

**ADVANCED GCE  
HUMAN BIOLOGY**

## F225 QP

Unit F225: Genetics, Control and Ageing

**Specimen Paper**

Candidates answer on the question paper.

Time: 1 hour 45 minutes

Additional Materials:

Ruler (cm/ mm)  
Scientific calculator

Candidate  
Name

Centre  
Number

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Candidate  
Number

--	--	--	--	--	--	--	--

**INSTRUCTIONS TO CANDIDATES**

- Write your name, Centre number and Candidate number in the boxes above.
- Answer **all** the questions.
- Use blue or black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure you know what you have to do before starting your answer.
- Do **not** write in the bar code.
- Do **not** write outside the box bordering each page.
- WRITE YOUR ANSWER TO EACH QUESTION IN THE SPACE PROVIDED.

**INFORMATION FOR CANDIDATES**

- The number of marks is given in brackets [] at the end of each question or part question.
- Where you see this icon you will be awarded marks for the quality of written communication in your answer.
- You may use a scientific calculator.
- You are advised to show all the steps in any calculations.
- The total number of marks for this paper is **100**.

FOR EXAMINER'S USE		
Qu.	Max.	Mark
1	11	
2	23	
3	17	
4	17	
5	15	
6	17	
<b>TOTAL</b>	<b>100</b>	

This document consists of **17** printed pages and **3** blank pages.

Answer **all** the questions.

- 1 Homeostasis is essential if the body is to remain healthy. Both the endocrine and the nervous systems control the homeostatic mechanisms in the body.

(a) Explain what is meant by the term *homeostasis*.

.....

.....

.....

..... [2]

(b) In the table below, list **four** differences between the endocrine and nervous systems.

	endocrine system	nervous system
1		
2		
3		
4		

[4]

(c) (i) State the exact site of insulin secretion in the pancreas.

..... [1]

(ii) State the stimulus which causes insulin secretion.

..... [1]

(d) Suggest **three** recommendations which might be given by a GP to a patient in order to reduce the risk of Type 2 diabetes developing.

- 1. ....
- 2. ....
- 3. .... [3]

[Total: 11]

SPECIMEN

[Turn Over

2 An understanding of the structure and function of the nervous system explains some of the social problems associated with Alzheimer’s disease.

(a) Fig. 2.1 is a diagram of a motor neurone.

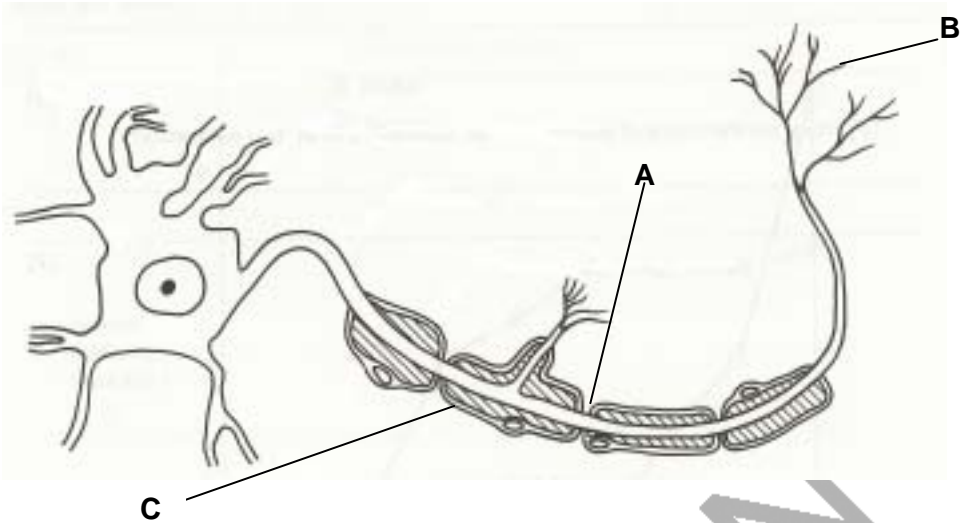


Fig. 2.1

(i) Indicate, by drawing an arrow on Fig. 2.1, the direction in which the nerve impulse travels. [1]

(ii) Name the structures labelled A to C.

A .....

B .....

C ..... [3]

(iii) State **two** ways in which the motor neurone in Fig. 2.1 differs from a sensory neurone.

1. ....

2. .... [2]

(b) Neurones have sodium-potassium pumps.

(i) Where are these pumps situated?

..... [1]

(ii) What is the immediate source of energy used to drive the sodium-potassium pumps?

..... [1]

(c) Studies have shown that about 5% of the neurones in the part of the brain called the hippocampus disappear with each decade after the age of 50.

For every 100 neurones present in the hippocampus at age 50, calculate how many will be present by the age of 70. Show your working.

Answer = ..... [2]

(d) Fig. 2.2 shows diagrams of neurones from the hippocampus in people aged 50, 60 and 70 years, and in a 70 year old with Alzheimer's disease.

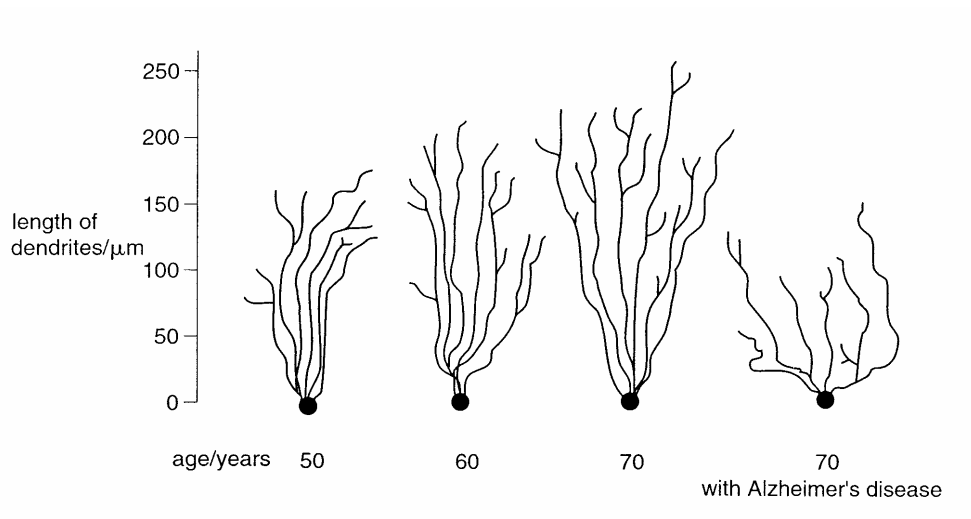


Fig. 2.2

Using the information in Fig. 2.2

(i) describe the change in the appearance of dendrites in **healthy** people with increasing age;

.....  
 .....  
 .....  
 ..... [2]

(ii) comment on the appearance of the dendrites in the person with Alzheimer's disease.

.....  
 .....  
 .....  
 ..... [2]

(e) Outline the **social** problems to the individual **and** to society of a patient with Alzheimer's disease.

In your answer, you should make clear how the problems for an individual result in problems for society.

.....  
 .....  
 .....  
 .....  
 .....  
 ..... [Turn Over]



3 The thyroid gland is composed of numerous follicles. Each follicle consists of a single layer of epithelial cells surrounding a lumen.

The lumen is filled with a large glycoprotein, known as thyroglobulin.

Lysosomes degrade thyroglobulin to produce thyroxine which is released into the blood.

Fig. 3.1 shows an epithelial cell in the wall of the thyroid follicle with an adjoining capillary.

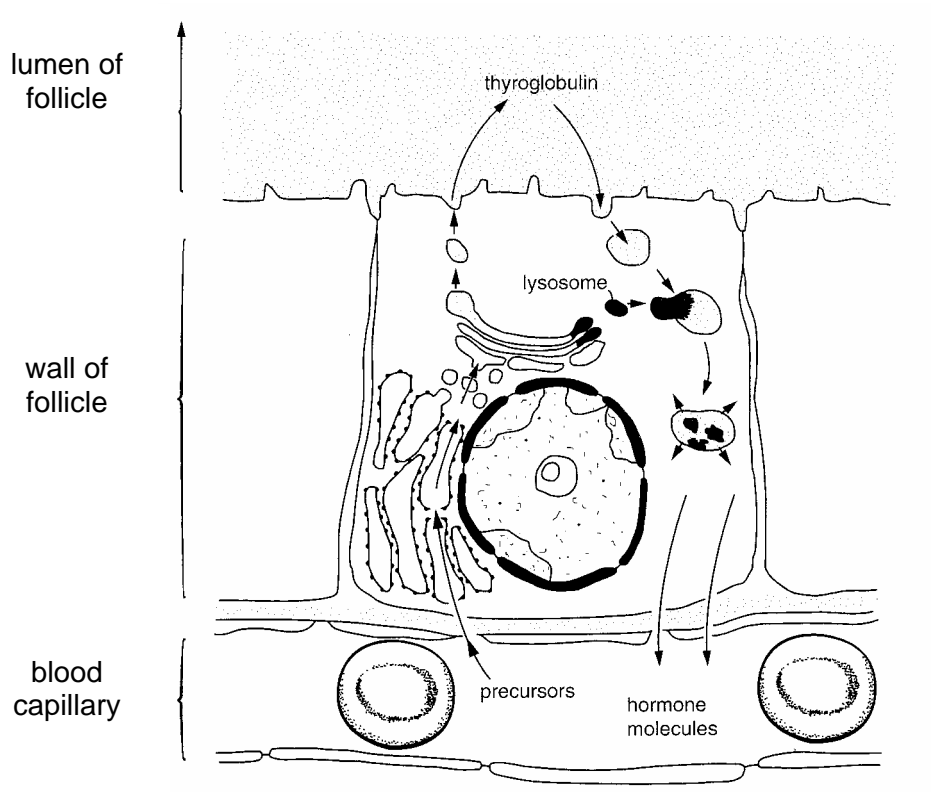


Fig. 3.1

(a) (i) Suggest **two** substances that must enter the epithelial cell of the follicle to form thyroglobulin.

1.....  
 .....

2.....  
 .....

[2]

(ii) Suggest how the lysosomes degrade the thyroglobulin to form thyroxine.

.....  
 .....

..... [3]

[Turn Over

(iii) Explain why thyroxine is stored as thyroglobulin.

.....  
 .....  
 .....  
 ..... [2]

(b) Myxoedema occurs in adults when the thyroid gland is not producing enough thyroxine. The effect of this condition is a lowered Basal Metabolic Rate (BMR), and poor resistance to cold environmental temperatures.

Table 3.1 shows the effect on BMR, resting pulse rate and body mass of administering a single dose of thyroxine on day 0 to an adult with myxoedema.

**Table 3.1**

	time after administering thyroxine / days					
	0	4	8	12	16	20
BMR / percentage of normal	55	70	95	100	95	85
body mass / kg	65	62	62	61	61	60

(i) Calculate the % change in body mass between day 0 and day 20.

answer ..... [2]

(ii) Outline how the changes in BMR and body mass result from the administration of thyroxine.

BMR

.....  
 .....  
 .....

body mass

.....  
 .....  
 .....  
 ..... [4]



(iii) Explain the relationship between BMR and body temperature.

.....  
.....  
.....  
..... [2]

(iv) At one time this condition was treated with thyroid gland extract rather than manufactured thyroxine.

Suggest the **disadvantages** of using thyroid gland extract to treat myxoedema.

.....  
.....  
.....  
..... [2]

**Total [17]**

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4 Analysis of the substances contained in a urine sample is useful in monitoring kidney function.

(a) Table 4.1 shows the mean concentration of some of the substances in blood plasma, the glomerular filtrate and urine of an individual, over 24 hours.

Table 4.1

solutes	mean concentration / g dm <sup>-3</sup>		
	plasma	glomerular filtrate	urine
protein	80.00	10.00	10.00
glucose	3.00	3.00	2.00

(i) Name the process which forms **the glomerular filtrate** in the Bowman's capsule.

..... [1]

(ii) Table 4.1 shows an abnormally high concentration of protein and glucose in the urine. Suggest an explanation for the abnormal concentration of:

protein


.....  
 .....  
 .....

glucose.

.....  
 .....  
 ..... [6]

(b) Chronic kidney failure can be caused by inflammation that damages the glomeruli (glomerulonephritis).

Describe the process of haemodialysis as a treatment for kidney failure.

 In your answer, you should make clear how the steps in the process are sequenced.

.....  
 .....  
 .....  
 .....  
 .....  
 .....  
 .....





(ii) Explain the differences in the percentage survival of transplants shown in Fig. 5.1.

.....  
.....  
.....  
.....  
.....  
.....  
.....  
..... [4]

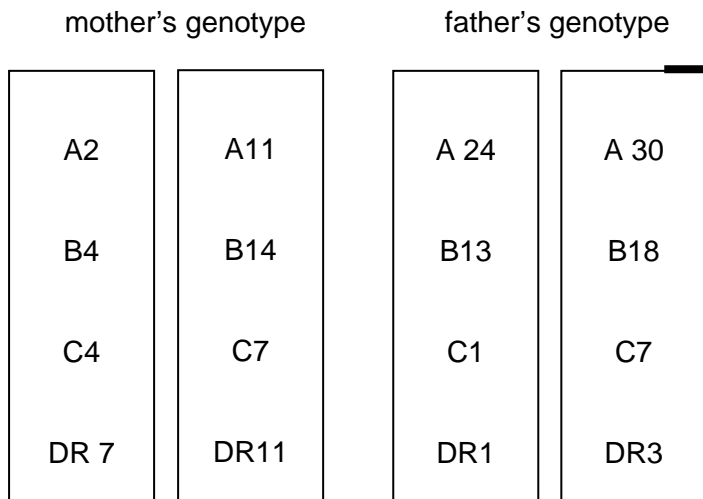
(iii) If the first transplant fails, a second transplant is necessary.

Suggest why individuals who had received a second transplant were not included in the survey.

.....  
.....  
.....  
.....  
.....  
..... [3]

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(b) The diagram below shows a mother's and father's HLA genotypes at four of the six HLA loci.



(i) State the term given to one haploid HLA genotype.

..... [1]

(ii) Complete Fig. 5.2 to show **one** possible HLA genotype of a child of the couple.

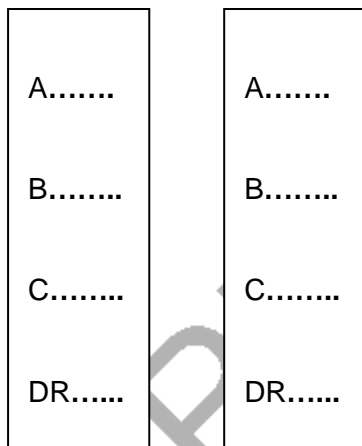


Fig. 5.2

[1]

(iii) State the probability of the child having the HLA genotype chosen in (ii).

..... [1]

(c) Explain why the number of possible HLA genotypes of the child is very limited.

.....  
 .....  
 .....  
 .....

[2]

Total [15]

6 The risk of developing breast cancer increases in post menopausal women.

(a) Outline the methods used to detect cancer of the breast.

.....  
.....  
.....  
.....  
..... [4]

(b) (i) Explain the use of HRT in treating symptoms of the menopause

.....  
.....  
.....  
.....  
.....  
..... [5]

(ii) Explain the link between the use of HRT and the prevalence of breast cancer.

.....  
.....  
..... [2]

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(c) One cause of ageing involves changes in the chromosomes.

The ends of chromosomes are protected by identical repeating lengths of DNA called **telomeres**.

These prevent the chromosomes unravelling during cell division. Each time a cell divides, the length of the telomeres shortens and the ability of the cell to divide decreases. This is part of the ageing process.

(i) Suggest why it may be an advantage if *'the ability of the cell to divide decreases'*.

.....  
.....  
.....  
..... [2]

(ii) Explain how an **enzyme**, such as telomerase, adds repeating units of DNA to the telomere.

.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
..... [4]

**Total [17]**

**Paper Total [100]**

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Unit F225: Genetics, Control and Ageing

**Specimen Mark Scheme**

The maximum mark for this paper is **100**.

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This document consists of **9** printed pages and **3** blank pages.

Question Number	Answer	Max Mark		
1(a)	maintenance of a stable internal environment; despite fluctuations in external environment; ref to negative feedback; ref to receptors and effectors;	[2] max		
(b)	<i>A four <b>matched</b> pairs from</i> <table border="1" data-bbox="316 555 1300 757"> <tr> <td data-bbox="316 555 810 757">           chemical            transmitted through blood stream            slow transmission            slower response            sustained response / AW            a diffuse / target         </td> <td data-bbox="810 555 1300 757">           electrical;            impulses along axon / neurone;            rapid transmission;            rapid response;            (usually) short term response;            a precise target / AW;         </td> </tr> </table>	chemical transmitted through blood stream slow transmission slower response sustained response / AW a diffuse / target	electrical; impulses along axon / neurone; rapid transmission; rapid response; (usually) short term response; a precise target / AW;	[4] max
chemical transmitted through blood stream slow transmission slower response sustained response / AW a diffuse / target	electrical; impulses along axon / neurone; rapid transmission; rapid response; (usually) short term response; a precise target / AW;			
(c)(i)	β cells;	[1]		
(ii)	<u>high / excess</u> blood glucose concentration;	[1]		
(d)	advice on BMI / obesity; (particularly individuals who distribute body fat round middle of abdomen / apple shaped / high waist to hip ratio; reduce excessive refined sugar intake /;  (increase) foods with low GI / described; (increase) exercise / physical activity; (increase )intake of fruit / vegetables;	[3] max		
2(a)(i)	arrow on diagram from left to right;	[1]		
(ii)	<b>A</b> node of Ranvier; <b>B</b> motor end plate; <b>C</b> nucleus of <u>Schwann cell</u> ;	[3]		
(iii)	cell body, at end / not in middle of fibre; axon and dendrites / dendron, of different length / equal length; nerve ending / motor end plate, at effector / at CNS; many dendrites into cell body / no dendrites into cell body;	[2] max		
(b)(i)	in / across cell membrane; intrinsic / transporter protein;	[1] max		

Question Number	Answer	Max Mark
(ii)	ATP;	[1]
(c)	90.75;; <i>correct method, wrong answer 1 max</i> <i>correct answer only 2 marks</i>	[2] max
(d)(i)	<i>penalise use of 'branches' once</i> dendrites get longer; develop more / dendrites; AVP; e.g. comparative figs	[2] max
(ii)	<i>penalise use of 'branches' once</i> dendrites shorter; fewer / dendrites; therefore fewer synapses / connections with other neurones; dendrites wider spread;	[2] max
2(e)	confusion; poor cognitive skills / ability to process information; loss of (short/ long term) memory; loss of personality poor recognition of places / people; loss of (voluntary) movement / loss (voluntary) muscles; inappropriate behaviour / dementia; e.g. imagines things, paranoia speech / language lost; loss of fine manipulation / AW e.g. using cutlery / writing; loss of control of basic functions / named; loss of independence; AVP; e.g. slower reaction time <span style="float: right;"><i>5 max</i></span>  burden on carer; anguish / AW, of relatives / friends; reduction economic input from carer / carer dependent on state; increased pressure on welfare / NHS services / named; increase in costs to NHS / described; increase in need for residential / respite, care / homes / carers ; increased incentive to find cures for degenerative diseases / named;	[8] max
	Award for clear linkage of at least 1 individual problem to a social problem. QWC	[1]
	<b>Total</b>	<b>[23]</b>

Question Number	Answer	Max Mark
3(a)(i)	amino acids / tyrosine; carbohydrate / glucose; iodide; <b>R</b> <i>iodine</i>	[2] max
(ii)	thyroglobulin passes into epithelial cell by pinocytosis / endocytosis; (thyroglobulin) fuses with lysosome; hydrolytic enzymes /; hydrolysis / split, thyroglobulin molecule; carbohydrate / glucose, from protein;	[3] max
(iii)	inert molecule / AW; not osmotically active / AW; can be stored; easily / quickly degraded / AW;	[2] max
(b)(i)	7.6%;; <i>correct method, wrong answer 1 max</i> <i>correct answer only 2 marks</i>	[2]
(ii)	<i>BMR</i> thyroxine controls BMR; ref to activation of genes / ref to increase in transcription; enzyme production; increases rate of respiration; AVP; e.g. increase in heart rate / cardiac output <i>3 max</i> <i>BODY MASS</i> respiratory substrates used more quickly / AW; les fat stored; AVP; e.g. excess water removed, more physically active	[4] max
(iii)	respiration releases thermal energy / heat;  during oxidative phosphorylation / ATP production; exothermic reaction; helps to maintain body temperature; <b>R</b> controls body temperature	[2] max





Question Number	Answer	Max Mark
4(b) cont'd	<p>dietary mineral supplements may be taken, time consuming</p> <p>QWC Mark for correct sequencing of steps</p>	<p>[6 max]</p> <p>[1]</p>
4(c)	<p>(i) (electron microscope gives) better resolution; bacteria are prokaryotic cells; (bacterial cells are ) smaller than eukaryotic cells; <i>look for comparative idea.</i> <b>R</b> small unqualified</p> <p>(ii) (treat with) antibiotics; AVP;</p>	<p>[2 max]</p> <p>[1 max]</p>
	<b>Total</b>	<b>[17]</b>
5(a)(i)	<p>(act as) antigens, on cell surface / cell membrane; recognition signal / cell signature; self / not self marker; stimulates antibody production if not self; detail of immune response / clonal selection / clonal expansion;</p> <p>(ii) antigen; <i>if not given in (i)</i> foreign tissue / cells; (stimulates) immune response; more mismatches / antigens, more (vigorous) response; comparative figs to illustrate; <u>rejection</u>; ref to T cells; antibodies / receptors bind with antigen; killer / cytotoxic T cells, destroy transplant; AVP;</p> <p>(iii) weakened due to, previous rejection / long term illness / AW; so more likely to die; memory of any antigen in previous graft / AW; memory cells; secondary response; quicker / more vigorous rejection; AVP;</p>	<p>[3] max</p> <p>[4] max</p> <p>[3] max</p>

Question Number	Answer	Max Mark
<p><b>5(b)(i)</b></p> <p><b>(ii)</b></p> <p><b>(iii)</b></p> <p><b>(c)</b></p>	<p>haplotype;</p> <p>correct genotype;</p> <p>0.25;</p> <p>HLA genes / loci, linked / on same chromosome / on chromosome 6; tightly linked / close together AW; rarely separated by crossing over/ few recombinants formed; inherited as a unit / haplotype; child receives one haplotype from each parent;</p>	<p>[1]</p> <p>[1]</p> <p>[1]</p> <p>[2]max</p>
	<b>Total</b>	<b>[15]</b>
<p><b>6(a)</b></p> <p><b>(b)(i)</b></p> <p><b>(ii)</b></p> <p><b>6(c)(i)</b></p>	<p>Tamoxifen; lumpectomy; mastectomy; chemotherapy; immunotherapy; <i>allow appropriate complimentary therapies</i></p> <p>(symptoms) hot flushes; vaginal dryness; night sweats</p> <p>oestrogen and progesterone/ progestin; (method) tablets/implants/patches etc; oestrogen on its own increases cancer risk;</p> <p>Increased risk of breast cancer with use of HRT; linked with oestrogen;</p> <p>prostate cancer will be slow growing; less likely to form metastases; less chance of forming / will not form cancer / tumour / AW; will not pass on mutations; AVP;</p>	<p>[4] max</p> <p>[2] max</p> <p>[5]max</p> <p>[2] max</p> <p>[2] max</p>

Question Number	Answer	Max Mark
(ii)	<p>has a specific;            active site;            (which) forms enzyme substrate complex;            and complements the <u>nucleotide</u> sequence;            on telomere / DNA;            and specific free (DNA) nucleotides;            (enzyme) decreases activation energy;            ( and ) forms bond between nucleotides;            sugar phosphate bond / phosphodiester bond;            AVP;</p>	[4]max
	<b>Total</b>	<b>[17]</b>
	<b>Paper Total</b>	<b>[100]</b>

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**Assessment Objectives Grid (includes QWC)**

<b>Question</b>	<b>AO1</b>	<b>AO2</b>	<b>AO3</b>	<b>Total</b>
1(a)	2			2
1(b)		4		4
1(c)(i)	1			1
1(c)(ii)	1			1
1(d)	1	3		3
2(a)(i)		1		1
2(a)(ii)		3		3
2(a)(iii)	2			2
2(b)(i)	1			1
2(b)(ii)	1			1
2(c)			2	2
2(d)(i)			2	2
2(d)(ii)			2	2
2(e)	5	4		9
3(a)(i)		2		2
3(a)(ii)		3		3
3(a)(iii)		2		2
3(b)(i)			2	2
3(b)(ii)	1	3		4
3(b)(iii)	1	1		2
3(b)(iv)		2		2
4(a)(i)	1			1
4(a)(ii)	3	3		6
4(b)	7			7
4(c)(i)	1		1	2
4(c)(ii)		1		1
5(a)(i)	3			3
5(a)(ii)	1	2	1	4
5(a)(iii)		3		3
5(b)(i)	1			1
5(b)(ii)		1		1
5(b)(iii)			1	1
5(c)		2		2
6(a)	4			4
6(b)(i)	5			5
6(b)(ii)	2			2
6(c)(i)		2		2
6(c)(ii)		4		4
<b>Totals</b>	<b>43</b>	<b>46</b>	<b>11</b>	<b>100</b>

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