce chances where recessive harmful alleles will be expressed;

Ensure cross pollination and only sexual reproduction</td><td>Any 1</td></tr>
<tr><td>4d</td><td>The pollen may have fallen on the stigma of different species of flower (R: different plants);
The stigma on which the pollen grain landed on is not mature [1]</td><td>Any 1</td></tr>
<tr><td>5ai
5aii</td><td> 
</td><td>2</td></tr>
<tr><td>5aii</td><td>correct shape
correct position: (n values) of each stage is important, time value is not</td><td>2</td></tr>
<tr><td>5b</td><td><table>
<tr><th>nuclear division</th><th>letter of stage</th></tr>
<tr><td rowspan="6">meiosis I</td><td>B</td></tr>
<tr><td>E</td></tr>
<tr><td>J</td></tr>
<tr><td>H</td></tr>
<tr><td>F</td></tr>
<tr><td>D</td></tr>
<tr><td rowspan="2">meiosis II</td><td>G</td></tr>
<tr><td>I</td></tr>
</table></td><td>7 – 8
correct: 3m

5 – 6
correct: 2m

3 – 4
correct: 1m

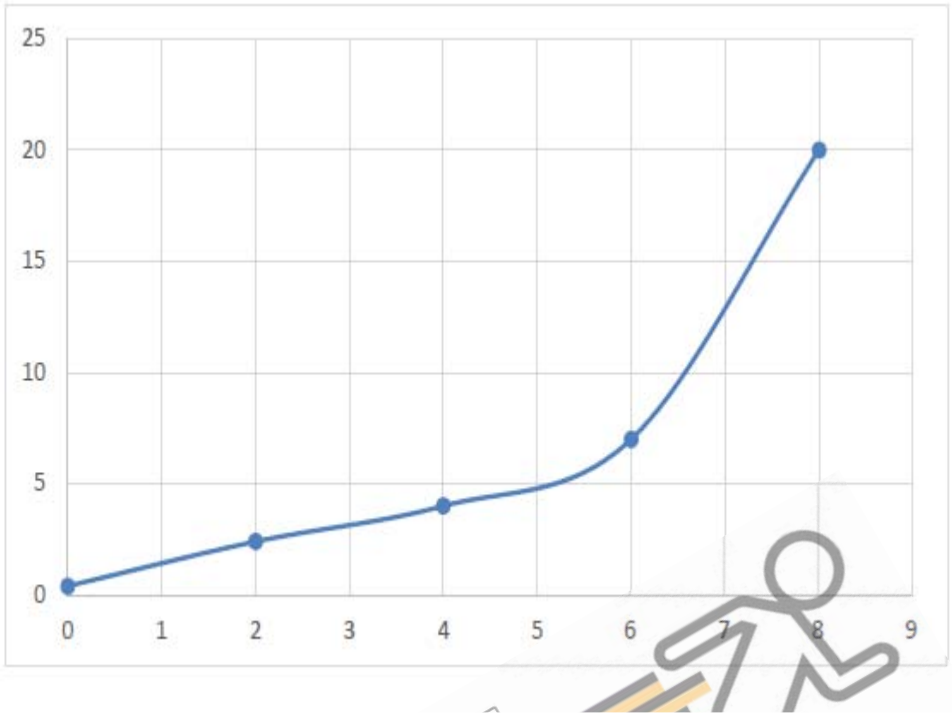
0 – 2
correct: 0m</td></tr>
</table>

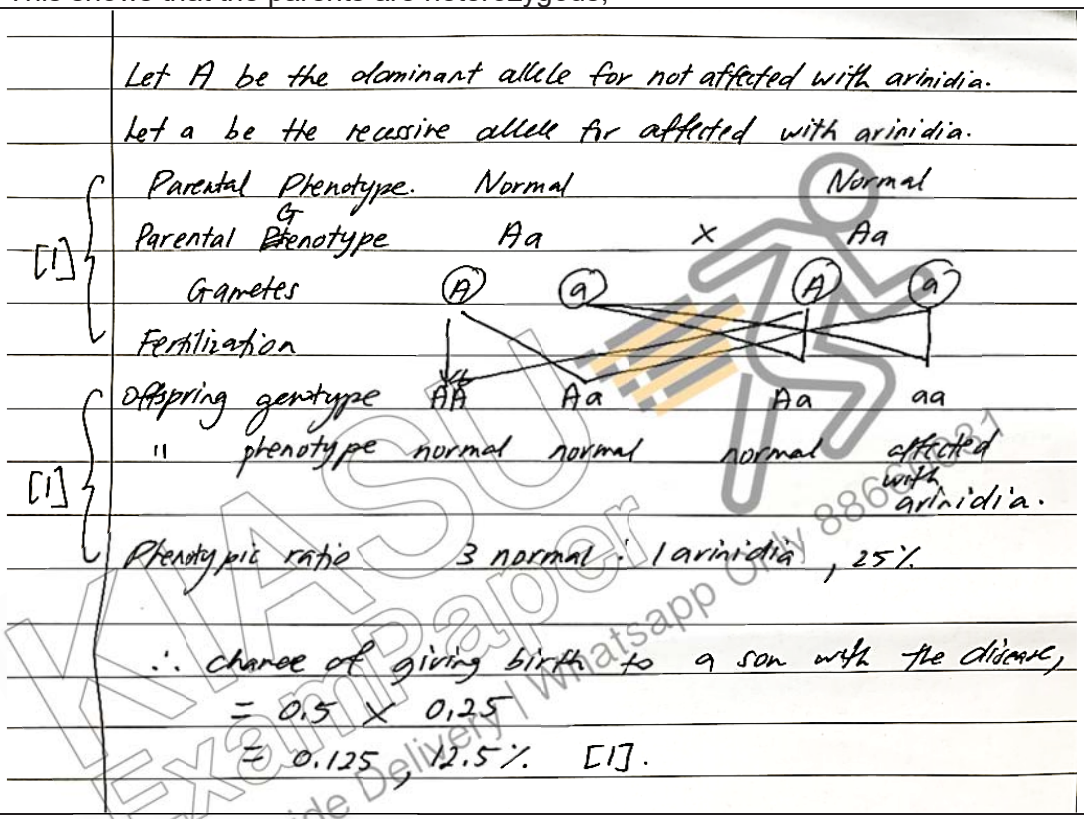
	<table><tr><td></td><td>C</td></tr><tr><td></td><td>**A**</td></tr></table>	
5c	During prophase I, there is crossing over between (non-sister) chromatids of homologous chromosomes at chiasma/chiasmata, hence there is exchange of genetic material / genetic recombination/ resulting in chromosomes with new combination of alleles from both parents' set of chromosomes [1] During metaphase I, independent assortment of homologous chromosomes results in random combination of alleles which introduces variation by producing gametes with different combinations of both mother's and father's set of chromosomes [1]	2
6a	Lactic acid [1]	1
6b	When the wild board dies, its lungs are no longer taking in oxygen; [1] Body cells begin to respire anaerobically, / anaerobic respiration occurs; [1] resulting in the production and accumulation of lactic acid in the wild boar tissues; [1] Hence, the pH continues to decrease over time.	3
7a	In the glomerulus, the high hydrostatic blood pressure caused glucose, urea and amino acids to be filtered and enter the glomerular filtrate and Bowman's capsule, as they are small enough to pass through the basement membrane; [1] However, plasma proteins and red blood cells are too large to pass through the filter, and thus zero concentration in glomerular filtrate and urine; [1]. In the proximal convulated tubule, selective reabsorption of glucose and amino acids take place, resulting in zero concentration in urine as they return back to the blood; [1] Urea is excreted via urine with 1.8 g/ 100 cm^3 of urea in urine; [1]	4
7b	Partially permeable dialysis membrane allows small molecules of water, urea and salts to diffuse out from the blood while preventing large molecules of protein and blood cells from diffusing out; convulated tubule of dialysis membrane provides large surface area to volume ratio for rapid diffusion; opposite flow of dialysis fluid and blood flow generates steep diffusion gradient for urea and excess water to be removed quickly from blood; Dialysis fluid contains the same concentration as salts glucose and same water potential as blood to prevent loss of essential nutrients; Absence of urea in dialysis fluid ensures removal by diffusion out from blood.	Any 3
8a	After Sam ate the ice cream, his core body temperature decreased from 37.1°C to 35.5°C over the next 15 minutes while his skin temperature increased from 35°C to 36.8°C; [1] His core temperature then increased back to normal/ 37.1°C over the following 15 minutes while his skin temperature dropped back to 35°C; [1]	2
8b	The drop in his core body temperature caused Hair erector muscles contract causing hairs to stand, trapping a layer of insulating air; [1] Sweat glands stop/reduce production of sweat to prevent heat loss by evaporation; [1]	Any 2

<table>
<tr><td></td><td colspan="2">Arteriole vasoconstriction occurred to reduce blood flow and thus, heat loss from the skin; [1]</td><td></td></tr>
<tr><td>9a</td><td colspan="2">Touch/ stimulus from finger stimulates nerve endings of sensory neurone to generate impulse;

Impulses generated travel along sensory neurone and transmitted across a synapse to the relay neurone;

And then across another synapse to the motor neurone. Motor neurone transmits the impulses to effector (hand muscles) to contract and hand withdrawn;</td><td>3m</td></tr>
<tr><td>9b</td><td></td><td>
<table>
<tr><th>Nervous control</th><th>Endocrine control</th></tr>
<tr><td>Involves neurons (nerve impulses)</td><td>Involves hormones (chemical substances)</td></tr>
<tr><td>Electrical and chemical transmission</td><td>Chemical transmission</td></tr>
<tr><td>Nerve impulses are transmitted by neurones</td><td>Hormones are transmitted by the blood</td></tr>
<tr><td>Rapid transmission and response</td><td>Slower transmission and relatively slow-acting</td></tr>
<tr><td>Often causes short-term changes</td><td>Can cause long-term or short-term changes</td></tr>
<tr><td>May be voluntary or involuntary</td><td>Always involuntary</td></tr>
<tr><td>Usually localised response (e.g. one muscle)</td><td>Widespread responses (usually affects more than one target organ)</td></tr>
</table>
</td><td>Any 2 comparison</td></tr>
<tr><td>10a</td><td colspan="2">20.0 mm per minute</td><td>1</td></tr>
<tr><td>10b</td><td colspan="2"></td><td>3</td></tr>
</table>

	 [1] for correct scale, axis and axis labelling [1] correct plotting of all points [1] curve of best fit without extrapolation	
10c	Rate of water uptake gradually increases from 0.4 mm per minute to 7.0 mm per minute as wind speed increases from 0 metres per second to 6 metres per second. [1] Rate of water uptake increases steeply from 7.0 mm min^{-1} to 20.0 mm min^{-1} as wind speed increases from 6 ms^{-1} to 8 ms^{-1} [1]	2
10d	- evaporation of water from surfaces of mesophyll cells into intercellular air spaces in leaf [1] - water vapour diffuses through stomata in leaves and is lost to drier air outside the leaves [1] - loss of water from mesophyll cells decreases water potential of cell sap, water moves into these cells via osmosis from cells deeper inside the leaf and xylem vessels [1] - this results in transpiration pull, a suction force which pulls the water column up the xylem vessels [1]	4
11a	**Absorption of nutrients** allows transfer/absorption/diffusion of nutrients from mother/into fetus [1] such as glucose/amino acids/mineral salts/vitamins [1] **Gaseous exchange** allows transfer / diffusion of oxygen from mother/to fetus [1] allows transfer / diffusion of carbon dioxide from fetus/to mother [1] **Removal of metabolic waste** allows transfer/diffusion of metabolic waste / excretory products from fetus/to mother [1] such as urea [1]	6
11b	The hormone gene is isolated by cutting it out with an appropriate restriction enzyme. [1] A plasmid is then cut using the same type of restriction enzyme and the human insulin gene is inserted in to the plasmid using DNA ligase. [1]The	Up to 4

	plasmids containing the hormone gene are then mixed with bacteria. The bacteria must be treated temporarily with heat or an electric shock to take up the plasmid. [1] Then, the bacteria containing the hormone gene is isolated. These transgenic bacteria are placed in a fermenter containing a nutrient broth where they will multiply and produce the hormone that can be harvested.[1]	
12a	The contracted ciliary muscles become relax; Suspensory ligament that was originally slacken becomes taut; Convex lens becomes less convex and thinner, increasing its focal length.	3m
12b	Person cannot respond/ is insensitive to changes in light intensity; Cannot see clearly in the dark or in bright light;	2m
12 ci	Recessive; as the parents are healthy but gives rise to offspring with the disease. This shows that the parents are heterozygous;	2m
12 cii		3m