

FOR OFFICIAL USE

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Total Marks

**0300/402**

NATIONAL  
QUALIFICATIONS  
2002

FRIDAY, 24 MAY  
10.50 AM - 12.20 PM

**BIOLOGY**  
**STANDARD GRADE**  
Credit Level

**Fill in these boxes and read what is printed below.**

Full name of centre

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Town

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Forename(s)

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Surname

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Date of birth

Day Month Year

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Scottish candidate number

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Number of seat

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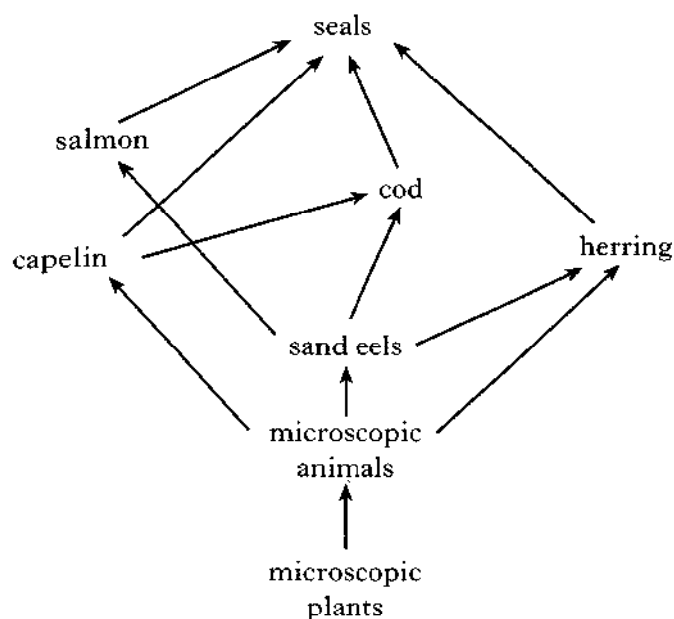
- 1 All questions should be attempted.
- 2 The questions may be answered in any order but all answers are to be written in the spaces provided in this answer book, and must be written clearly and legibly in ink.
- 3 Rough work, if any should be necessary, as well as the fair copy, is to be written in this book. Additional spaces for answers and for rough work will be found at the end of the book. Rough work should be scored through when the fair copy has been written.
- 4 Before leaving the examination room you must give this book to the invigilator. If you do not, you may lose all the marks for this paper.



Marks

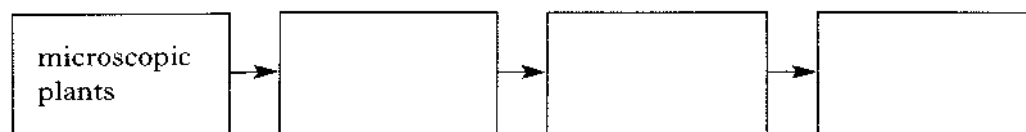
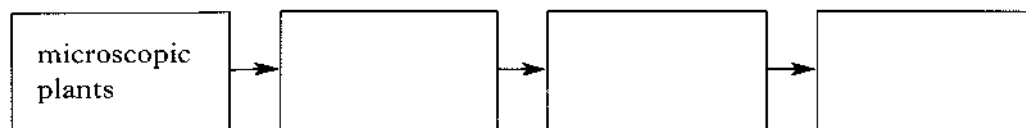
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1. The diagram below shows part of a food web in the Irish Sea.



- (a) Two food chains from the food web are made up of four populations of organisms.

Complete both of these food chains in the spaces below.



1

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(b) Predict the effect on the population of (i) capelin, and (ii) seals if the sand eels were removed from this food web.

Capelin would  $\left\{ \begin{array}{l} \text{increase} \\ \text{decrease} \\ \text{stay the same} \end{array} \right\}$

1

Seals would  $\left\{ \begin{array}{l} \text{increase} \\ \text{decrease} \\ \text{stay the same} \end{array} \right\}$

**1**

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1

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2. (a) Tropical rain forests are estimated to contain more than half of the Earth's existing species of plants and animals, many of which have not yet been studied.

Rain forests are being destroyed, leading to a reduction in the number of species. This has possible consequences for humans and other animals.

Describe **one** such possible consequence for humans.

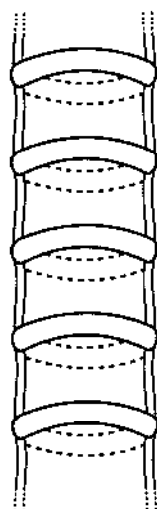
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- (b) The diagrams show two types of structures found in plants.



A



B

- (i) Which structure would be found in the phloem?

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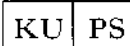
- (ii) Xylem helps to support a plant. State **one** other function of xylem.

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- 1**

[illegible]

- 1**

[illegible][illegible]

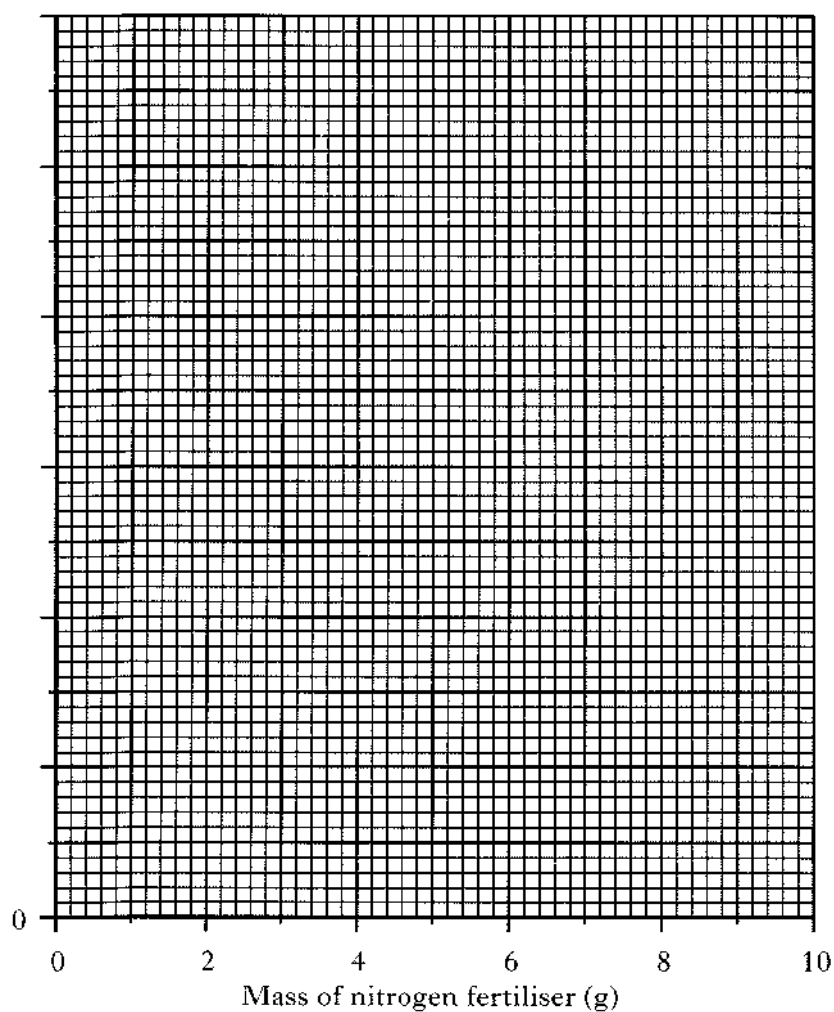
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4. Dwarf bean plants were grown in pots of sand containing different masses of nitrogen fertiliser. Five pots were set up for each mass of fertiliser. After 10 weeks, the plants were dug up and their root nodules were removed, washed and weighed. The results are shown in the table.

<i>Mass of nitrogen fertiliser (g)</i>	<i>Average mass of root nodules per plant (g)</i>
0	5.3
0.2	1.6
1.0	0.8
5.0	0.4
10.0	0.1

- (a) (i) On the grid below, complete a **line graph** to show the effects of increasing the mass of nitrogen fertiliser on the mass of root nodules formed by the bean plants.  
(An additional grid, if required, will be found on page 27.)



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## 4. (a) (continued)

- (ii) What effect does increasing the mass of nitrogen fertiliser have on the mass of root nodules formed per plant?

\_\_\_\_\_

1

- (b) Why was it good experimental technique to set up five pots for each mass of fertiliser?

\_\_\_\_\_

1

- (c) What type of bacteria is found in the root nodules of the dwarf bean plants?

\_\_\_\_\_

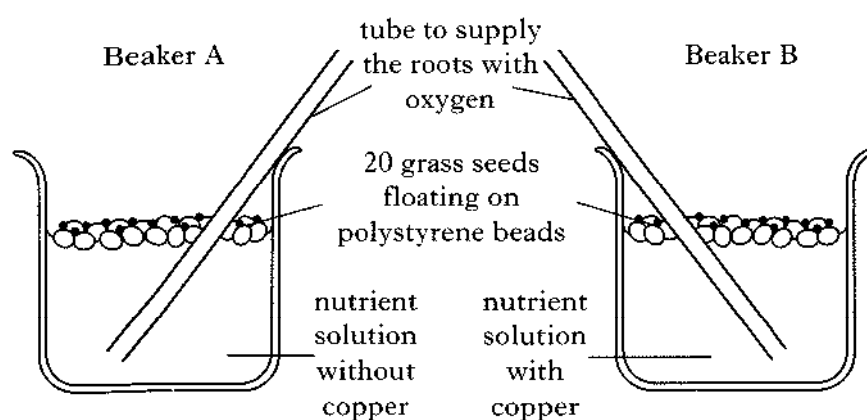
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5. (a) The experiment below was set up to investigate the effect of copper on the growth of one species of grass plant.



The length of the roots was measured every five days. The results are shown in the table.

Day	Average length of roots (mm)	
	Beaker A	Beaker B
0	0	0
5	13	9
10	15	13
15	19	13
20	22	14
25	30	18

- (i) Calculate the average increase in root length per day, during the 25 days, for the grass plants in Beaker A.

*Space for calculation*

Average increase in root length \_\_\_\_\_ mm per day.

1

- (ii) Calculate the simplest whole number ratio of average length on day 25 for the roots of the plants in Beaker A to those in Beaker B.

*Space for calculation*

\_\_\_\_\_ : \_\_\_\_\_  
Beaker A      Beaker B

1



2

(iii) Describe the difference which copper makes to the growth of the grass plants.

(iv) Beaker A is a control. What is the purpose of the control in this experiment?

(b) A similar experiment was carried out to investigate the effect of copper on the growth of a different species of grass plant.

State **two** precautions that would have to be taken to ensure that a valid comparison could be made between the two experiments.

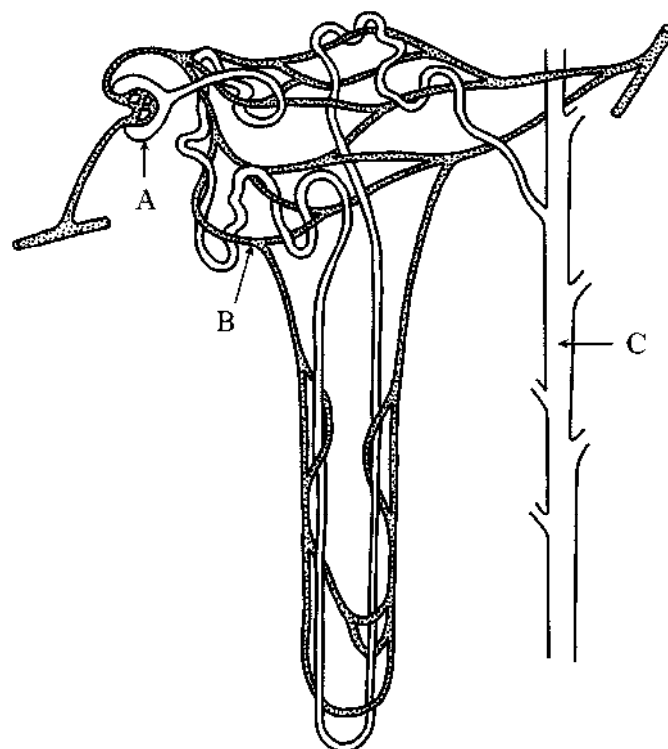
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(a) The diagram below represents a kidney nephron.



Complete the table by adding the correct letters, name and function.

Letter	Name	Function
	Collecting duct	Collects urine
A		Filters the blood
	Blood capillary	

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## 6. (continued)

- (b) Dialysis is a process by which waste products are removed from the blood. The following information refers to artificial dialysis used as treatment for kidney failure.

**Haemodialysis.** Blood is removed from a vein in the forearm and passed into a "kidney machine". A synthetic membrane separates the blood from dialysis fluid into which impurities from the blood diffuse. This treatment lasts for five hours and is required three times per week.

**Peritoneal Dialysis.** The natural membrane (called the peritoneum) lining the abdomen is used to filter waste from the blood vessels that surround the peritoneum. Three times each day, fluid is run through a plastic tube into the abdomen and left for four hours. The fluid is then drained out and fresh fluid is run in to continue the process.

- (i) Complete the table to summarise this information.

<i>Name of treatment</i>	<i>Type of membrane (natural or synthetic)</i>	<i>How often the treatment is required</i>

2

- (ii) One of the impurities removed from the blood is urea.  
From which food component is urea produced?

\_\_\_\_\_

1

- (iii) People with kidney failure can be given a kidney transplant. Give **one** benefit to the patient of having a kidney transplant compared to dialysis.

\_\_\_\_\_

1

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[illegible]

- 
- The diagram illustrates a bomb calorimeter setup. A central chamber contains a dried food sample (burning). This chamber is surrounded by water. A copper tube is coiled around the water, and a thermometer is inserted into the water to measure its temperature. A stirring rod is also present in the water. Labels with leader lines identify the thermometer, copper tube, water, stirring rod, and dried food sample (burning).

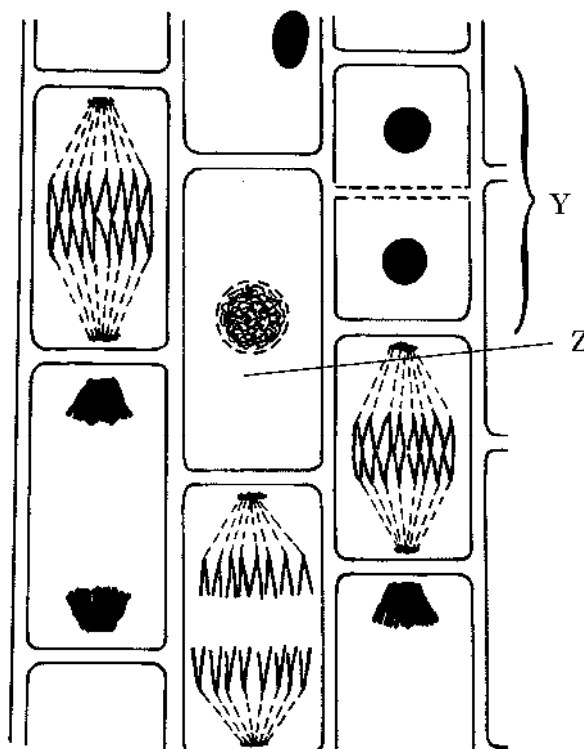
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- 1**

- 1

Each food sample had a dry weight of 5 g.

8. The drawing represents part of a root tip as seen under high magnification.



(a) (i) What name is given to the type of cell division that can be seen in some of the cells?

\_\_\_\_\_

1

(ii) Describe what is happening in cells Y and Z.

Cell Y \_\_\_\_\_

---

**1**

Cell Z \_\_\_\_\_

**Table 1** Demographic characteristics of study population

**1**

(iii) Daughter chromosomes produced by this type of cell division contain the same number of chromosomes as their parent cell. Explain the importance of this.

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000 1001 1002 1003 1004 1005 1006 1007 1008 1009 1010 1011 1012 1013 1014 1015 1016 1017 1018 1019 1020 1021 1022 1023 1024 1025 1026 1027 1028 1029 1030 1031 1032 1033 1034 1035 1036 1037 1038 1039 1040 1

**1**

(b) (i) The process of cell division is controlled by many specific enzymes. Explain the term *specific* as used in this context.

\_\_\_\_\_

**1**

- (ii) Enzymes have an optimum temperature and pH. Explain the meaning of the word *optimum*.

\_\_\_\_\_

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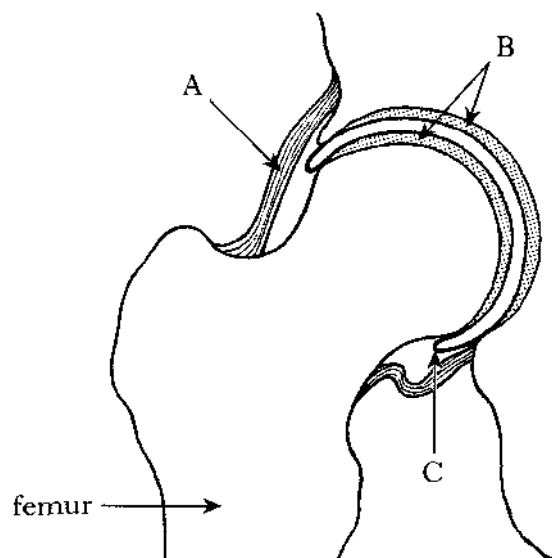
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9. The diagram shows a human hip joint.



- (a) Complete the table below by inserting the correct letters, name and functions.

Letter	Name	Function
B		cushions the bone
	synovial membrane	
	ligament	

2

- (b) Decide if each of the following statements about the breathing system is **True** or **False** and tick (✓) the appropriate box.

If the statement is **False**, write the correct word in the **Correction** box to replace the word underlined.

Statement	True	False	Correction
The trachea is supported by rings of <u>lignin</u> .			
The air passages are lined by tiny hair-like <u>cilia</u> .			
Special cells produce sticky <u>plasma</u> which prevents dust entering the lungs.			

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## 9. (continued)

- (c) The following statements refer to gas exchange between the blood capillaries and the air sacs in the lungs.

- 1 Carbon dioxide diffuses in.
- 2 Carbon dioxide diffuses out.
- 3 Oxygen diffuses in.
- 4 Oxygen diffuses out.

Complete the tables by inserting the number of each statement in the correct box.

<i>Air sacs</i>	

<i>Blood capillaries</i>	

1

- (d) The following grid contains terms which refer to parts of the nervous system.

A		B		C		D	
	spinal cord		touch receptor		relay nerve cell		medulla
E		F		G		H	
	cerebrum		cerebellum		motor nerve cell		sensory nerve cell

Use the letters from the grid to identify the following.

- (i) Part of the brain concerned with balance \_\_\_\_\_
- (ii) Structure which carries information from the sense organs \_\_\_\_\_
- (iii) Structure which carries information across the spinal cord during a reflex action \_\_\_\_\_
- (iv) Part of the brain which controls breathing and heart rates \_\_\_\_\_

2

[Turn over]

- All The Better To See You With**, adapted from J. Marsden, *Biological Sciences Review*, Vol 8, 1995

Glaucoma occurs when the pressure inside the eye rises above normal. If not controlled, the pressure can squeeze the blood vessels in the eye. The increased pressure is usually due to problems with the drainage of the aqueous humour rather than too much being made. The effect is that the optic nerve is damaged due to decreased blood flow and poor oxygen supply resulting in loss of vision.

Chronic glaucoma results from a small rise in pressure over a long period of time. Sufferers feel no pain but the optic nerve is slowly damaged and peripheral vision is gradually reduced. This type of glaucoma is often discovered during a routine eye test. Families of glaucoma sufferers are able to obtain free eye tests. Drugs, in the form of eye drops, are used to increase the drainage of aqueous humour.

Acute glaucoma is a massive and rapid increase in the internal pressure of the eyeball caused by the iris blocking the drainage mechanism of the aqueous humour. It causes severe pain and loss of vision. A laser beam is used to form a hole in the iris to make a new drainage channel. People tend to get one type of glaucoma or the other, but not both.

- (a) Why must the fluid of the aqueous humour be clear?

1

- (b) How will carbon dioxide, produced by the respiring tissue of the cornea, be removed from the cornea?

1

- (c) What is the usual cause of increased pressure in the eyeball?

1

(d) Explain how an increase in pressure inside the eye can cause damage to the optic nerve.

**1**

- (e) What information in the passage suggests that glaucoma has a genetic component?

1

- (f) Describe **one** difference between chronic glaucoma and acute glaucoma.

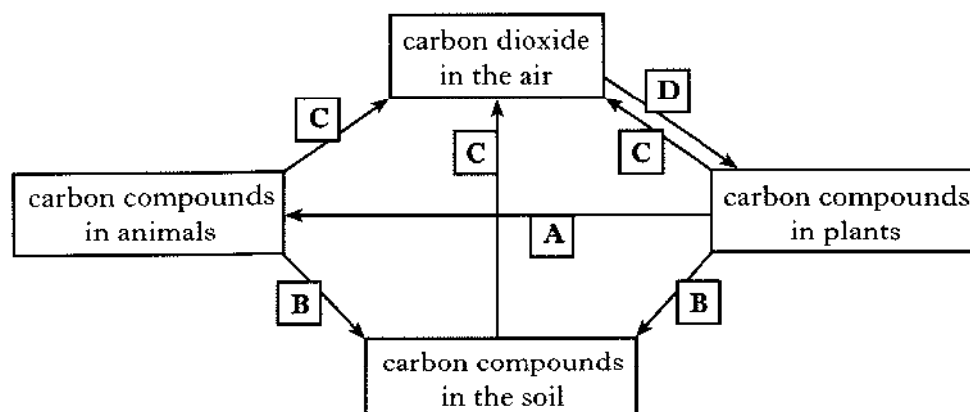
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11. The diagram below shows part of the carbon cycle.



- (a) Use **one** letter from the diagram to identify each of the stages in the table below.

Stage	Letter
photosynthesis	
death and decay	
respiration	

- (b) Name a type of organism responsible for process B.

\_\_\_\_\_

- (c) The following statements refer to the use of fossil fuels and nuclear fuels.

- 1     Contributes to acid rain.
- 2     Fuel supply likely to run out.
- 3     Waste material must be sealed in lead containers.
- 4     Releases carbon dioxide into the atmosphere.

Which statements refer to fossil fuels?

*Tick the correct box.*

- 1 and 2 only     ☐
- 2 and 3 only     ☐
- 1, 2 and 3       ☐
- 1, 2 and 4       ☐

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12. In dogs, the difference between a coat which is the same colour all over, and a coat which has blotches of colour, is controlled by different forms of the same gene.

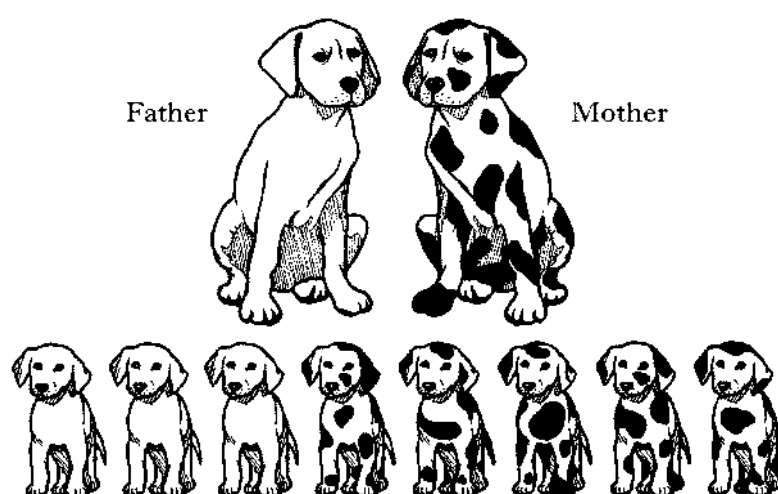
**B** (dominant) causes a blotched coat pattern and **b** (recessive) causes the same colour all over.

- (a) What name is given to the different forms of the same gene?

\_\_\_\_\_

1

- (b) A dog with the same coat colour all over mates with a blotched one. They have eight puppies, of which five have blotched coats and three are the same colour all over.



- (i) What are the genotypes of the parent dogs?

Father \_\_\_\_\_ Mother \_\_\_\_\_

2

- (ii) The predicted proportion of coat colours was equal numbers of each type. Explain why the actual numbers were different.

\_\_\_\_\_  
\_\_\_\_\_

1

- (c) Predict the genotypes and phenotypes of the puppies which would be produced if both parents had the same coat colour all over.

Genotype(s) \_\_\_\_\_

Phenotype(s) \_\_\_\_\_

2

- (d) Is the variation in the dogs' coat pattern caused by the gene, continuous or discontinuous?

\_\_\_\_\_

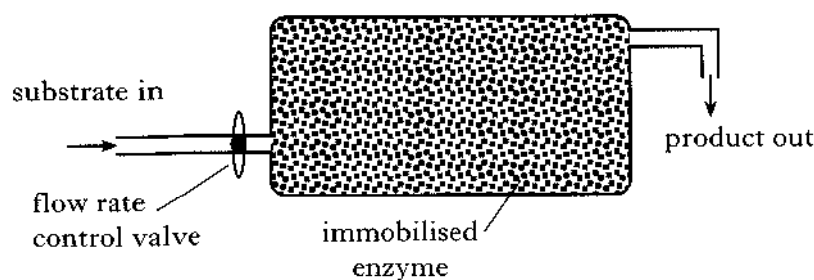
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13. Sugar can be produced from starch using an immobilised enzyme in the apparatus shown in the diagram below.



- (a) (i) What is meant by the word "immobilised" in connection with enzymes?

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- (ii) Describe **one** advantage of using immobilised enzymes.

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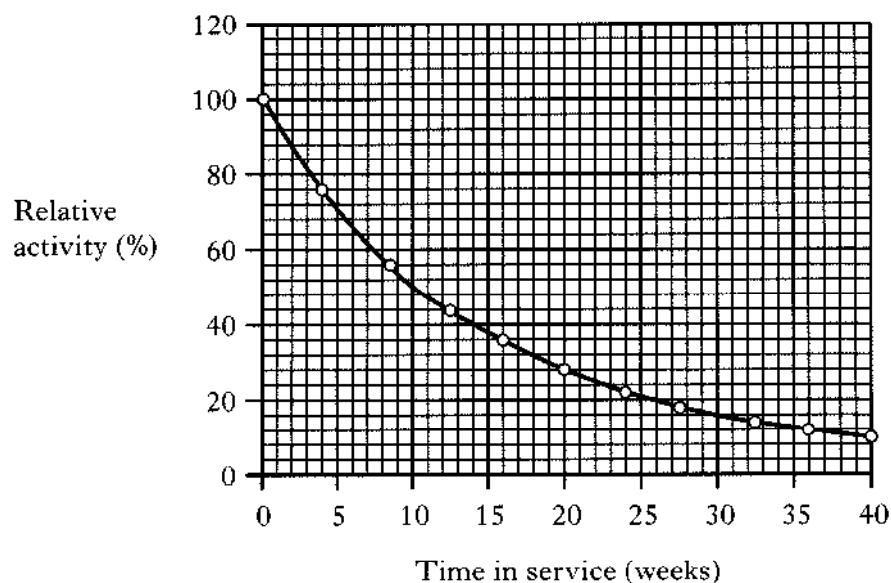


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- (b) Immobilised enzymes lose some of their activity over time. The graph shows the results of tests on the effectiveness of one immobilised enzyme produced by a Scottish company.

The tests were carried out at a temperature of 40 °C.



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14. The table gives information about the composition of some fatty foods.

<i>Food</i>	<i>Fat</i> (g per 100g)	<i>Cholesterol</i> (mg per 100g)
Pork sausage	25	60
Cheddar cheese	36	80
Low fat spread	82	0
Butter	84	225
Milk	4	15
Egg	12	450

- (a) Express as a simple whole number ratio the mass of fat for milk, cheddar cheese and butter.

*Space for calculation*

\_\_\_\_\_ : \_\_\_\_\_ : \_\_\_\_\_  
milk            cheddar       butter  
                  cheese

1



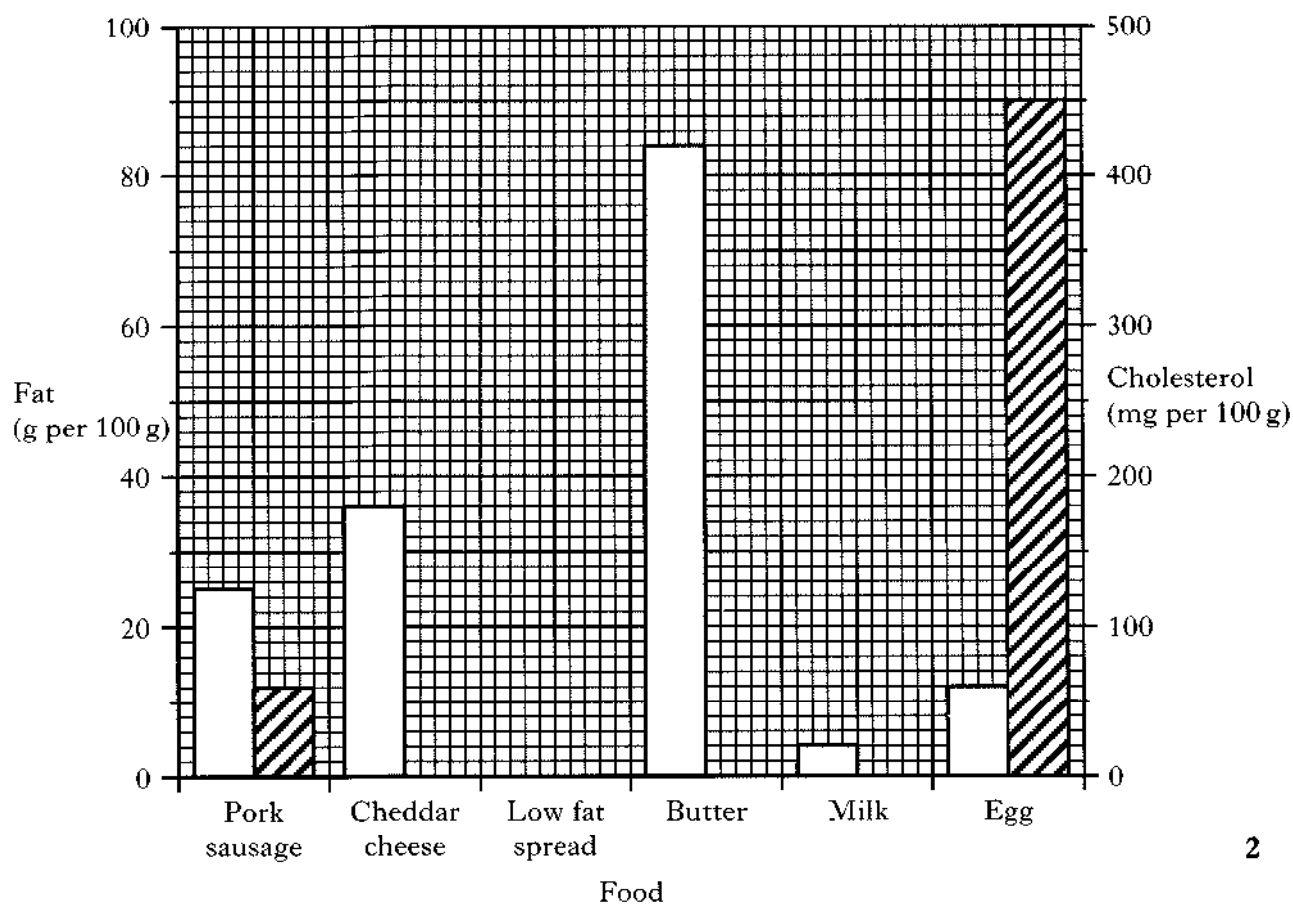
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## 14. (continued)

- (b) Complete the bar chart using information from the table.  
(An additional grid, if needed, will be found on page 28.)

- Fat (g per 100 g)  
▨ Cholesterol (mg per 100 g)



2

- (c) What is the main difference in composition between low fat spread and butter?

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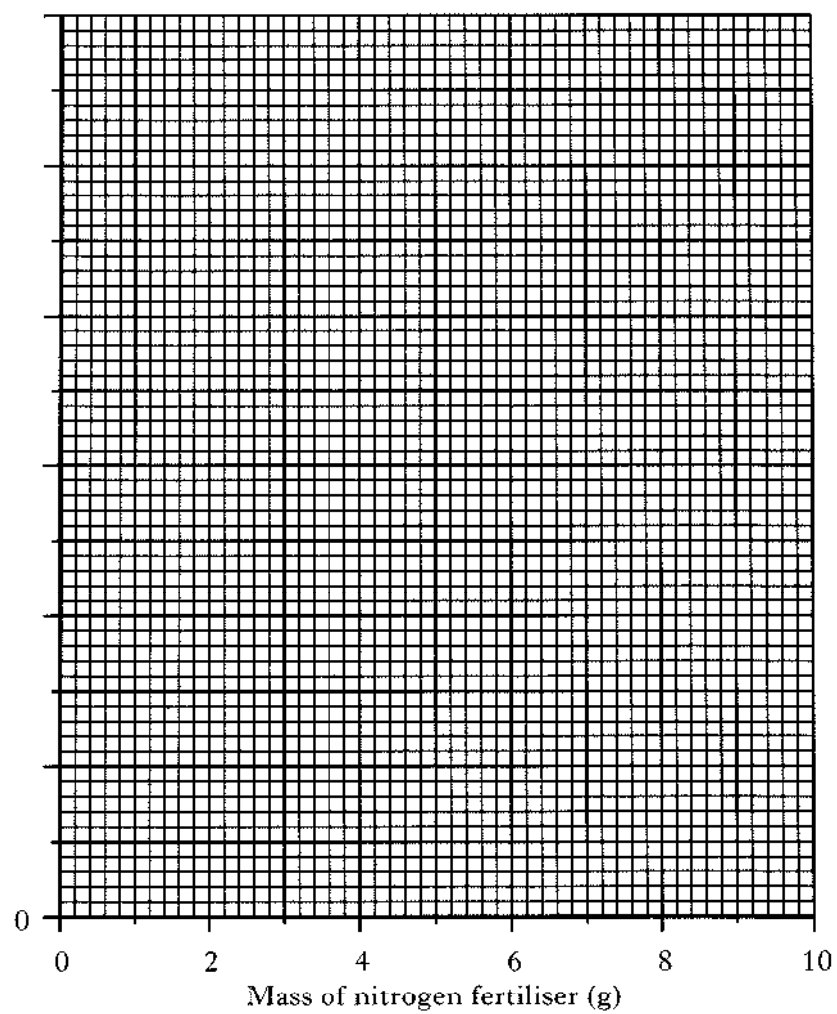
- | <i>Species</i> | <i>Size of scales</i> | <i>Number of dorsal fins</i> | <i>Barbels</i> |
|----------------|-----------------------|------------------------------|----------------|
| Burbot         | small                 | two                          | present        |
| Pike           | large                 | one                          | absent         |
| Eel            | small                 | one                          | absent         |
| Grayling       | large                 | two                          | absent         |
| Miller's thumb | small                 | two                          | absent         |

1 Large scales ..... go to 2  
Small scales ..... go to 3

- 2 One dorsal fin.....
- Two dorsal fins.....
- 3 Barbels present .....
- ..... go to 4
- 4 ..... Eel
- ..... Miller's thumb

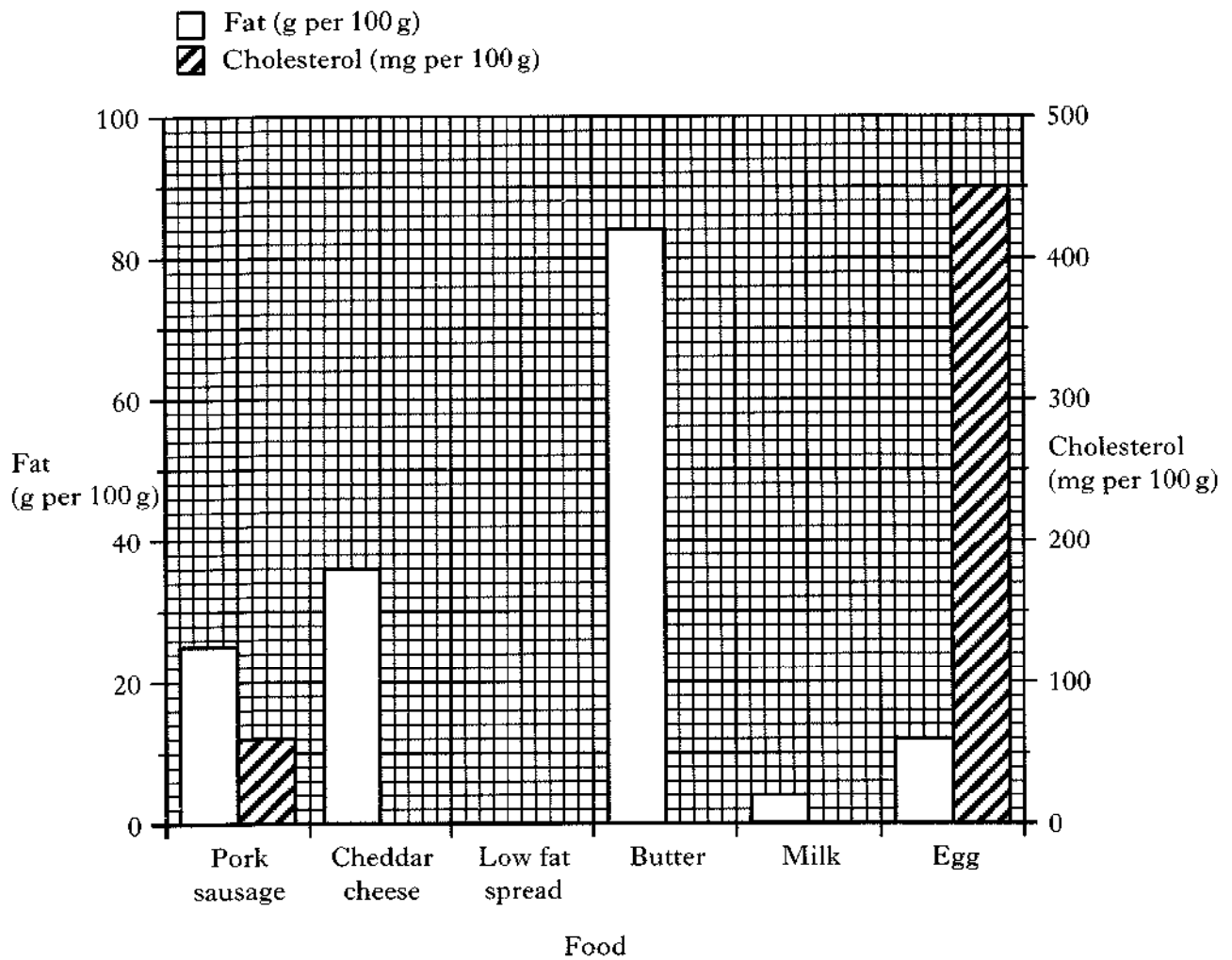
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ADDITIONAL GRAPH PAPER FOR QUESTION 4(a)(i)



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ADDITIONAL GRID FOR QUESTION 14(b)



SPACE FOR ANSWERS  
AND FOR ROUGH WORKING

SPACE FOR ANSWERS  
AND FOR ROUGH WORKING

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