Cell Division, Cell Diversity & Cellular Organisation

Question Paper 1

Level	A Level
Subject	Biology
Exam Board	OCR
Module	Foundations in Biology
Topic	Cell Division, Cell Diversity & Cellular Organisation
Booklet	Question Paper 1

Time allowed: **38 minutes**

Score: **/28**

Percentage: **/100**

Grade Boundaries:

A*	A	B	C	D	E
>69%	56%	50%	42%	34%	26%

In human cells, the tumour suppressor gene *TP53* codes for a protein that interrupts the cell cycle if there is any damage to the DNA and prevents the copying of damaged DNA.

Which of the stages, **A** to **D**, could *TP53* interrupt the cell cycle? **[1]**

A. mitosis

B. G_1

C. S

D. cytokinesis

Question 2

The cell cycle includes a number of checkpoints.

Which of the following statements about the cell cycle is correct?

A. If damaged DNA is detected at a checkpoint apoptosis is triggered.

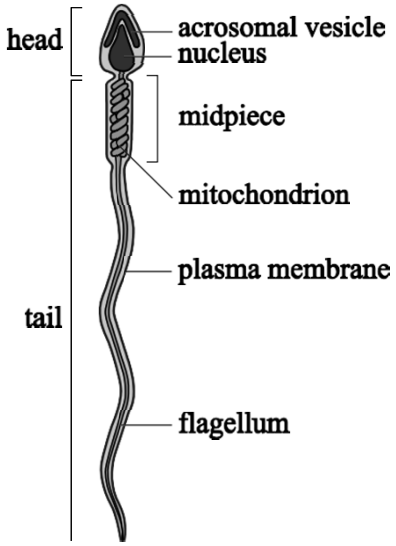
B. If damaged DNA is detected at the G_2 checkpoint the cell cycle is halted and the cell tries to repair the damage.

C. If a mistake is detected at a checkpoint the cycle reverts to an earlier checkpoint and is repeated.

D The G_1 checkpoint checks for mistakes in DNA replication.

[1]

Sperm cells are an example of a specialised cell.



Which statement correctly describes one specialisation of a sperm cell?

A tail contains flagellum which generates ATP

B head contains chromosomes in homologous pairs

C acrosome contains enzymes to digest outer portion of egg

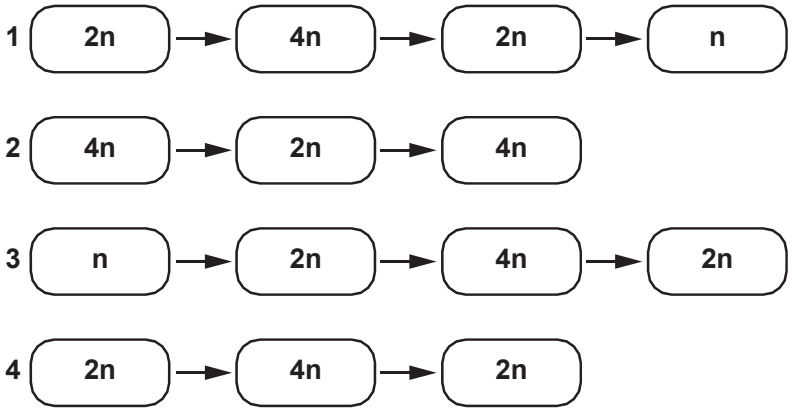
D midpiece contains mitochondria which enter egg

[1]

Question 4

During cell division, the chromosome number in the cells changes.

The following sequences describe the chromosome number in cells before, during and after different types of cell division.



Which of the options, **A** to **D**, correctly describes the stages of mitosis and meiosis in human cells?

A 1 is mitosis, 2 is meiosis

B 2 is mitosis, 3 is meiosis

C 3 is mitosis, 4 is meiosis

D 4 is mitosis, 1 is meiosis

[1]

.

Question 5

The haploid chromosome number in the koala, *Phascolarctos cinereus*, is 8.

Independent assortment of chromosomes in meiosis contributes to genetic variation in the gametes of the koala.

How many genetically different versions of koala gamete would it be possible for one individual to produce if independent assortment were the only source of genetic variation?

A 64

B 128

C 256

D 512

[1]

(a) Mitosis and meiosis play an important role in the life cycles of organisms.

Fig. 2.1 and Fig. 2.2 represent an outline of the life cycles of two different organisms.

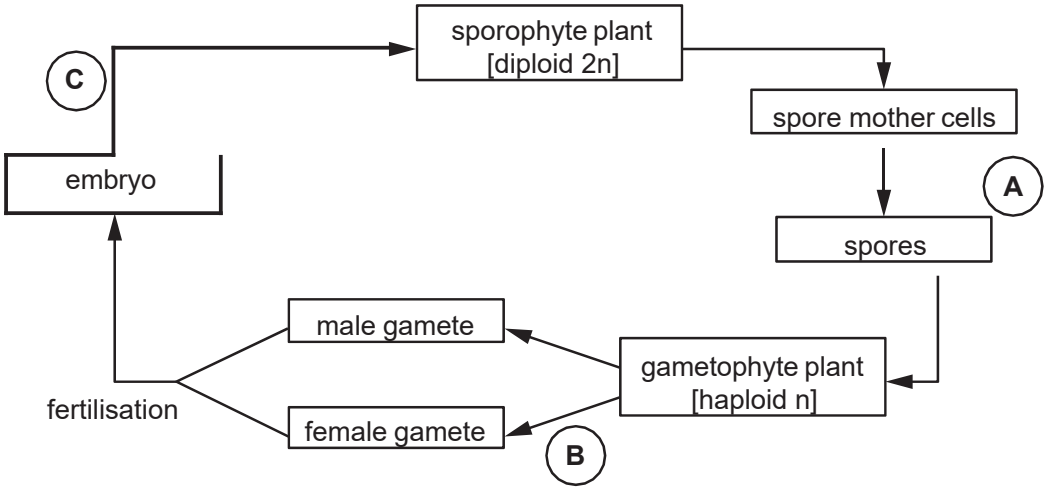


Fig. 2.1

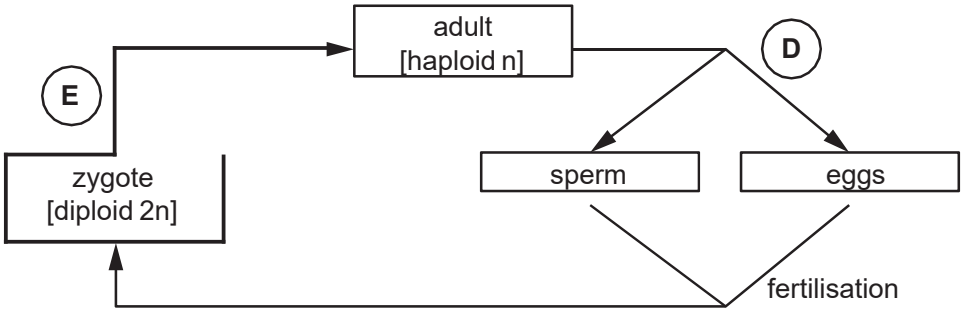


Fig. 2.2

Place a tick (**3**) in each row of the table to indicate the type of nuclear division that occurs at each of the letters **A** to **E**.

	Mitosis	Meiosis
A		
B		
C		

	Mitosis	Meiosis
D		
E		

[3]

(b) Fig. 2.3 is a diagram that represents the different phases of the cell cycle.

X, **Y** and **Z** represent checkpoints in the control of the cell cycle.

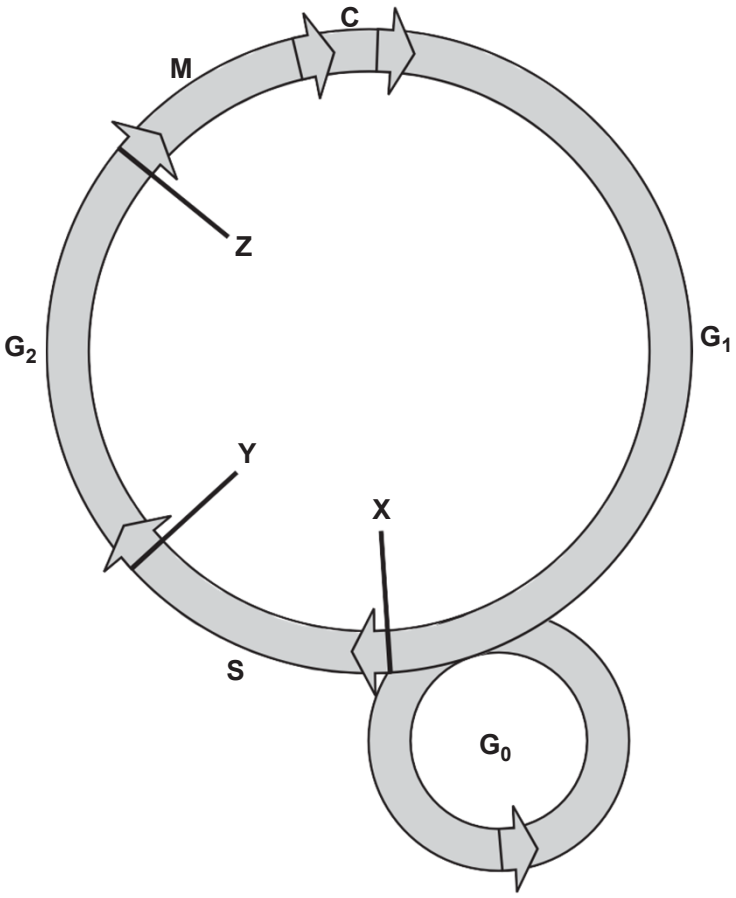


Fig. 2.3

(i) State all the letters in Fig. 2.3 that represent the **phases** of interphase. **[1]**

(ii) Suggest what is being checked at checkpoint **Y** on Fig. 2.3. **[1]**

(c) Table 2.1 indicates the relative time spent in different phases of the cell cycle for three different types of cell, **P**, **Q** and **R**.

Cell type	Relative time spent in a phase			
	G_1/G_0	S	G_2	M/C
P	18	50	13	19
Q	18	25	11	16
R	100	0	0	0

Table 2.1

(i) Which of the cells **P**, **Q** or **R** takes the shortest time to divide? **[1]**

(ii) Suggest why cell **P** spends twice as much time in phase **S** than cell **Q**. **[1]**

(iii) What can be deduced about the behaviour of cell **R**?
Give reasons for your answer. **[2]**

(d) An experiment was carried out where a student observed cells in different tissues under the microscope.

- The cells were undergoing mitosis.
- 200 cells were observed for each tissue.
- The number of cells in each stage of mitosis was recorded.

The results are shown in Table 2.2.

Tissue type	Number of cells in stage of mitosis				Total
	Prophase	Metaphase	Anaphase	Telophase	
V	65	55	7	73	200
W	85	59	6	50	200

Table 2.2

The student had expected that the results observed for tissue type **W** would not be significantly different from those for tissue type **V**.

(i) Identify the pieces of evidence in Table 2.2 that caused the student to suspect that the results for tissue type **W** might be **significantly** different from those for tissue type **V**.

[1]

(ii) The student decided to analyse the data using a statistical test.

A friend suggested using Student's *t*-test.

Why is Student's *t*-test **not** suitable for dealing with this data? **[1]**

(e) The chi-squared (χ^2) test can be used to analyse the data.

(i) Complete the rows for metaphase and telophase in the table below and calculate the χ^2 value for the data.

The χ^2 value is calculated using the following formula:

$$\chi^2 = \Sigma \frac{(O - E)^2}{E}$$

Cells	Observed (O)	Expected (E)	(O–E)	$(O–E)^2$	$\frac{(O - E)^2}{E}$
In prophase	85	65	20	400	6.154
In metaphase					
In anaphase	6	7	-1	1	0.143
In telophase					
Total	200	200			

[3]

(ii) The value of chi-squared (χ^2) can be used to conclude whether the results for cells in tissue type **W** differ significantly from those for tissue type **V**.

The number of **degrees of freedom** determines which row of the χ^2 probability table is used.

The number of degrees of freedom is defined as:

the number of categories – 1

What will be the number of degrees of freedom used in this analysis? . **[1]**

(iii) The student had expected that the results observed for tissue type **W** would not be significantly different from those for tissue type **V**.

Use your calculated value for χ^2 and the information from the χ^2 probability table below to conclude whether or not the results observed for tissue type **W** are significantly different from those for tissue type **V**.

Degrees of freedom	Probability (p)				
	0.99	**0.95**	**0.05**	**0.01**	**0.001**
1	0.00	0.00	3.84	6.64	10.83
2	0.02	0.10	5.99	9.21	13.82
3	0.11	0.35	7.82	11.35	16.27
4	0.30	0.71	9.49	13.28	18.47
5	0.55	1.15	11.07	15.09	20.52
6	0.84	1.64	12.59	16.81	22.46
7	1.24	2.17	14.07	18.48	24.32

[2]

[Total: 17]

Fig. 23 shows a microscope image of a cross section taken from the stem of a sunflower, *Helianthus annuus*.

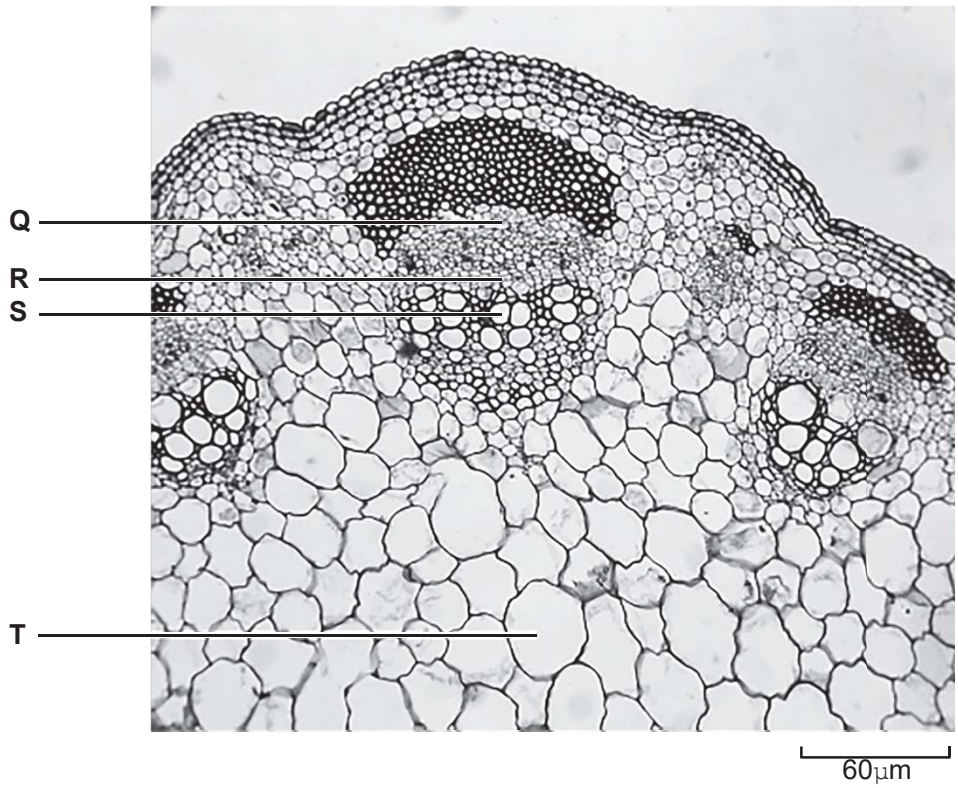


Fig. 23

(a) Calculate the magnification of this image. **[2]**

(b) (i) The cell labelled **T** on Fig. 23 is a parenchyma cell which carries out photosynthesis and stores starch. Suggest why cell **T** and the cells surrounding it, can be classified as parenchyma **tissue**.

[1]

(ii) **Name** the two tissues labelled **Q** and **S** on Fig. 23. **[2]**

Q .....

S .....

(c) The tissues labelled **Q** and **S** in Fig. 23 are produced by mitosis from the tissue labelled **R** on Fig. 23. Identify the tissue labelled **R**.

[1]

R .....

[Total: 6]