

OCR A-LEVEL BIOLOGY B • H422

BIOLOGY



EXAM QUESTION PACK

3.3.1 THE CELLULAR BASIS OF CANCER AND TREATMENT

SCORE

/86

PERCENTAGE

%

STEMUP

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- 1 The World Health Organisation (WHO) provides information about risk factors to support the prevention and control of non-communicable diseases (NCDs) such as bowel cancer.

Complete the passage below about bowel cancer using the most appropriate word or words.

Bowel cancer is one of the most common types of cancer in the UK. It usually starts in the large bowel but cancerous cells can spread to other organs in the body by

The use of that uses a combination of X-ray images taken from different angles can detect the spread of cancer to the liver or lungs. Risk factors, such as eating a diet high in processed meat are called factors. These factors can increase the risk of bowel cancer but they can be controlled to reduce the probability of the disease. However, other risk factors, such as cannot be controlled or reduced by intervention.

Surgery is the most common treatment for bowel cancer which is often followed by which uses drugs toxic to cancer cells to destroy them.

[5]

- 2 Memory loss is one of the symptoms of Alzheimer's disease (AD).
AD leads to the death of neurones in the brain resulting in loss of cognitive function and behavioural changes.
AD is described as multifactorial, as several factors may lead to the development of the disease.

Fig. 1.1, on the Insert, shows PET scans of a normal brain and the brain of a patient diagnosed with AD.

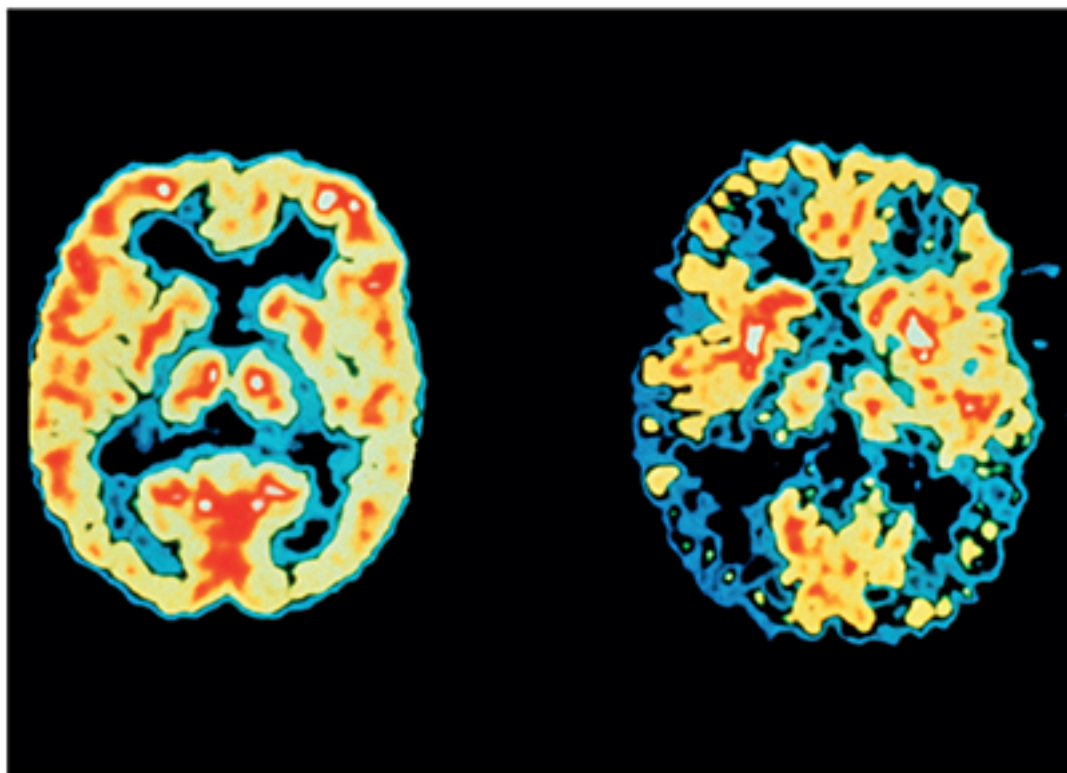


Fig. 1.1

Using Fig. 1.1, describe the effects of AD on the **structure** of the brain.

[2]

3(a) The faecal occult blood test (FOBT) is a screening method that is now used routinely in people over the age of 65 years.

The presence of blood in faeces (a positive result) is thought to be caused by chronic inflammation of the gut and indicates an increased risk of developing colorectal cancer (CRC).

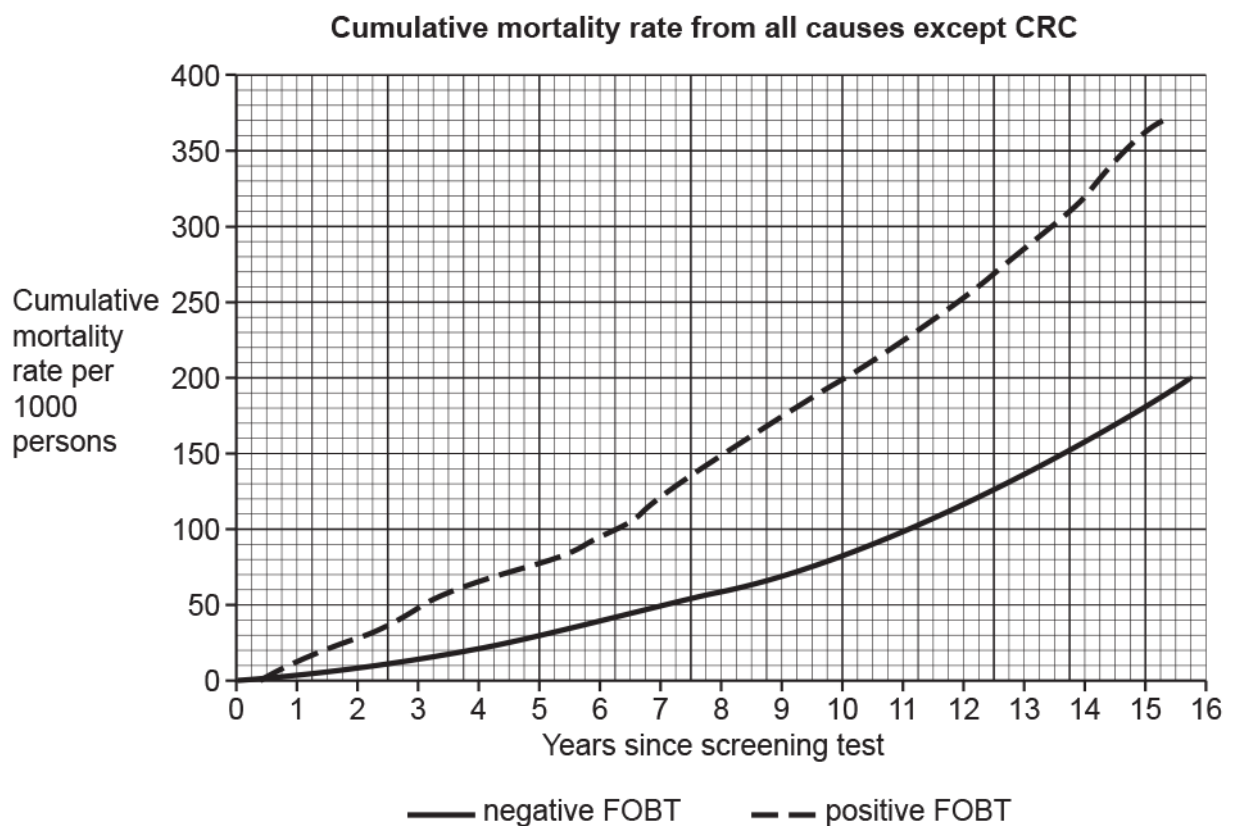
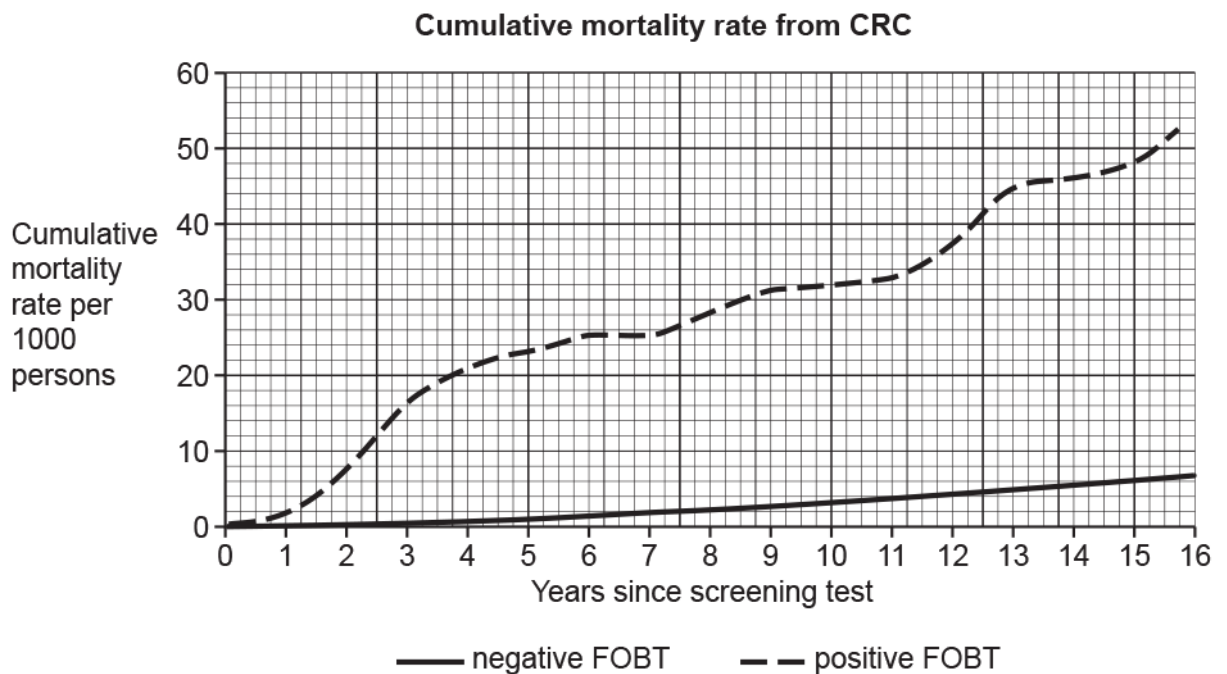
A Scottish study looked at 133 921 individuals who were tested with FOBT and then followed for up to 16 years.

- 131 207 had a negative FOBT
- 2714 had a positive FOBT

(i) Outline a method that a doctor could use to confirm that a person with a positive FOBT has CRC.

[2]

(ii) The graphs show cumulative mortality rate from CRC and cumulative mortality rate from all causes except CRC in the two groups studied over the 16-year period.



The scientists who carried out this study concluded that a positive FOBT was an indicator of increased risk of death from other (non-cancerous) diseases linked to inflammation of the gut.

Explain whether the data in the graphs support their conclusion.

[2]

(iii) An FOBT kit is sent to everyone in England between 60 and 74 years of age.

Using your own knowledge and the data in the graphs, evaluate the effectiveness of FOBT in screening for CRC.

[4]

(b) CRC is one of more than 100 forms of cancer.

Describe, with examples, how mutations in genes that control cell division can lead to cancer.

Blank lined paper for writing.

----- [2]

5 Which of the cancer treatments, **A** to **D**, can result in the need for a bone marrow stem cell transplant?

- A chemotherapy
- B hormone therapy
- C immunotherapy
- D surgery

Your answer

[1]

6 Which of the imaging techniques, **A** to **D**, uses X-rays to detect cancerous lung tissue?

- A computed tomography imaging
- B magnetic resonance imaging
- C mammography
- D ultrasound

Your answer

[1]

7 A population of 1000 cancer cells was growing in culture. The doubling time of the cells was 36 hours.

Which of the options, **A** to **D**, is the theoretical number of cells present after 6 days?

- A 3600
- B 6000
- C 16 000
- D 36 000

Your answer

[1]

8 Which of the protein types, **A** to **D**, could be coded for by a tumour suppressor gene?

- A** a protein activated by a growth factor
- B** a protein that helps prevent apoptosis
- C** a protein that promotes the cell cycle
- D** a protein that repairs DNA

Your answer

[1]

9 A mutation in a gene may cause the protein for which the gene codes to become inactive.

Which of the proteins, **A** to **D**, would promote the development of cancer if it were inactivated?

- A** EPO
- B** Myc
- C** p53
- D** Ras

Your answer

[1]

10(a) Fallopian tube cancer may result in the formation of tumours in the epithelial tissue lining the Fallopian tubes.

Name the type of cell division that occurs in a tumour.

[1]

(b) The table below contains information about some of the methods used for detecting cancer.

Complete the table by inserting the missing information.

Method used to detect cancer	What does the method involve?	Which parts of the body are examined?
Blood test	antibody test (ELISA)	blood
Mammography	low energy x-rays	
CT scan		whole body scans
.....	high frequency sound waves	soft tissue
MRI scan	 field and waves	soft tissue, bone, brain or spinal cord tumours
.....	radioactive tracer and gamma waves	produces three-dimensional images of any part of the body
Biopsies	needle, scalpel or speculum	tissues identified as possible tumours

[5]

- 11 The extracellular matrix (ECM) can be thought of as the 'glue' that holds together the cells in a tissue. The ECM consists of water, proteins and polysaccharides.

Matrix metalloproteinases (MMPs) are a group of proteases that hydrolyse proteins in the ECM.

Each MMP consists of a single polypeptide chain.

MMP activity has been linked to the development of cancer.

Women with tumours in their breasts will often have biopsies (tissue samples) taken and tested to see if the tumours are malignant (cancerous) or benign (non-cancerous).

In one study, the total MMP activity was measured in breast biopsies that were classed as either:

- benign
- malignant grade I (the least malignant)
- malignant grade II
- malignant grade III (the most malignant).

Table 3 shows the results of this study.

Tumour classification	MMP activity (units per μg protein)
Benign	6.58
Malignant grade I	1.34
Malignant grade II	6.80
Malignant grade III	32.29

Table 3

- (i) The researchers carried out a statistical test to compare the MMP activity in grade III tumours with the mean activity in all other tumours (benign, grade I and grade II).

Suggest a null hypothesis that the researchers would have used.

[1]

- (ii) The result of this test gave $p < 0.0001$.

Use the words 'probability' and 'chance' to describe the conclusion the researchers would make.

[1]

(iii) Use the data in Table 3 to evaluate the hypothesis that MMP activity increases the severity of breast cancer.

[3]

12 Here are three statements about the *BRCA1* gene:

- 1 Women with mutations in *BRCA1* are at increased risk of breast cancer.
- 2 *BRCA1* mutations can be inherited by males.
- 3 *BRCA1* is a proto-oncogene.

Which of the statements is/are correct?

- A 1, 2 and 3 are correct
- B Only 1 and 2 are correct
- C Only 2 and 3 are correct
- D Only 1 is correct

Your answer

[1]

13(a) Researchers were studying the possible association between smoking and the respiratory tract infections, pneumonia and bronchitis.

The study included an analysis of the infection figures for **all** admissions to a hospital.

- Data from 5018 patients were collected.
- 4022 of these patients were **non-smokers**.
- Each patient had only **one** infection.

Some of the data from this study are shown in Table 5.1.

	Number of patients admitted with a respiratory tract infection		Number of patients admitted with other type of infection
	Pneumonia	Bronchitis	
Smokers	335	230	431
Non-smokers	1166	526	2330

Table 5.1

Calculate the percentage of patients who were **smokers**.

Give your answer to **two** decimal places.

----- % [2]

- (b) The researchers stated the following null hypothesis:

Smoking does not affect the incidence of respiratory tract infections.

- (i) Analyse the data in this study **and** comment on the researchers' hypothesis.

In your answer you should use data to support your analysis.

[3]

- (ii) Suggest **one** statistical test that could be used to analyse the data further.

[1]

- (iii) Why would this statistical test be the most useful?

[1]

Hereditary non-polyposis colorectal cancer (HNPCC) is a type of bowel cancer caused by a mutation in genes that normally repair DNA.

Explain why mutations in DNA repair genes lead to development of cancer in the bowel and other organs.

[3]

Neuropathic pain is a type of pain caused by neurones malfunctioning following nerve damage. When this happens, some voltage-gated sodium ion channels (VGSCs) in pain receptors open spontaneously.

- (i) Single nucleotide polymorphisms (SNPs) have been detected in the genes coding for several types of VGSC. It is thought that these SNPs might alter the response of different patients to drugs that block VGSCs.

Describe the steps involved in identifying the SNPs present in a DNA sample from a patient.

----- [2]

- (ii) Screening for other SNPs is used in the study, diagnosis, and treatment of cancer.

A mutation in either the *BRCA1* or *BRCA2* gene increases the risk of breast cancer.

Explain why screening for these mutations is only offered to individuals with a strong family history of breast cancer and a living relative with breast cancer.

----- [2]

- 16 Which of the options, **A** to **D**, is a cancer therapy that damages **only** cancer cells?

- A chemotherapy
- B immunotherapy
- C radiotherapy
- D surgery

Your answer

[1]

17(a) The graph in Fig. 34.1 shows the percentage of male smokers in the UK between 1951 and 2010.

It also shows the prevalence of lung cancer among males in the UK between 1975 and 2010.

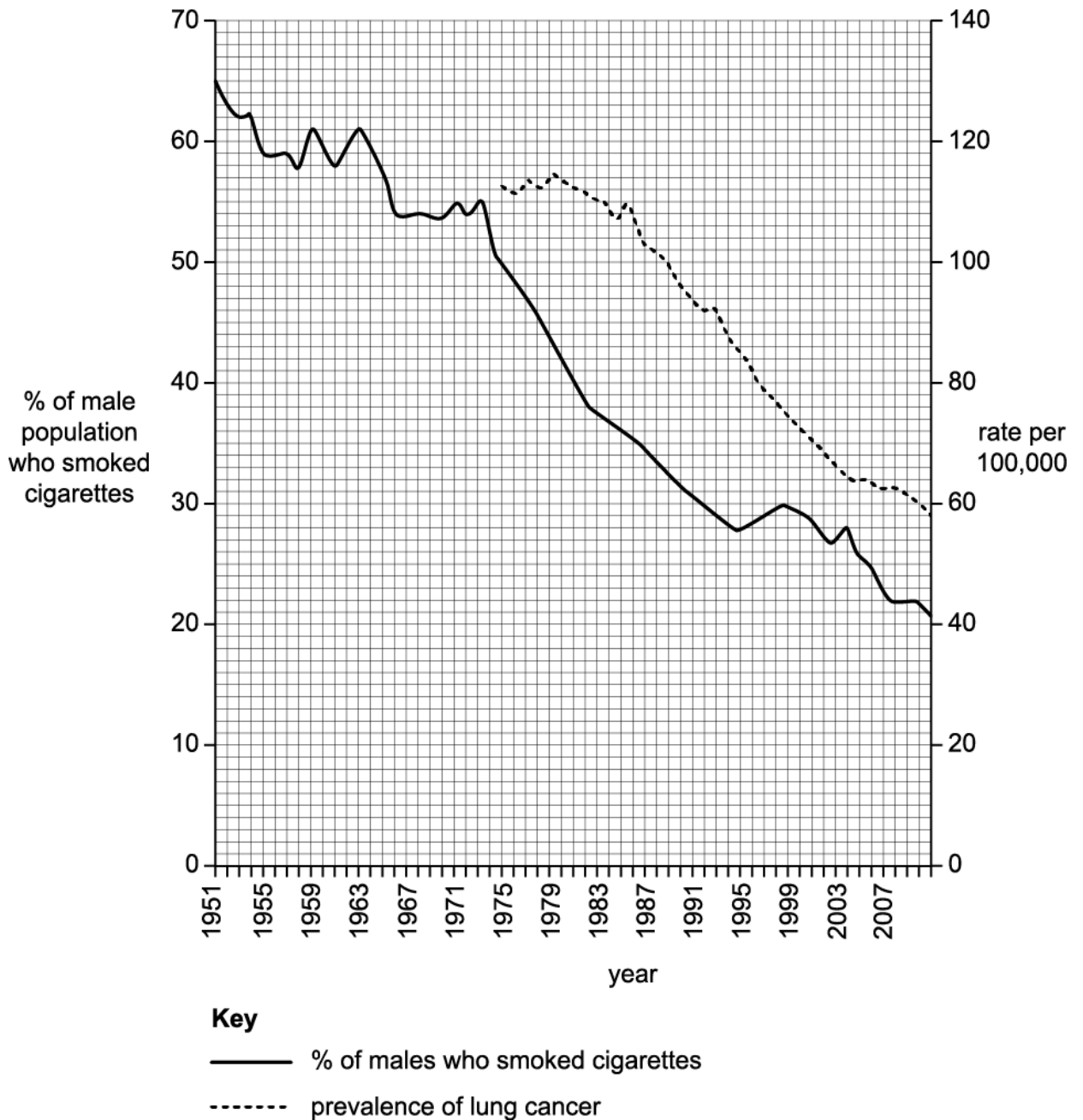


Fig. 34.1

Using the data in Fig. 34.1, evaluate the following statement:

“The data suggest, but do not prove, that smoking causes lung cancer”.

[4]

(b) Computed tomography (CT) scans and X-rays are both used to detect lung cancer.

(i) In the UK, trials have investigated the use of CT scans and X-rays as screening methods for lung cancer.

Describe **two** ethical implications associated with cancer screening.

1

2

[2]

(ii) A CT scan is more likely to detect a small lung tumour than an X-ray.

Explain why.

[2]

(iii) Monoclonal antibodies can be used to treat some patients with lung cancer.

State the name of this type of treatment.

[1]

18 RNA interference can be carried out by a type of non-coding RNA molecule known as microRNA.

Some microRNA molecules are tumour suppressors.

Which of the options, **A** to **D**, is an action of a tumour suppressor microRNA molecule?

- A** degradation of a messenger RNA transcript encoding Myc
- B** degradation of a messenger RNA transcript encoding p53
- C** inhibition of translation from a messenger RNA transcript encoding Myc
- D** inhibition of translation from a messenger RNA transcript encoding p53

Your answer

[1]

19 This question is based on the Advance Notice article **CATALASE**.

Uric acid is an excretory product formed from the breakdown of purines.

- (i) Name **two** molecules other than DNA or RNA which contain a purine.

-----[2]

- (ii) Suggest why the removal of free radicals by uric acid might reduce the risk of cancer.

-----[1]

20 For intrauterine insemination to be successful, the timing of insemination must coincide with successful ovulation.

- LH and hCG are known to bind to the same receptors.
- Injections of hCG can be given so the time of ovulation is known precisely.
- hCG has a half-life of up to 39 hours.

Explain why a **false positive** result could occur if a **pregnancy test** is taken too soon after an **hCG** injection and intrauterine insemination.

[2]

21 This question is based on the Advanced Notice article **CHANGES IN THE NUCLEUS THAT LEAD TO CANCER**, which is an insert.

You were told in Extract 1 of the Advanced Notice article that cancers can be caused by the activation or inactivation of certain genes.

Changes to the *p53* gene have been associated with many different types of cancer.

Suggest whether the *p53* gene is activated or inactivated when a cell becomes cancerous. Explain your suggestion.

[2]

22(a) Ocular melanoma is the most common form of cancer to affect the eye. More than 400 new cases are diagnosed each year in the UK.

Fig. 7.1 shows the structure of a human eye.

Ocular melanoma can develop in the choroid, ciliary body or at A in Fig. 7.1. Diagnosis is usually made earlier for melanomas that have developed at A.

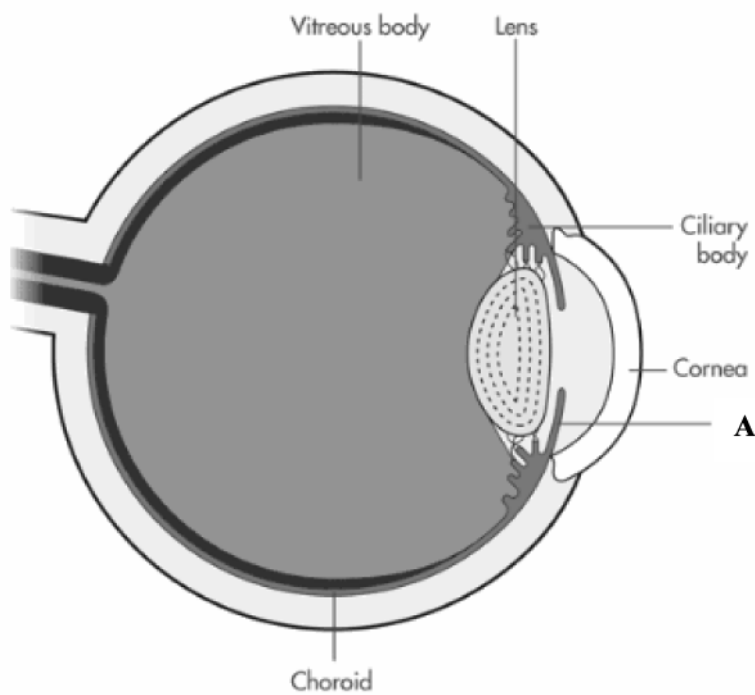


Fig. 7.1

(i) Name the part of the eye labelled A in Fig. 7.1.

-----[1]

(ii) Suggest why melanomas at A are diagnosed earlier than other ocular melanomas.

-----[1]

(iii) Cells in the choroid and A in Fig. 7.1 produce a pigment called melanin.

Suggest and explain **two** functions of melanin.

1

2

[2]

(b) The GNA11 gene codes for a protein that is involved in cell signalling.

(i) Outline the changes in DNA which would lead to a faulty version of the GNA11 gene.

[1]

(ii) Suggest how the faulty version of the GNA11 gene is formed and suggest how the faulty GNA11 causes the development of ocular melanoma.

[3]

23 Radiotherapy is a widely-used method of cancer treatment.

Cancer cells are more sensitive to radiotherapy than healthy cells.

Which of the options, **A** to **D**, is a property of cancer cells that causes increased sensitivity to radiotherapy?

- A faster division rate than healthy cells
- B faster mutation rate than healthy cells
- C altered metabolic pathways
- D impaired oxygen uptake

Your answer

[1]

24 Penicillin is **not** effective against Gram negative bacteria and has no effect on plant and animal cells.

(i) Explain why penicillin has no effect on Gram negative bacteria.

----- [2]

(ii) Explain why penicillin has no effect on plant or animal cells.

----- [1]

END OF QUESTION PAPER

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
1			metastasis / metastases ✓ CT / computerised tomography (scans) ✓ behavioural / lifestyle ✓ ageing / genetics ✓ chemotherapy ✓	5(AO1.2)	
			Total	5	
2			<i>Alzheimer's brain:</i> (has) smaller / decreased, volume ✓ (is) more/ AW, deeply folded ✓ (has) wider, gaps between folds ✓ (has) narrower, folds ✓ (has) larger, ventricles / voids / AW ✓	2max(AO 2.5)	IGNORE references to brain activity All marking points must be comparative ALLOW ora throughout
			Total	2	
3	a	i	(use) endoscopy / colonoscopy ✓ (to obtain a) biopsy sample ✓ observe cancerous cells in sample ✓ OR take a blood sample ✓ use flow cytometry with (monoclonal) antibodies to colorectal cancer (markers) ✓	max 2(AO2.5)(AO2.5)(AO2.5)(AO2.5)	ALLOW description of any valid method such as microscopy, histology, etc.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		ii	(yes because) mortality rate is higher in the (FOBT) positive group ✓ (but there is) no evidence that this is linked to inflammation ✓	2(AO3.2)(AO3.2)	
		iii	<i>for</i> (there is a) correlation between positive FOBT and risk of CRC ✓ the initial screening is non-invasive ✓ test can be done at home ✓ <i>against</i> (however, there is still) a need for confirmation by other means ✓ (there is a) risk of false , negatives / positives ✓ (there could be a) high cost ✓ many people may not want to do the test ✓ people may not attend follow-up screening ✓	max 4(AO3.2)(AO3.2)(AO3.2)(AO3.2)(AO3.2)(AO3.2)(AO3.2)	ALLOW the test does not identify all cases of CRC / test may not be performed correctly.

Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
	b	<i>Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.</i> <i>In summary:</i> <i>Read through the whole answer. (Be prepared to recognise and credit unexpected approaches where they show relevance.)</i> <i>Using a 'best-fit' approach based on the science content of the answer, first decide which of the level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer.</i> <i>Then, award the higher or lower mark within the level, according to the Communication Statement (shown in italics):</i> <i>award the higher mark where the Communication Statement has been met.</i> <i>award the lower mark where aspects of the Communication Statement have been missed.</i> <i>The science content determines the level.</i> <i>The Communication Statement determines the mark within a level.</i> Level 3 (5–6 marks) Description, with examples, of the action of tumour suppressor genes and proto-oncogenes, with no / few errors or omissions. <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i> Level 2 (3–4 marks) Description of the action of tumour suppressor genes and proto-oncogenes, with an example. <i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i>	6(AO1.1) (AO1.2)	<i>Indicative scientific content:</i> Tumour suppressor genes - slow the rate of cell division - stimulate apoptosis of cells with damaged / faulty DNA Examples - TP53 protein / <i>p53</i> gene <i>BRCA1/BRCA2</i> - refer to list / TL Proto-oncogenes mutate to become oncogenes - stimulate cell division - activate DNA replication - control production of growth factors, cyclins and CDKs Examples <i>Ras</i> <i>c-Myc</i>

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
			Level 1 (1–2 marks) Description of the action of tumour suppressor genes or proto-oncogenes. <i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i> 0 marks <i>No response or no response worthy of credit.</i>		
			Total	14	
4		i	more cases of cervical cancer caused by HPV16 <u>and</u> 18 ✓ fewer caused by HPV 31/33/45/52 ✓ could be caused by another / named factor ✓ no comparison to see if healthy women have HPV ✓	2 max AO3.1	ACCEPT no control group
		ii	(unpaired) T-test ✓ because means are being compared ✓ unpaired because the strains of HIV are unrelated ✓	2 max AO2.8	
			Total	4	

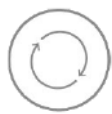
Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
5			A	1 AO1.1	
			Total	1	
6			A	1 AO1.1	
			Total	1	
7			C	1 AO2.4	
			Total	1	
8			D	1 AO2.1	
			Total	1	
9			C	1 AO1.1	
			Total	1	

Mark Scheme

Question			Answer/Indicative content			Marks	Guidance																								
10	a		<u>mitosis</u> ✓			1 (AO 1.1)	DO NOT ALLOW binary fission																								
	b		<table><tr><td>Method used to detect cancer</td><td>What does the method involve?</td><td>Which parts of the body are examined?</td></tr><tr><td>Blood test</td><td>antibody test (ELISA)</td><td>blood</td></tr><tr><td>Mammo-graphy</td><td>low energy x-rays</td><td>breast (tissue) ✓</td></tr><tr><td>CT scan</td><td>x-rays ✓</td><td>whole body scans</td></tr><tr><td>Ultrasound ✓</td><td>high frequency sound waves</td><td>soft tissue</td></tr><tr><td>MRI scan</td><td>magnetic field and radio ✓ waves</td><td>soft tissue, bone, brain or spinal cord tumours</td></tr><tr><td>PET (scan) ✓</td><td>radioactive tracer and gamma waves</td><td>produces three-dimensional images of any part of the body</td></tr><tr><td>Biopsies</td><td>needle, scalpel or speculum</td><td>tissues identified as possible tumours</td></tr></table>	Method used to detect cancer	What does the method involve?	Which parts of the body are examined?	Blood test	antibody test (ELISA)	blood	Mammo-graphy	low energy x-rays	breast (tissue) ✓	CT scan	x-rays ✓	whole body scans	Ultrasound ✓	high frequency sound waves	soft tissue	MRI scan	magnetic field and radio ✓ waves	soft tissue, bone, brain or spinal cord tumours	PET (scan) ✓	radioactive tracer and gamma waves	produces three-dimensional images of any part of the body	Biopsies	needle, scalpel or speculum	tissues identified as possible tumours	5 (AO 1.2) (AO 2.5)	Both words correct for one mark <u>Examiner's Comments</u> This question was generally answered well with many candidates gaining full marks. Common mistakes in those that did not gain full marks were: a) to not specify breast tissue for the mammograms, and only to stipulate soft tissue b) not specify radio waves for the MRI scans		
Method used to detect cancer	What does the method involve?	Which parts of the body are examined?																													
Blood test	antibody test (ELISA)	blood																													
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PET (scan) ✓	radioactive tracer and gamma waves	produces three-dimensional images of any part of the body																													
Biopsies	needle, scalpel or speculum	tissues identified as possible tumours																													
			Total			0																									

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
11		i	there is no (significant) difference (in MMP activity) between grade III tumours and all other groups ✓	1 AO2.6	ALLOW the difference (between grade III tumour activity and other groups) is due to chance <u>Examiner's Comments</u> A few candidates answered this correctly. Although most candidates did attempt a negative idea, e.g. no effect/ no change, they did not phrase their answer in a statistical manner with emphasise on 'the difference'.  AfL With statistical style terminology, candidates should always look for the two groups of data. Many examples can be given, relevant to them, e.g. hours of sleep and playtime on Fortnite, and students have to write the null hypothesis etc. for these examples.  OCR support 'Mathematical skills statistics booklet' can offer support the correct use of statistical tests: https://www.ocr.org.uk/Images/338621-mathematical-skills-statistics-booklet.doc

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		ii	there is less than, 0.01% / 0.0001, <u>probability</u> that the differences in activity (between the two groups / grade III and other tumours) are due to <u>chance</u> ✓	1 AO2.6	ALLOW <0.01% for 'less than 0.01%' <u>Examiner's Comments</u> Candidates found it difficult to answer this question even with the scaffolding of the question. Candidates often related probability to 'p' and the 'p value' but struggled with 'chance'. Candidates often referred to a correlation with the two groups without using set statistical terminology for a 'difference' between the data of the two groups. More able candidates used their null hypothesis to aid with this answer. Quite a few candidates did not attempt this question.  OCR support Help with probability and chance definitions can be found at; https://ocr.org.uk/subjects/biology/maths-for-biology/handling-data/ Exemplar 2 Use the words 'probability' and 'chance' to describe the conclusion the researchers would make. <i>The probability that this result was purely down to chance is less than 0.0001</i> This is a correct response showing a clear understanding of the p value and the probability and chance terms.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		iii	yes Y1 the activity is significantly greater in, grade III / the most malignant, tumours ✓ Y2 <u>positive correlation</u> (between MMP activity and severity of breast cancer) ✓ No N1 activity is, the same in grade II and benign / lower in grade I than benign ✓ N2 other factors may be involved OR N2 correlation does not imply causation ✓	3 max AO3.2	ALLOW severity of breast cancer increases as activity of malignant grade tumour increases. <u>Examiner's Comments</u> Most candidates achieved 2 marks, recognising the trend in the data and the differences with benign tumours. A few candidates evaluated this effectively, however. Candidates should remember that evaluate in this context requires a recognition of a point and then why this may occur.
			Total	0	
12			B	1	<u>Examiner's Comments</u> Almost all candidates opted for either A or B. However, <i>BRCA1</i> is a tumor suppressor gene.
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
13	a		19.85 ✓✓	B	ALLOW maximum of one mark for 19.849 OR 19.8 (incorrect number of decimal places) DO NOT ALLOW 19.9 (incorrect rounding) If answer is incorrect or missing ALLOW maximum of one mark for correct working $\frac{996}{5018} \times 100$ Examiner's Comments Q5(a) was a straightforward calculation and the majority of candidates gained the mark here. Some however did not quote their answer to the correct number of decimal places and/or had rounding errors.
	b	i	<i>Analysis of data</i> more cases of respiratory tract infections among smokers than expected OR pneumonia is more common than bronchitis among both smokers and non-smokers OR smoking appears to significantly increase the risk of bronchitis and may also (slightly) increase the risk of getting pneumonia ✓ supporting data referring to expected number of cases ✓ supporting data referring to % of cases ✓	3	ALLOW more cases of pneumonia <u>and</u> bronchitis among smokers than expected e.g. expected cases of pneumonia among smokers 297.95 or 298 OR expected cases of bronchitis among smokers 150.07 or 150 OR e.g. expected cases of pneumonia among non-smokers 1203.05 or 1203 OR expected cases of bronchitis among non-smokers 605.93 or 606 23.09% or 23.1% or 23% of smokers had bronchitis compared with 13.08 or 13.1% or 13% of non-smokers OR

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
			<i>Comment on hypothesis</i> null hypothesis should be rejected ✓		about 33.63% or 33.6% or 34% of smokers had pneumonia compared to 28.99% or 29.0% or 29% of non-smokers ALLOW hypothesis is not supported IGNORE hypothesis is, false / wrong / contradicted Examiner's Comments Q5(b)(i) proved to be a challenging question as candidates were not confident in selecting the appropriate data to analyse. Candidates were expected to calculate the % of smokers and % of non-smokers in the study and use these percentages to then determine whether the actual observed numbers/% were in-line with, or different from, the expected values. Again errors were seen with candidates referring to the null hypothesis being wrong/invalid/disproved/incorrect rather than rejected/not supported.
		ii	<u>chi-squared</u> ✓	1	ALLOW χ^2 test Examiner's Comments Few candidates gained the mark for Q5(b)(ii) with the most common answer incorrectly being a <i>t</i>-test. Candidates did not appreciate the need to test whether the observed values were significantly different from the expected values.
		iii	(chi-squared test) tests the significance of the difference between, observed and expected results □	1	Examiner's Comments Candidates who gave the incorrect answer to Q5(b)(ii) were unable to gain the mark for Q5(b)(iii) and often did not give the appropriate reason as to why the test would be appropriate.
			Total	7	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
14			Mutation / fault / damage, in <u>DNA</u> is not removed ✓ (this) increases (general) mutation rate / accumulation of DNA damage ✓ (increased) mutation in proto-oncogenes / tumour suppressor genes ✓ apoptosis, is not triggered / does not occur ✓ (leads to) uncontrolled, mitosis / cell division ✓	3 max	Look for linking of faulty DNA repair mechanisms with increase in mutation rate. Examiner's Comments For (c) most candidates achieved mp5 as a clear description of cancer development. Many candidates discussed this in terms of mutations in tumour suppressor genes or proto-oncogenes.
			Total	3	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
15		i	DNA, cut / fragmented, using, restriction enzymes / endonucleases ✓ separate fragments using gel electrophoresis ✓ sequence fragments / add labelled probe ✓ compare to database / DNA samples from other individuals ✓	2 max	ACCEPT any valid method of labelling Examiner's Comments Candidates struggled with (c)(i) and could not discuss it in sufficient detail. Many candidates discussed electrophoresis separating the SNPs, not appreciating that it separates on the basis of size and a probe would need to be used to pick up individual SNPs. Indeed some candidates stated that the DNA ladder would identify the SNPs and did not seem to realise that a DNA ladder is also based on size only. Many candidates spoke about PCR being used to amplify the sample thus not realising that this would not be necessary as enough DNA would be available to proceed without performing PCR.
		ii	greater risk of, developing breast cancer / having mutated gene, if have family history ✓ high cost means screening must be restricted ✓ living relative needed to identify faulty gene ✓ (this gene) tested for in the individual / predictive testing ✓	2 max	Examiner's Comments For (c)(ii) most candidates achieved mp2 with a good understanding of the financial cost of testing everyone. Some candidates felt that the emotional impact of testing everyone should be considered and a few discussed the testing in terms of causing harm to the patient. Thus some candidates had not connected this question with the previous question of taking a blood sample and were visualising this method as a radioactive procedure. Many candidates wrote about the increased chance of inheriting the gene without realising that it is the mutated gene that is relevant, as everyone inherits these genes. The importance of the BRCA genes should not be restricted to their mutated forms and breast cancer.
			Total	4	
16			B ✓	1	Examiner's Comments This was a straightforward question which only demanded a small amount of biological knowledge.
			Total	1	

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17	a		suggestion of cause: data for smoking and cancer prevalence similar in trend ✓ there is a lag time / takes time before it is diagnosed ✓ specify lag time ✓ no proof: correlation is not cause ✓ may be other influencing factors ✓ example of factors, e.g. inherited predisposition ✓	max 4	AW
	b	i	who should be eligible for screening ✓ ref to medical benefit to early diagnosis ✓ ref to release of data / insurance implications ✓ weighing up cost and effectiveness / money could be spent on other conditions ✓	max 2	DO NOW ALLOW 'expensive' unqualified
		ii	CT involves more than one X-ray ✓ CT is a 3D image ✓ CT has greater resolution / can see greater detail with CT ✓	max 2	ORA
		iii	immunotherapy ✓	1	ALLOW 'biological therapy' or 'targeted therapy'
			Total	9	
18			C ✓	1	
			Total	1	

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Question			Answer/Indicative content	Marks	Guidance
19		i	ATP / ADP / AMP / NAD / NADH / FAD / FADH ✓✓	2	
		ii	<i>idea that free radicals cause mutations within proto-oncogenes and/or tumour suppressor genes ✓</i>	1	ALLOW DNA damage rather than mutation but the link to relevant genes must be present
			Total	3	
20			pregnancy test strips detect hCG (1) <i>idea that</i> long half-life means hCG remains high (in blood plasma and) in urine for several days (1) <i>idea that</i> large dose of hCG means it remains high (in blood plasma and) in urine for several days (1)	2	
			Total	2	
21			<i>Inactivated</i> (no mark) <i>Explanation:</i> (p53 is a) tumour suppressor gene (1) (<i>inactivation results in</i>) failure of DNA repair / DNA damaged (1) <i>idea that</i> cell cycle is not stopped at check points (1) <i>idea that</i> apoptosis not initiated (1)	2	Award a maximum of one mark for an explanation if 'activated' is given DO NOT ALLOW mp 1 if given as part of a list with proto-oncogene or oncogene ALLOW reverse argument for mark points 2 to 4 e.g. p53 initiates apoptosis
			Total	2	

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Question			Answer/Indicative content	Marks	Guidance
22	a	i	iris	1	
		ii	visible externally / AW	1	
		iii	Any 2 from: (choroid), absorbs light, (giving) clearer image / AW (iris), absorbs light, (allowing) amount of light entering the eyeball to be controlled / AW protection from, UV / dangerous, radiation	2	ALLOW choroid reduces light reflection (within eyeball)
	b	i	idea of changes in, base / nucleotide / triplet, sequence	1	
		ii	mutation / AW, to proto-oncogene (leads to) faulty, receptor / growth factor (leads to) uncontrolled cell division	3	ALLOW forms oncogene DO NOT ALLOW (cell) signalling molecule because this is referenced in the stem
			Total	8	
23			A	1	
			Total	1	
24		i	Any 2 from: (Gram negative bacteria have) outer, membrane / lipopolysaccharide layer idea that this is impermeable to penicillin idea that penicillin cannot reach, murein / peptidoglycan layer	2	
		ii	animal cells do not have a cell wall AND cell wall in plants is, cellulose / not peptidoglycan	1	Both needed for one mark
			Total	3	