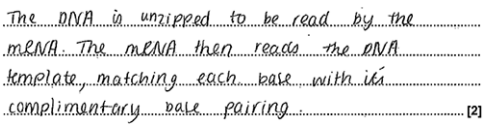
Mark scheme – What Happens in Cells (H)

Question			Answer/Indicative content	Marks	Guidance
1			A	1 (AO 1.1)	**Examiner's Comments** A very accessible question with the majority of candidates realising that DNA has a double helical structure.
			Total	**1**	
2			C	1 (AO 1.1)	**Examiner's Comments** Another very accessible question which was answered correctly by most candidates.
			Total	**1**	
3			C	1 (AO 1.1)	**Examiner's Comments** This question proved to be challenging with a number of candidates choosing distractor A as the answer.
			Total	**1**	
4			D	1 (AO 1.1)	**Examiner's Comments** Recalling their knowledge in this AO1.1 question was answered well by higher ability candidates, less so by others. Lower ability candidates were frequently distracted by A.
			Total	**1**	
5			B ✓	**1 (AO 2.1)**	
			Total	**1**	
6	a		smallest: nucleotide / allele / chromosome / largest: genome	1 (AO1.1)	
	b		66000000 ÷ 500 = 132 000 ✓	1 (AO2.2)	**ALLOW** 0.132 million or 132 thousand
	c		man: D, d; woman: d, d; Dd, dd, Dd, dd ✓	2 (AO2.2) (AO3.1a)	**ALLOW** appropriate use of other lower/upper case letters **ALLOW** ECF

			0.5 / 50(%)✓		**ALLOW** 1 in 2 / ½ / 1:1 ✓ **DO NOT ALLOW** 1:2
	d		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 839 award 2 marks** 2517/3 ✓ = 839 ✓	2 (AO2 x 1.2)	**ALLOW** 840 or 2521/3 ✓
			Total	**6**	
7			**Any four from:** DNA unwinds/unzips ✓ during transcription mRNA is made ✓ mRNA moves from the nucleus to the cytoplasm/ribosomes ✓ translation on the ribosomes ✓ carrier molecules/tRNA bring specific amino acids ✓ amino acids joined to form a protein ✓	4 (AO4 x 1.1)	**DO NOT ALLOW** amino acids are produced
			Total	**4**	
8	a		more accurate/precise measurement (of volume/amount of gas) ✓	1 (AO3.3b)	**ALLOW** gas could dissolve in water / less gas can escape **IGNORE** gives exact measurement of gas release
	b	i	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 2.3 (cm^3 / min) award 3 marks** $\frac{25+23+22}{3}$ = 23.3333333 ✓ $\frac{23.3^{\cdot}}{10}$ = 2.3333333 ✓ = 2.3 (cm^3 / min) ✓	3 (AO1 x 1.2) (AO2 x 2.2)	**ALLOW** one mark for clear evidence of rounding incorrect answer correctly to one dp.
		ii	increased movement of molecules / increased kinetic energy ✓ therefore, more chance of substrate colliding with enzymes/active sites ✓	3 (AO2 x2.1)	increased KE of enzymes and substrates leads to more

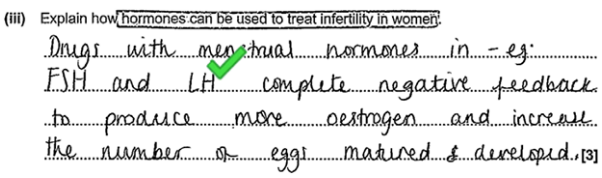
			more chance of substrate entering active site ✓		collisions = 2 marks **ALLOW** more enzyme-substrate complexes forming
	c		(phenols) alter the shape of the active site/enzyme / block active site/enzyme ✓ so substrate no longer fits/binds with active site/enzyme ✓	2 (AO2.1)	**IGNORE** reference to denaturing need reference to active site once only for 2 marks
			Total	**9**	
9	a	i	**small traces** of DNA can now be replicated (using PCR) ✓ PCR **makes enough** DNA to profile / PCR **makes enough** DNA to match with suspects ✓	2 (AO 2.1)	**IGNORE** single copy of DNA Small traces of DNA can be replicated using PCR so that it can match to suspects = 2 marks DNA can be replicated using PCR so that there is enough to match to suspects = 2 marks **Examiner's Comments** A number of candidates thought that the PCR process actually matched the DNA samples. Often the ability to copy small amounts of DNA to make enough for testing was not appreciated.
		ii	S phase / DNA replication ✓	1 (AO 2.1)	**ALLOW** DNA duplication / **IGNORE** synthesis unless qualified **Examiner's Comments** S phase or DNA replication was stated by a number of candidates but more commonly there were references to mitosis or one of the stages of mitosis.
	b	i	**Any two from:** check on heredity ✓ look for genetic disorders /identify health risk factors ✓ idea of choosing correct medication / genomics ✓ to confirm a person's identity ✓	2 (AO 2.1)	**ALLOW** establish family tree / find relatives **ALLOW** specified health risk factor **Examiner's Comments** There were many correct references to genetic conditions, making ancestral links or the identification of individuals.
		ii	avoid being identified for a crime / avoid high insurance costs / reluctance of employers to offer jobs / remain unaware of family history/genetic disorders /	1 (AO 3.1a)	**ALLOW** do not want to be found by lost relatives

			idea of dislike of sharing personal details / privacy (reasons) ✓		**ALLOW** against the Human Rights Act **Examiner's Comments** A number of candidates seemed to think that the database actually stored physical samples of DNA that could be used for cloning. The most common creditable answers referred to protection of privacy.
	c	i	**Any two from:** transcription ✓ DNA (template) used to code for/make mRNA ✓ mRNA nucleotides/bases used to synthesis a mRNA molecule / mRNA nucleotides/bases pair with DNA nucleotides/bases ✓	2 (AO 1.1)	**Examiner's Comments** There were some correct references to transcription, but this question was intended as a high demand question and did prove to be quite challenging. Exemplar 8 shows an answer that does gain credit for referring to the pairing of DNA bases with mRNA bases. **Exemplar 8**  The DNA is unzipped to be read by the mRNA. The mRNA then reads the DNA template, matching each base with its complimentary base pairing. [2]
		ii	**Any two from:** translation ✓ mRNA attaches to ribosome✓ tRNA is a carrier molecule for amino acids / tRNA/carrier molecule brings (correct) amino acids into place / tRNA reads the triplets on the mRNA✓	2 (AO 1.1)	**ALLOW** each triplet code on tRNA/carrier molecule is specific for an amino acid. **DO NOT ALLOW** amino acids are made **Examiner's Comments** Again, there were some correct references to translation, but many answers confused the roles of ribosomes, mRNA and tRNA. Another common error was to refer to the making of amino acids, rather than proteins.
			Total	**10**	
10		i	mRNA carries the code for proteins ✓ more protein will be made ✓	**2 (AO 2 × 2.1)**	**ALLOW** protein will be made faster **Examiner's Comments** This question assessed AO2.1. Many candidates were able to link mRNA to either more or faster protein synthesis, but very few referred to the term 'code' to link mRNA and protein synthesis.
		ii	**First check answer on answer line** **If answer = 40 award 2 marks**	**2 (AO 2 × 2.2)**	

			$\frac{20 \times 200}{100}$ ✓ = 40 ✓		**Examiner's Comments** Candidates found this AO2.2 mathematics skills question quite challenging. 240 was a common incorrect response. Candidates need to have more practice at similar questions using percentages to develop their mathematical skills in this area.
		iii	new method uses the plants **own** genes ✓ concern that plants with the insecticide/gene might be harmful to humans / might impact on food chains / might kill useful insects ✓	**2 (AO 2.2)** **(AO3.2a)**	**ALLOW** might have side-effects **IGNORE** ideas about cultural or religious or ethical objections or that it is playing God **Examiner's Comments** This question assesses both AO2 and AO3. Candidates were most likely to score a mark for the AO3 marking point, but it was rare for them to gain the AO2 mark. Many candidates described the effect of the gene on the plant, not consumers, or did not pick up on the possible problems of the insecticide itself. There were several responses written about the concern about genetic modification not being a natural process. This is an idea that mark schemes are unlikely to credit, preferring instead to focus on the effects of GM food on all consumers. Candidates also frequently missed out writing about the plants own genes and just focused on the AO3 marking point of the bacterial gene so missed the AO2 marking point. It was common for candidates to write about general dangers of bacteria and infections and not specifically the gene.
			Total	**6**	
11	a		can control temperature (easier)/ can be set to a specific / constant temperature ✓✓ limited fire risk✓	**2 (AO 2 ×2.2)**	**IGNORE** reference to ease of measurement **ALLOW** less risk of burns **ALLOW** ORA **Examiner's Comments** Many candidates correctly focussed on the fact that an electric water bath will maintain a constant temperature. Fewer candidates stated the need to prevent ethanol from being near a naked flame. Exemplar 1 contains both these points, therefore achieved both marks. **Exemplar 1**

					1 When you use an electric water bath it's easier to set the temperature and maintain the temperature. 2 Electric water bath is safer than using bunsen burner especially when substance you are heating is flammable. [2]
	b		for 60°C / high temperatures: idea that (membranes break down) at 60°C releasing more DNA / DNA is extracted easily ✓ against 60°C / high temperatures: increased risk of DNA breaking down at 60°C / more DNA destroyed at 60°C / DNA not preserved at 60°C✓	**2 (AO 2 × 2.2)**	**ALLOW** idea that enzymes destroying DNA are denatured so less DNA destroyed Answers must make it clear which temperature they are referring to. **ALLOW** ORA
	c		wear face mask / goggles to prevent protease/ethanol/chemicals being inhaled / entering eyes gloves / use tongs prevent ethanol/protease/chemicals being in contact with skin ✓ turn Bunsen off as ethanol is flammable ✓	**2 (AO 2 × 2.2)**	**ALLOW** use tongs as solution/ tube may be hot **IGNORE** reference to lab coats / glass breakages **Examiner's Comments** Lower ability candidates did not gain marks in this question as they often gave vague answers such as references to being careful or not dropping equipment. An example of an answer that did not receive credit is seen in exemplar 2. **Exemplar 2** 1 Safety precaution: Do not shake the test tube. Explanation: This may spill the mixture and DNA. 2 Safety precaution: Do not place the test tube down. Explanation: This may break it. [2]
	d	i	**First check answer on answer line** **If answer = 33.1 (mg) award 2 marks** $\frac{99.2}{3}$ **OR** 33.067 / 33.07✓	**2 (AO 1.2) (AO 2.2)**	**Examiner's Comments** The majority of candidates could correctly calculate the mean mass and give the answer to one decimal place.

					A small but significant number only gained one mark as they quoted too many decimal places.
		ii	(yes because) idea that there is a greater mean / yield / mass produced (of DNA) ✓ there is less range/variation in results ✓	**2 (AO 2 × 3.1b)**	**ALLOW** ECF **ALLOW** examples of data from table to indicate less range/variability **Examiner's Comments** There were many correct references to the differences in the ranges of readings, although in some cases the range for the water bath was incorrectly calculated. Fewer candidates commented on the differences between the mean mass of DNA obtained.
			Total	**10**	
12		i	**First check answer on answer line** **If answer = 19.98 (mm) award 3 marks** 20 - 0.025✓ but 19.975 (mm)✓ 19.98 (mm)✓	**3 (AO 2 × 2.2) (AO 1.2)**	**Examiner's Comments** The manipulation of standard form was often correct in this question.
		ii	lining is not repaired correctly✓	**1 (AO 1.1)**	**ALLOW** lining will not thicken / not build up **IGNORE** lining will not be maintained / will become thinner **Examiner's Comments** There was some confusion in the answers between the roles of progesterone and oestrogen. Common incorrect answers referred to the breaking down of the uterus lining.
		iii	**Any three from:** gonadotrophins used✓ FSH and LH used✓ FSH lead to ripening of follicle✓ and LH causes ovulation✓ human chorionic gonadotrophin✓ causes egg/ovum to mature inside follicle✓	**3 (AO 3 × 1.1)**	**ALLOW** stimulate egg production/development **Examiner's Comments** Candidates often gave the hormones that might be given to women to treat infertility, i.e. LH and FSH but did not specifically link them to their function. This is illustrated in exemplar 7, which would only gain one mark for naming the two hormones.

					Exemplar 7  (iii) Explain how hormones can be used to treat infertility in women. Drugs with menstrual hormones in - eg: FSH and LH complete negative feedback to produce more oestrogen and increase the number of eggs matured & developed. [3]
		iv	order of bases is changed (in gene)✓ order of amino acids changed in protein / change in shape of the enzyme✓	**2** **(AO 1.1)** **(AO 2.1)**	**ALLOW** nucleotides **ALLOW** mutation in base sequence **ALLOW** different amino acids in protein **IGNORE** codes for wrong amino acid to be made **Examiner's Comments** Many candidates correctly linked changes in the DNA base sequence to alterations in the amino acids in the protein or the shape of the protein molecule.
			Total	**9**	