# East Spring Secondary School

*Towards Excellence and Success*

**Name:** ..... (  )

**Class:** .....

## Second Semestral Assessment 2019
## Secondary 2 Express

## Science

**4 October 2019**
**Friday**

**2 hours**
**0800 - 1000**

Additional materials:
1 sheet of OTAS

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**INSTRUCTIONS TO CANDIDATES**

Write your name, class and register number in the spaces provided above, and on all the work you hand in.
Write in dark blue or black pen.
You may use a soft pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.
Calculators and mathematical sets are allowed.

**Section A [30 marks]**
Answer **all** questions in soft pencil on the OTAS.

**Section B [30 marks]**
Answer **all** questions.
Write your answers in the spaces provided.

**Section C [40 marks]**
Answer question **C1** and **any three** of the other four questions.
Write your answers in the spaces provided.

A copy of the Periodic Table is given on page 27.
The number of marks is given in brackets [ ]
at the end of each question or part question.

| Section | Marks |
|---|---|
| A | / 30 |
| B | / 30 |
| C | / 40 |
| Total: | / 100 |

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This question paper consists of **27** printed pages including the cover page.

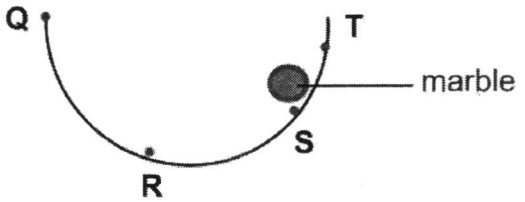
## Section A [30 marks]

Answer **all** the questions on the OTAS provided.

**A1** 200 kJ of electrical energy is supplied to the television. What would happen to this amount of energy when it is turned off?

**A** The energy is destroyed.
**B** It is given out to the surroundings mainly as heat energy.
**C** It returns to the power supply.
**D** It remains in the television as stored energy.

**A2** A marble is allowed to roll to and fro in a bowl as shown below. Both the marble and bowl have highly polished surfaces.



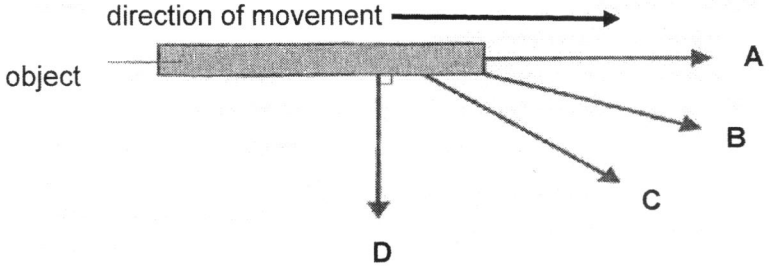

Assuming that there is no friction, which of the statements about the energy of the marble at the four different positions (**Q**, **R**, **S** and **T**) is correct?

**A** The gravitational potential energy in the marble at **S** is higher than at **T**.
**B** The marble has lower kinetic energy at position **R** and **S**.
**C** The marble has the highest gravitational potential energy at position **Q**.
**D** The marble at position **T** has no energy and will remain there.

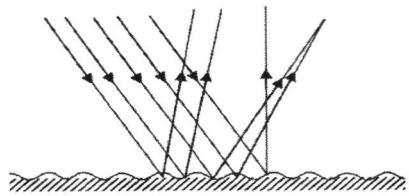
**A3** Which of the following correctly classifies the sources of energy as renewable and non-renewable?

| | renewable | non-renewable |
|---|---|---|
| **A** | hydroelectric energy | wind energy |
| **B** | wind energy | natural gas |
| **C** | coal | wind energy |
| **D** | natural gas | coal |

**A4** The diagram below shows the direction of movement and the direction of force applied on an object. The direction of the object movement is horizontal. Which position of the force applied would result in no work done on the object in the horizontal direction?



**A5** The diagram below shows a beam of light undergoing irregular reflection.



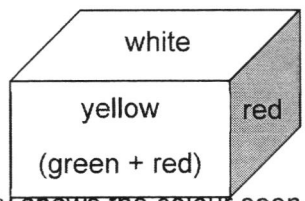
Which of the following statement about irregular reflection is true?

**A** A sharp image is formed.
**B** It occurs on a smooth surface.
**C** The angle of incidence is always equal to the angle of reflection.
**D** The incident ray, reflected ray and normal do not lie on the same plane.

**A6** Which of the following shows the correct properties of the images formed by the two types of curved mirrors?

| | convex mirror | concave mirror |
|---|---|---|
| **A** | wider field of vision | smaller field of vision |
| **B** | wider field of vision | wider field of vision |
| **C** | virtual | wider field of vision |
| **D** | wider field of vision | inverted |

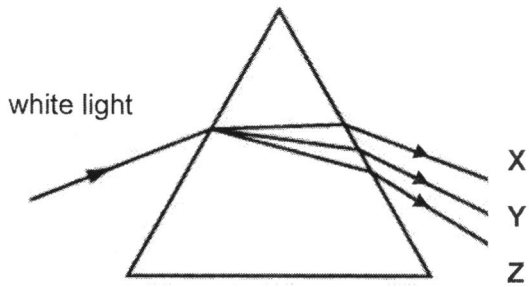
**A7** Three surfaces of a large block are painted with white, yellow and red as shown.




Which of the following correctly shows the colour seen under blue light?

| | white surface | yellow surface | red surface |
|---|---|---|---|
| **A** | blue | black | black |
| **B** | blue | white | red |
| **C** | white | black | white |
| **D** | white | yellow | black |

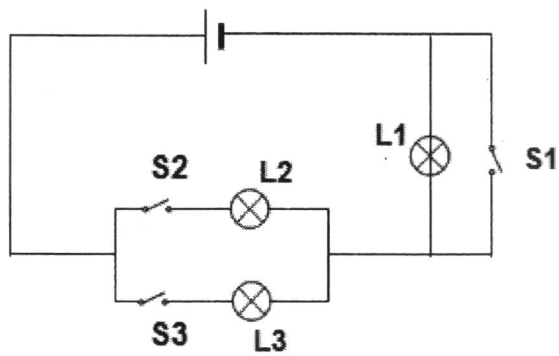
**A8** A colour spectrum is formed when white light passes through a prism.




What are the colours of **X**, **Y** and **Z**?

| | X | Y | Z |
|---|---|---|---|
| **A** | violet | red | orange |
| **B** | violet | orange | red |
| **C** | red | violet | orange |
| **D** | red | orange | violet |

**A9** In the circuit diagram below, **S1**, **S2** and **S3** are switches. **L1**, **L2** and **L3** are identical bulbs with the same resistance.

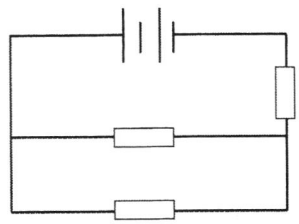



Which statement about the circuit is correct?

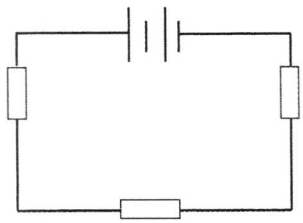
**A** The three bulbs will light up when **S1** and **S2** are closed.
**B** The three bulbs will light up when **S1** and **S3** are closed.
**C** The three bulbs will light up when **S2** and **S3** are closed.
**D** The three bulbs will light up when **S1**, **S2** and **S3** are closed.

**A10** Three identical resistors are used in four different electric circuits. Which electric circuit has the lowest total resistance?

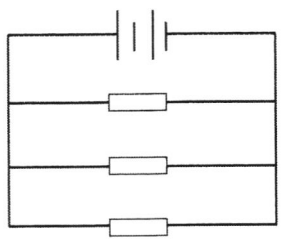
A



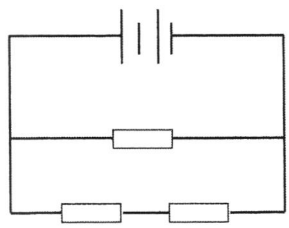
B



C



D



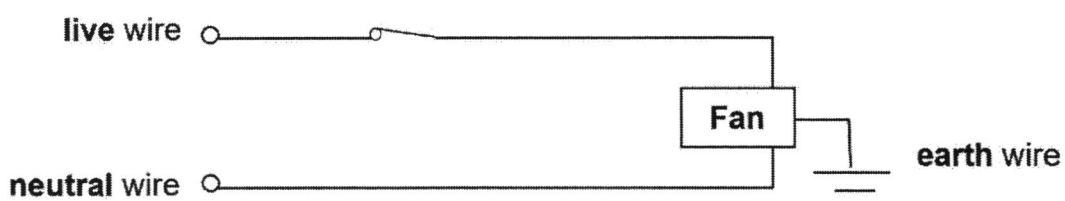
**A11** An electric kettle is commonly used to heat up water at home. The heating element used nichrome wire instead of copper. Which of the following best explains this?

**A** Nichrome conducts more current than copper, so more heat can be generated.
**B** Nichrome has higher resistance than copper, so more heat can be generated,
**C** Nichrome has higher voltage than copper, so more heat can be generated.
**D** Nichrome are cheaper than copper, so it is more economical.

**A12** Which of the following is not considered as an electrical hazard?

**A** Drying the hands before turning on a switch.
**B** Turning on a switch before plugging into a socket.
**C** Poking scissors into an electrical socket.
**D** Plugging more than one electrical appliance into the same socket.

**A13** The diagram below shows a working fan when it is switched on.




What should be the current flowing in each of the wire if the fan is working properly?

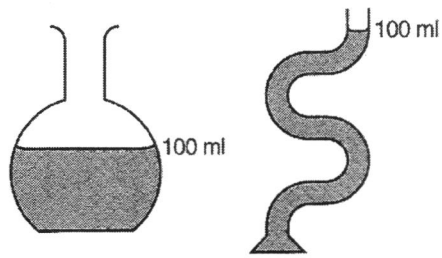
| | earth | live | neutral |
|---|---|---|---|
| **A** | 0 A | 10 A | 0 A |
| **B** | 0 A | 10 A | 10 A |
| **C** | 10 A | 10 A | 0 A |
| **D** | 10 A | 10 A | 10 A |

**A14** Which of the following is true when a substance is heated?

1 The particles move faster.
2 The particles move further.
3 The size of particles increases.
4 The particles become lighter.

**A** 1 and 2 **B** 1, 2 and 4 **C** 2, 3 and 4 **D** 1, 2, 3 and 4

**A15** Ashley poured some water into two containers so that each contains 100 ml of water. This is shown in the diagrams below. What can be infered from them?




1 Liquid has a fixed volume.
2 Liquid has a variable volume.
3 Liquid has a fixed shape.
4 Liquid has a variable shape.

**A** 1 and 2 **B** 1 and 3 **C** 1 and 4 **D** 2 and 4

**A16** What would happen to helium particles in a balloon when the balloon is compressed?

**A** Helium particles shrink in size.
**B** Helium particles arrange in a regular pattern.
**C** Helium particles have less space between each other.
**D** Helium particles vibrate only at their fixed positions.

**A17** What is the correct charge on each particle in an atom?

| | proton | electron | neutron |
|---|---|---|---|
| **A** | positive | negative | no charge |
| **B** | negative | no charge | positive |
| **C** | positive | negative | negative |
| **D** | negative | positive | positive |

**A18** Which of the following options is correct?

| | molecule of a compound | molecule of an element |
|---|---|---|
| **A** |  |  |
| **B** |  |  |
| **C** |  |  |
| **D** |  |  |

**A19** Which of the following substances contains the least number of elements?

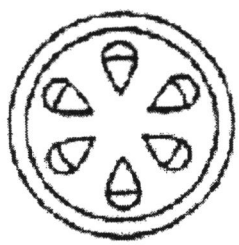
**A** $SiO_2$ **B** KOH **C** $KMnO_4$ **D** $NaSO_4$

**A20** Which statement is true about diffusion?

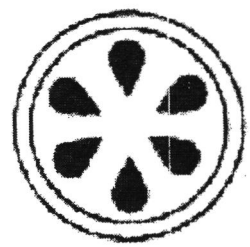
**A** Diffusion requires the presence of a partially permeable membrane.
**B** Diffusion only takes place in living tissues.
**C** Diffusion involves movement of substances against a concentration gradient.
**D** Diffusion is faster when the surface area to volume ratio of the cell increases.

**A21** A cross section of a plant stem is dipped in dark blue ink solution. Which diagram would be observed from the stem after two hours?

**A**

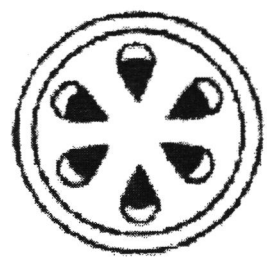


**B**

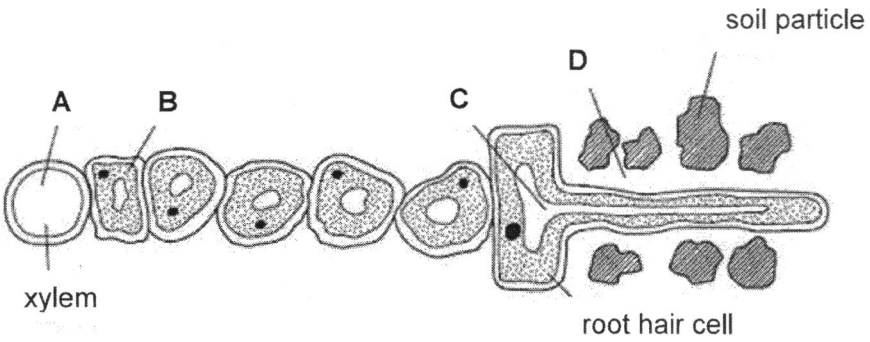


**C**

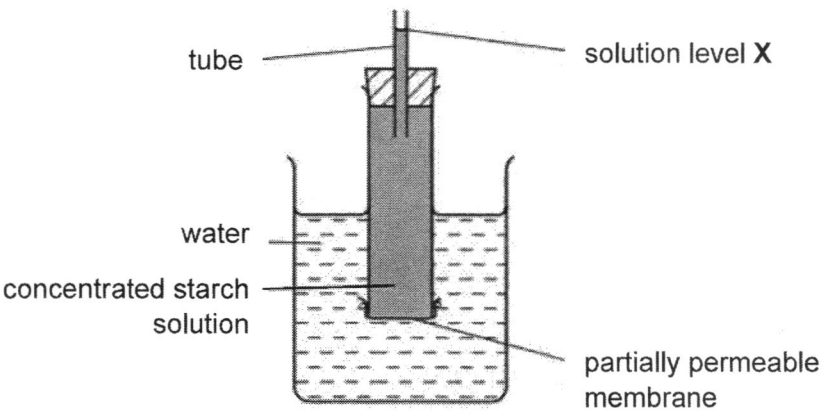
**D**



**A22** The diagram shows part of a plant root in the soil. At which labelled point is the water potential highest for the root to take in water?




**A23** The set-up below is used to investigate the movement of substances.




Which molecules will move across the partially permeable membrane and what is the change that will occur to the level of solution **X**?

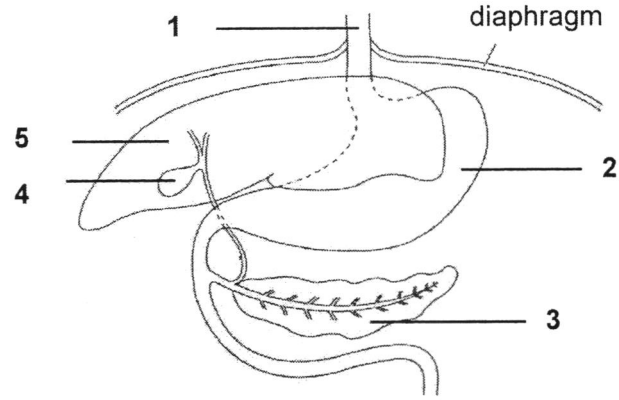
| | molecules | solution level **X** |
|---|---|---|
| **A** | starch | fall |
| **B** | starch | rise |
| **C** | water | fall |
| **D** | water | rise |

**A24** Which substances are transported by blood plasma?

1 carbon dioxide
2 hormones
3 nutrients
4 waste materials
5 oxygen

**A** 1 and 3 only
**B** 2, 3, and 4
**C** 1, 2, 3 and 4
**D** 1, 2, 3, 4 and 5

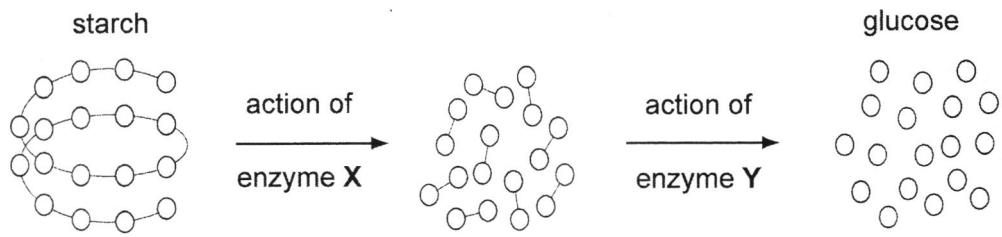
**A25** The diagram shows part of the human alimentary canal.




Which two structures produced substances involved in the digestion of proteins?

**A** 1 and 4
**B** 2 and 3
**C** 3 and 5
**D** 4 and 5

**A26** The diagram shows the stages in which a starch molecule is broken down to glucose.




What are enzymes **X** and **Y**?

| | enzyme **X** | enzyme **Y** |
|---|---|---|
| **A** | amylase | protease |
| **B** | amylase | maltase |
| **C** | protease | maltase |
| **D** | protease | lipase |

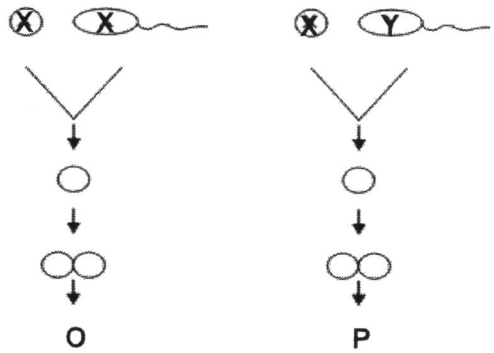
**A27** The table below shows the protein, fat and carbohydrate content in 10g of rice and white fish.

| food | protein/g | fat/g | carbohydrate/g |
|---|---|---|---|
| white fish | 1.7 | 0.0 | 0.0 |
| rice | 0.5 | 0.1 | 8.8 |

What would be the main end-products of the digestion of a meal of rice and white fish?

**A** simple sugars and fats
**B** fatty acids and simple sugars
**C** amino acids and glycerol
**D** amino acids and simple sugars

**A28** The diagram below shows the formation of a set of twins.




Which of the following correctly describes the pair of twins?

| | description | gender | |
|---|---|---|---|
| | | O | P |
| **A** | identical twins | male | female |
| **B** | Identical twins | female | male |
| **C** | non-identical twins | female | male |
| **D** | non-identical twins | male | female |

**A29** Which contraceptive method does not prevent fertilisation process from taking place?

**A** diaphragm
**B** intra-uterine device
**C** tubal ligation
**D** vasectomy

**A30** Which precautions should be taken to prevent the spread of HIV?

1 avoidance of any direct skin contact with another person
2 keep to one unaffected sexual partner
3 medical staff wearing gloves when treating patients
4 take birth control pills
5 do not share injection needle

**A** 1 and 3 **B** 2 and 3 **C** 1, 3 and 4 **D** 2, 3 and 5

**End of Section A**

## Section B [30 marks]

Answer **all** the questions in the space provided.

**B1 (a)** Fig B1.1 is a diagram of a big letter '**L**' placed in front of a plane mirror as shown below. A spot, **X**, is marked on top of the letter.

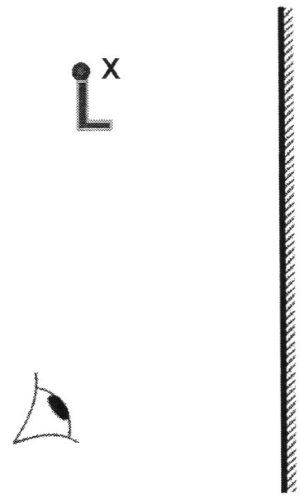



**Fig B1.1**

On Fig B1.1 draw

**(i)** the image of letter '**L**', as seen by the eye, **[1]**

**(ii)** the path of two rays of light leaving point X and then reflecting at the mirror before entering the eye to allow the eye to see image of letter '**L**'. **[2]**

**(b)** An optician's test panel is located 0.5 m behind the eyes of a patient who looks into a plane mirror 2.5 m in front of him, as shown in Fig B1.2 below.

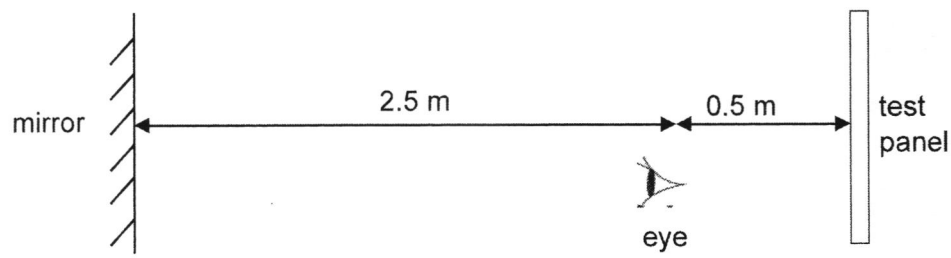



**Fig B1.2**

Calculate the distance of the image of the test panel in the mirror from the patient's eyes. Show your working clearly.

distance : .....m **[1]**

**B2** A tank containing a toy fish has accidentally toppled off from a cruise ship and landed in the seawater. The tank is made of a transparent material **Y** and has a toy fish within an enclosed space containing liquid **X**, as shown in Fig B2.1

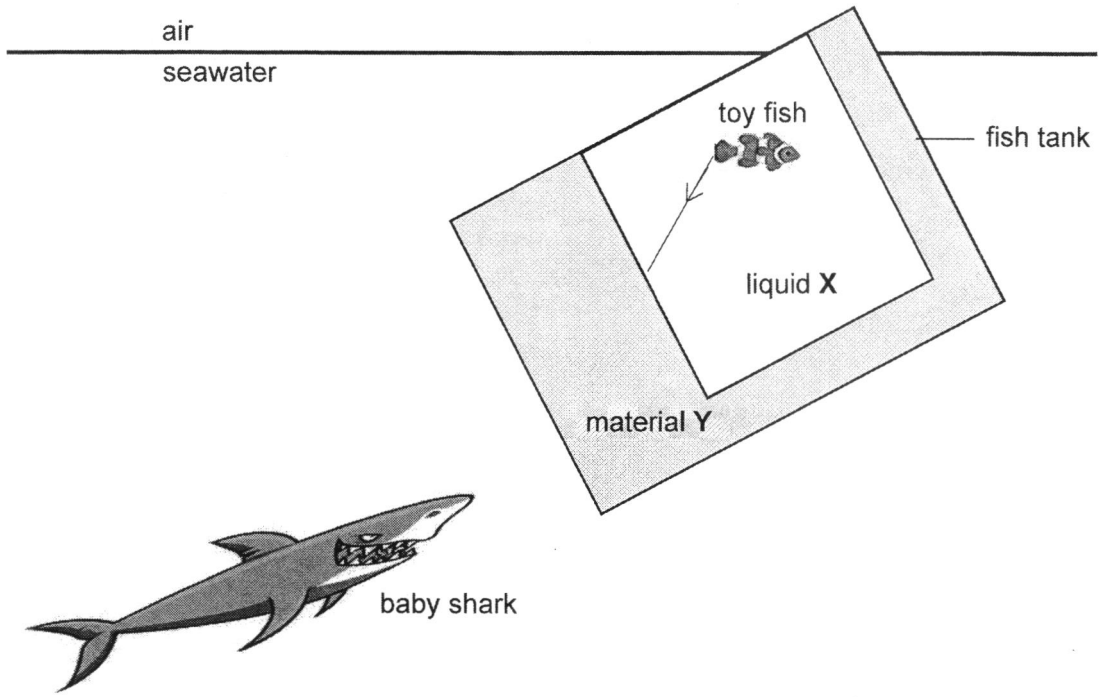



**Fig B2.1**

A baby shark swimming near the fish tank is able to see the toy fish inside the tank.

Of the three optical media, material **Y** has the highest optical density, followed by seawater and then liquid **X**.

**(a)** Describe and explain how the given ray in Fig B2.1 will bend when it travels from liquid **X** to material **Y**.

.....

.....

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

**(b)** An incident ray has been drawn from the toy fish to the interface between liquid **X** and material **Y**. On Fig B2.1,

**(i)** measure and label the angle of incidence of the given ray. **[1]**

**(ii)** continue the path of the ray to show how the ray emerges from the fish tank to reach the eye of the baby shark. **[2]**

**B3** Fig B3.1 shows two 10 Ω resistors connected in parallel in a circuit. The reading on the ammeter shows 3.0 A.

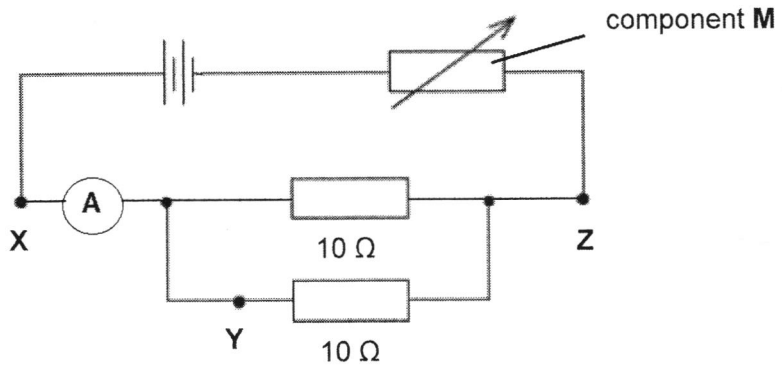



**Fig B3.1**

**(a)** Name component **M**.

.....**[1]**

**(b)** State the current flowing through **Y**.

.....**[1]**

**(c)** Calculate the total effective resistance of the two 10 Ω resistors.

resistance : ..... Ω **[1]**

**(d)** Calculate the potential difference across each 10 Ω resistor.

potential difference : ..... V **[1]**

**(e)** Explain what will happen to the current flowing through the ammeter if another 10 Ω resistor is connected in parallel to the two other resistors.

.....

.....**[1]**

**B4** **(a)** Fig B4.1 shows a section through a blood vessel in the tissue cells of the hand.

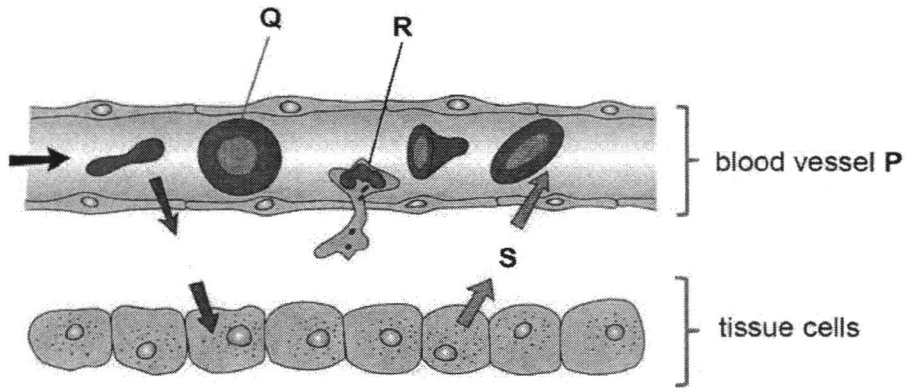



**Fig B4.1**

Identify **P**, **Q**, **R** and **S**.

**P**: ..... **Q**: .....

**R**: ..... **S**: ..... **[2]**

**(b)** Fig B4.2 shows a section of the human heart.

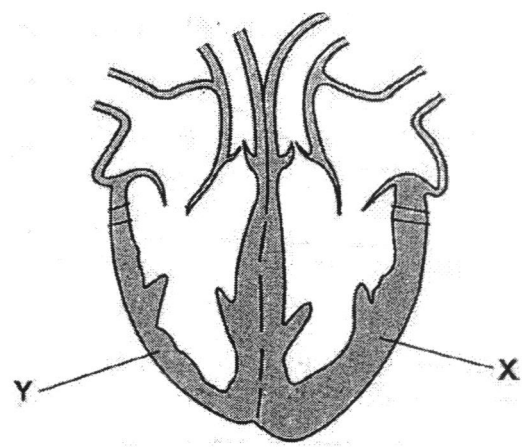



**Fig B4.2**

**(i)** Explain why the wall at **X** is thicker than the wall at **Y**.

.....

.....

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

**(iii)** On Fig B4.2, use 4 arrows to show the direction of blood flow in and out of the heart. **[2]**

**B5** Fig B5.1 shows the male and female reproductive systems.

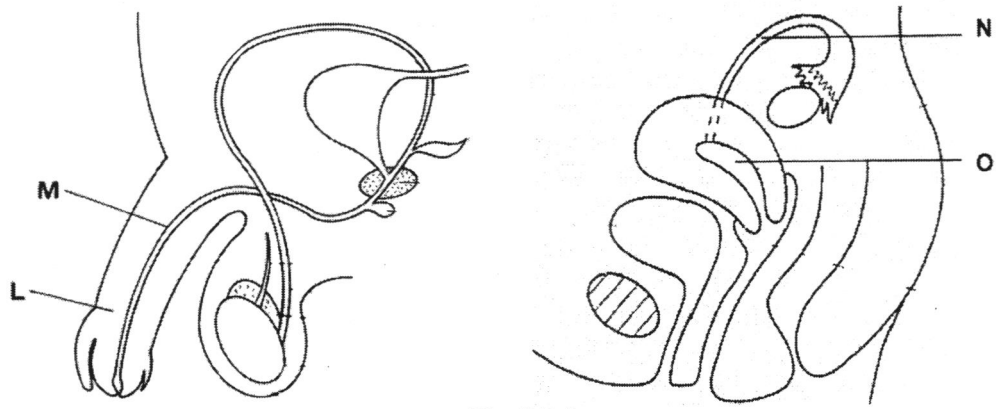



**Fig B5.1**

**(a)** **(i)** Identify parts **L** to **O**.

**L**: ..... **M**: .....

**N**: ..... **O**: ..... **[4]**

**(ii)** Name the organ that produces the male sex hormones.

.....**[1]**

**(b)** Fig B5.2 below shows the calendar of August and September 2019. It was used to track the menstrual cycle of a female. She had the first day of menstruation on 4th August (bolded and with *).

| August 2019 | | | | | | |
|---|---|---|---|---|---|---|
| **Sun** | **Mon** | **Tue** | **Wed** | **Thu** | **Fri** | **Sat** |
| | | | | 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 |

| September 2019 | | | | | | |
|---|---|---|---|---|---|---|
| **Sun** | **Mon** | **Tue** | **Wed** | **Thu** | **Fri** | **Sat** |
| 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 | | | | | |

**Fig B5.2**

**(i)** Assuming the female has a 28-day menstrual cycle, state the range of dates in August she should avoid sexual intercourse to prevent pregnancy.

.....**[1]**

**(ii)** Explain your answer in **(i)**.

.....

.....

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

**(iii)** Circle the date of the start of the next menstruation in September. **[1]**

**(iv)** State what happens to the uterine lining after the fertile period if she gets pregnant?

.....**[1]**

**End of Section B**

## Section C [40 marks]

Answer **C1 and any three** questions in the space provided.

**C1** Table C1.1 shows the melting and boiling points of some elements in Group VII of the periodic table. Group VII elements have 7 valence electrons.

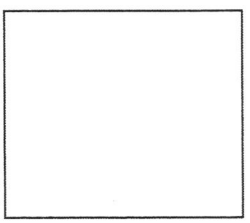
| element | melting point/ °C | boiling point/ °C | state at room temperature |
|---|---|---|---|
| **X** | -110 | -34 | |
| bromine | -7 | 59 | liquid |
| iodine | 114 | 184 | |

**Table C1.1**

**(a)** Complete Table C1.1 to show the physical states of the elements at room temperature.

**[2]**

**(b)** In the box below, draw the arrangement of molecules of bromine at 60°C.



**[1]**

**(c)** Draw the 'dot and cross' diagram of an iodide ion. Show only the outermost electrons.

**[2]**

Fig C1.2 shows the mass spectrometry of isotopes of element **X**. Isotopes are atoms of the same element with the same number of protons but different number of neutrons in the nucleus. Mass spectrometry is a technique that analyses the relative abundance of isotopes in the air.

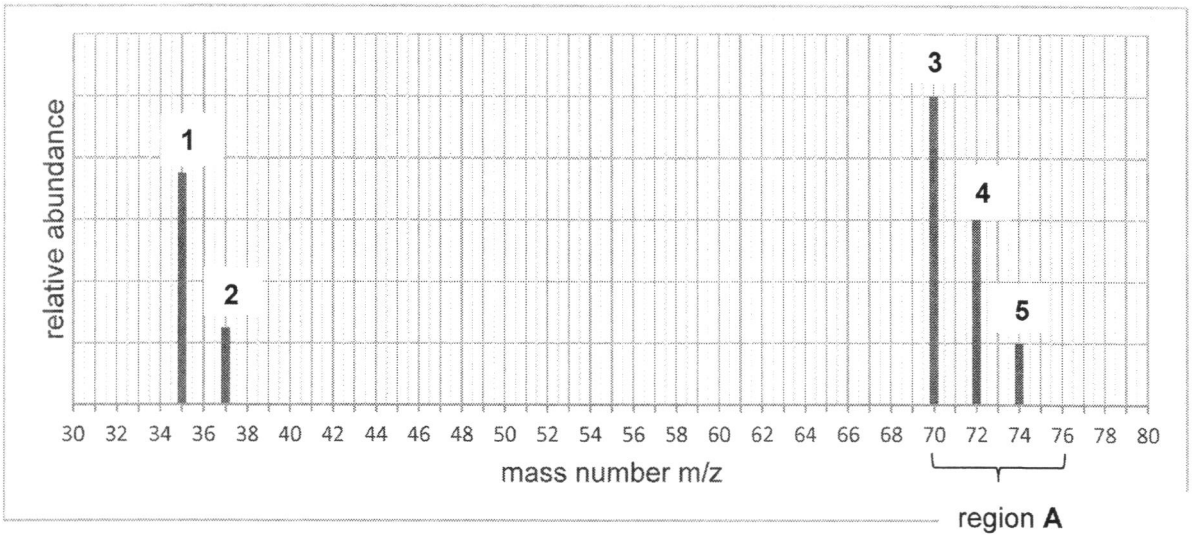



**Fig C1.2**

**(d) (i)** With reference to Fig C1.2, complete Table C1.3 showing the mass number of the substance at the respective peaks.

| peak number | mass number m/z |
|---|---|
| 1 | 35 |
| 2 | |
| 3 | |
| 4 | |
| 5 | |

**Table C1.3** **[2]**

**(ii)** Hence, deduce the identity of element X.

.....**[1]**

**(e)** Using your knowledge of atoms and molecules, explain why there are 3 peaks shown region **A**.

.....

.....

.....

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

**C2** A solar power station is designed for use in desert countries. The flow chart in Fig C2.1 shows the steps involved in the production of electricity.

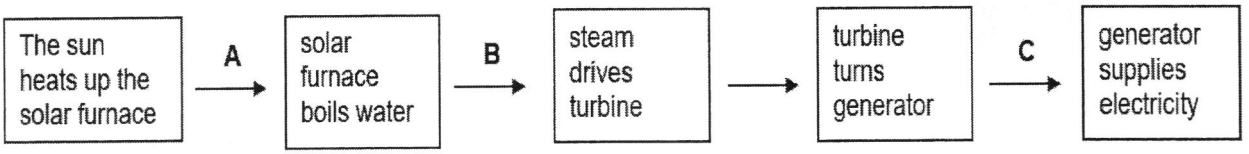



**Fig C1.1**

**(a) (i)** With reference to Fig C2.1, list the energy conversion that takes place at **A**, **B** and **C** in process of electricity generation as shown in the flow chart.

**A**: .....**[1]**

**B**: .....**[1]**

**C**: .....**[1]**

**(ii)** Suggest one advantage of using the solar power station in the production of electricity.

.....**[1]**

The solar furnace consists of many mirrors as shown in Fig C2.2.

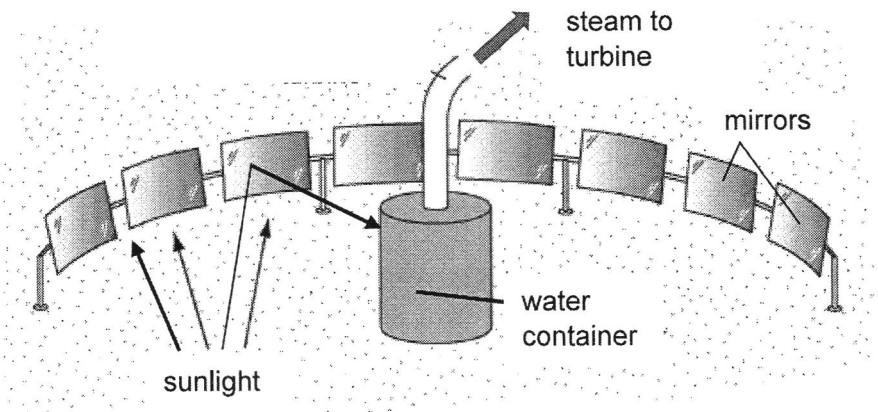



**Fig C2.2**

**(b) (i)** Suggest the type of mirrors used in the solar furnace.

.....**[1]**

**(ii)** Explain your answer in (b)(i) and how it is important in stages **A** and **B** of Fig C2.1.

.....

.....

.....

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

**(c)** Using The Particulate Nature of Matter, describe the arrangement and movement of the water molecules when water is heated to steam in the process of electricity generation.

.....

.....

.....

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

**C3** Shane cut and weighed five similar-sized potato strips. He placed each strip in salt solution of different concentrations for 60 minutes. He then re-weighed each potato strip and tabulated the results in Table C3.1.

| salt concentration/ mol/dm$^3$ | mass of potato/ g | | change in mass (final- initial)/ g |
|---|---|---|---|
| | initial | final | |
| 0.0 | 6.00 | 6.80 | +0.80 |
| 0.2 | 6.00 | 6.50 | |
| 0.4 | 6.00 | 6.18 | |
| 0.6 | 6.00 | 5.90 | |
| 0.8 | 6.00 | 5.60 | |
| 1.0 | 6.00 | 5.35 | -0.65 |

**Table C3.1**

**(a)** Complete Table C3.1 for the values of the change in mass. **[2]**

**(b)** **(i)** Describe the appearance of a cell in the potato strip placed in the 1.0 mol/dm$^3$ salt solution under the microscope.

.....**[1]**

**(ii)** In the space below, draw and label the cell you described in (b)(i).

**[2]**

Shane plotted a graph of change in mass against concentration of salt solution graph as shown in Fig C3.2 below.

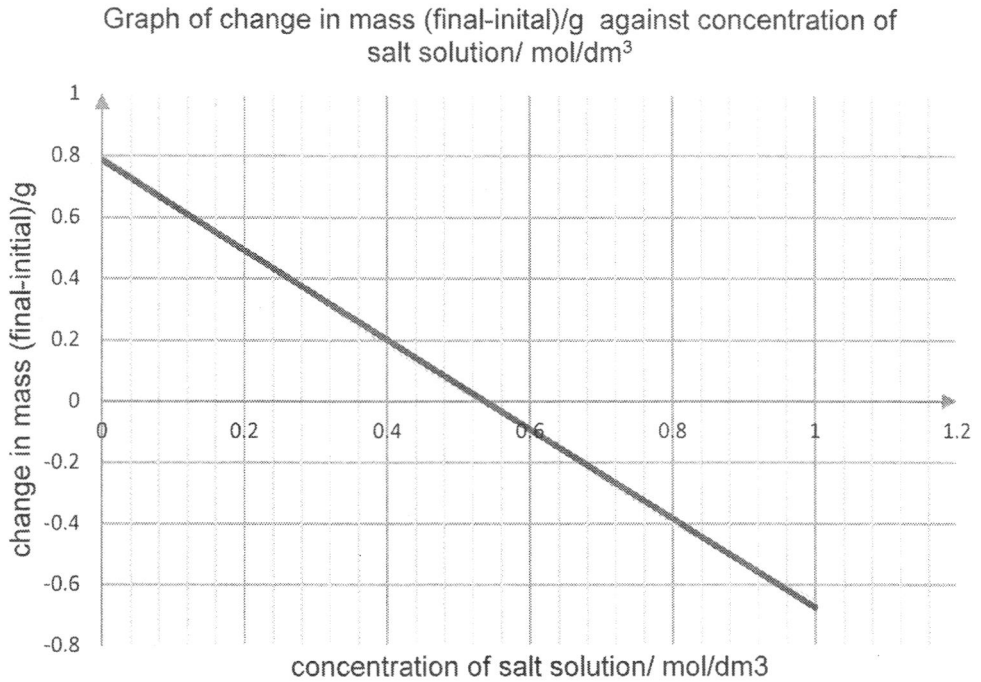



**Fig C3.2**

**(c) (i)** From the graph, deduce the concentration of the potato strip which has a similar water potential as the salt solution.

..... mol/dm$^3$ **[1]**

**(ii)** Explain your answer in (c)(i).

.....

.....**[1]**

**(d)** Explain why the mass changed when the potato strips were added to 0.2 mol/dm$^3$ of salt solution.

.....

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

**(e)** Suggest one way to improve the accuracy of this experiment.

.....**[1]**

**C4** Fig C4.1 is a simplified diagram of the human alimentary canal.

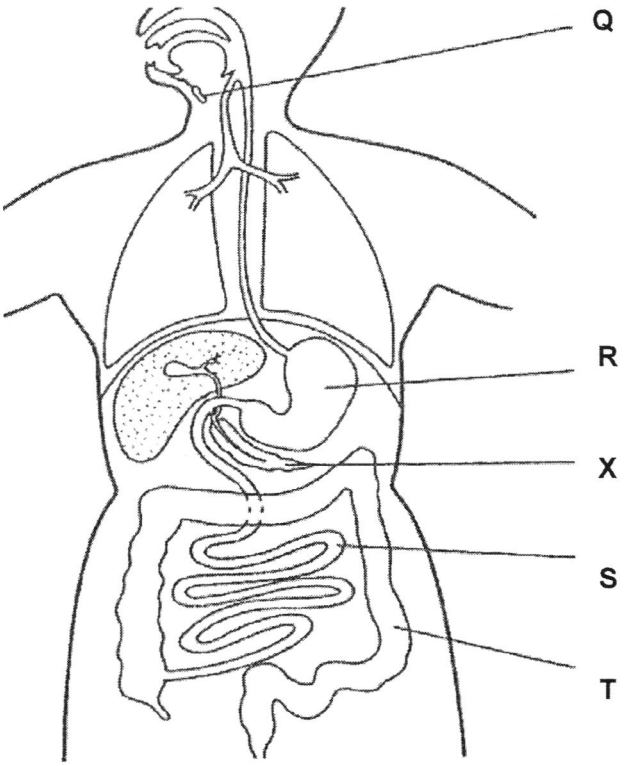



**Fig C4.1**

**(a)** Identify **Q** to **T**.

**Q**: ..... **R**: .....

**S**: ..... **T**: ..... **[4]**

Some fluid from organ **X** was retrieved and added to a fat sample. Fig C4.2 shows the fate of one fat molecule in this fluid.

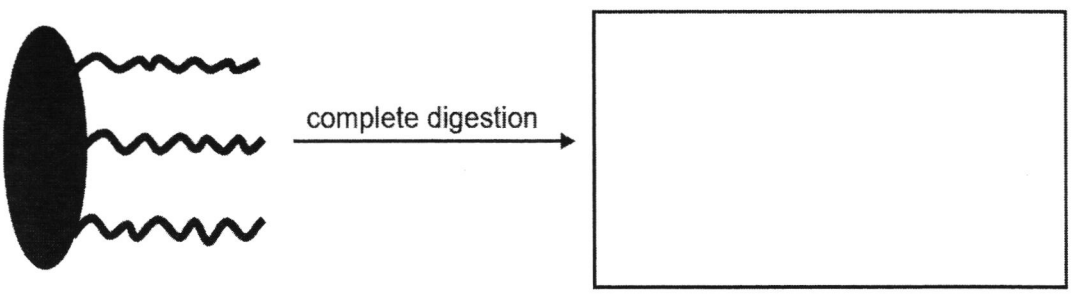



**Fig C4.2**

**(b)** In the box on the right of Fig C4. 2, draw and label the products that are formed upon complete digestion of the fat molecule. **[2]**

**(c)** The activity of enzymes from organ **X** on fats was investigated by measuring the amount of products formed over time. This experiment was carried out at 15 °C and a graph was plotted as shown in Fig C4.2.

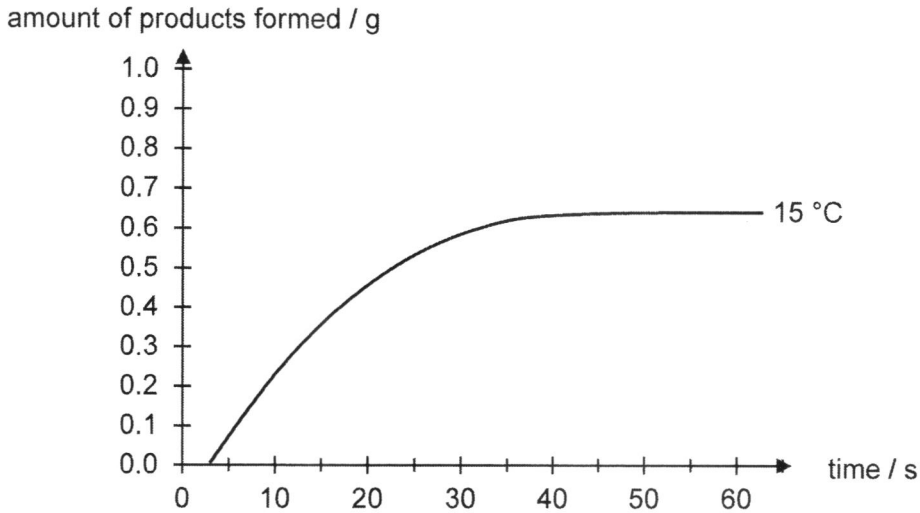



**Fig C4.2**

**(i)** With reference to Fig C4.2, describe the graph.

.....

.....

.....

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

**(ii)** Explain the shape of the graph from 40 to 60 seconds.

.....

.....**[1]**

**(iii)** Add a line to the graph to show the amount of products formed over time when the experiment was repeated using protease. **[1]**

**C5** Mrs Tay bought an electric iron with an operational voltage of 240 V and a current of 8 A flowing through it. When she tried to plug the electric iron into the main switch, it did not work. Fig C5.1 shows a plug with its cover removed while Fig C5.2 shows the wires in the iron.

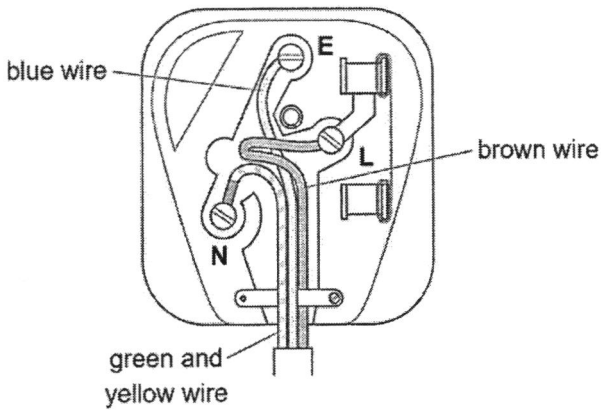



Fig C5.1

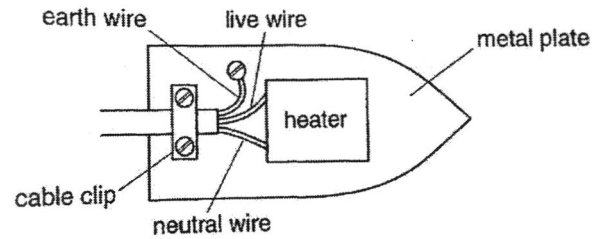



Fig C5.2

**(a)** **(i)** With reference to Fig C5.1, state **two** mistakes made in the wiring of this plug.

.....

.....

.....

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

**(ii)** Suggest a suitable current rating for the fuse in the plug.

.....**[1]**

After fixing the plug, Mrs Tay also discovered that the earth wire in the iron was disconnected.

**(b)** **(i)** State whether the iron is still able to work.

.....**[1]**

**(ii)** Describe and explain the protective function of the earth wire in the event where the live wire touches the metal casing of the iron.

.....

.....

.....

.....

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

Table C5.3 shows the electrical appliances that can be found in Mrs Tay's house, their usage time in hours per day and their power rating.

| electrical appliance | usage time in hours per day | power rating in watts |
|---|---|---|
| air-conditioner | 7 | 1500 |
| ceiling fan | 4 | 100 |
| lighting | 4 | 180 |
| television | 3 | 220 |

**Table C5.3**

**(c)** If Mrs Tay's electrical bill for 30 days is $184.20, calculate the cost of each unit of electricity per kWh. Show your working clearly.

Cost of each unit of electricity per kWh = $..... **[3]**

**END OF PAPER**

**East Spring Secondary End of Year 2019**

**Sec 2 Express Science**

**Q1** B

**Q2** C

**Q3** B

**Q4** D

**Q5** C

**Q6** D

**Q7** A

**Q8** D

**Q9** C

**Q10** C

**Q11** B

**Q12** A

**Q13** B

**Q14** A

**Q15** C

**Q16** C

**Q17** A

**Q18** D

**Q19** A

**Q20** D

**Q21** D

**Q22** D

**Q23** D

**Q24** C

**Q25** B

**Q26** B

**Q27** D

**Q28** C

**Q29** B

**Q30** D

**Section B [30 marks]**

Answer **all** the questions in the space provided.

**B1 (a)** Fig B1.1 is a diagram of a big letter 'L' placed in front of a plane mirror as shown below. A spot, **X**, is marked on top of the letter.

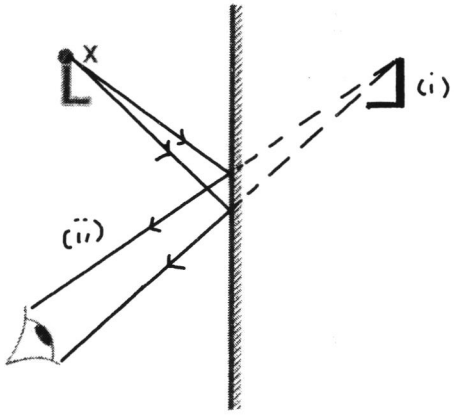



**Fig B1.1**

On Fig B1.1 draw

**(i)** the image of letter 'L', as seen by the eye, **[1]**

**(ii)** the path of two rays of light leaving point X and then reflecting at the mirror before entering the eye to allow the eye to see image of letter 'L'. **[2]**

**(b)** An optician's test panel is located 0.5 m behind the eyes of a patient who looks into a plane mirror 2.5 m in front of him, as shown in Fig B1.2 below.

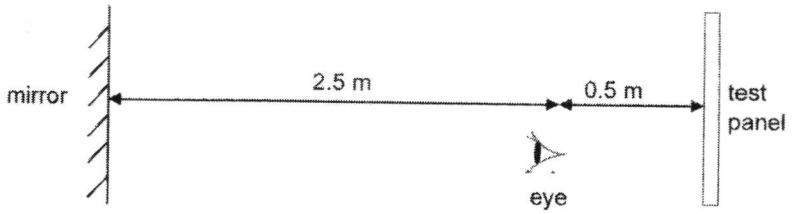



**Fig B1.2**

Calculate the distance of the image of the test panel in the mirror from the patient's eyes. Show your working clearly.

3 + 2.5 = 5.5

distance : 5.5 m **[1]**

**B2** A tank containing a toy fish has accidentally toppled off from a cruise ship and landed in the seawater. The tank is made of a transparent material **Y** and has a toy fish within an enclosed space containing liquid **X**, as shown in Fig B2.1

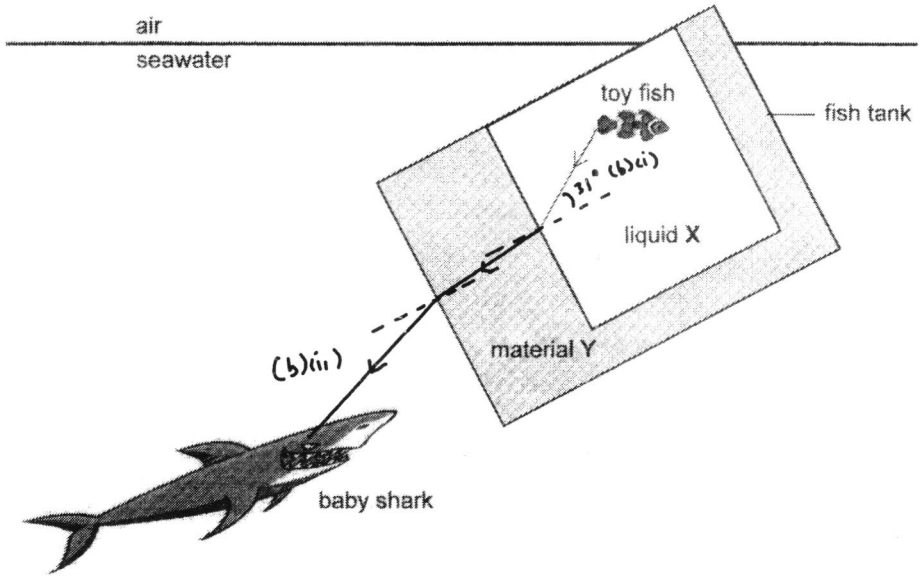



**Fig B2.1**

A baby shark swimming near the fish tank is able to see the toy fish inside the tank.

Of the three optical media, material **Y** has the highest optical density, followed by seawater and then liquid **X**.

**(a)** Describe and explain how the given ray in Fig B2.1 will bend when it travels from liquid **X** to material **Y**.

The ray will bend towards the normal as it travels from X to Y.
Refraction of light occurs.
The speed of light decreases as it travels from X to Y, as Y is denser than X.
The sudden decrease in the speed of light at the boundary of the 2 media caused the light ray to bend towards the normal. **[2]**

**(b)** An incident ray has been drawn from the toy fish to the interface between liquid **X** and material **Y**. On Fig B2.1,

**(i)** measure and label the angle of incidence of the given ray. 31° **[1]**

**(ii)** continue the path of the ray to show how the ray emerges from the fish tank to reach the eye of the baby shark. **[2]**

**B3** Fig B3.1 shows two 10 Ω resistors connected in parallel in a circuit. The reading on the ammeter shows 3.0 A.

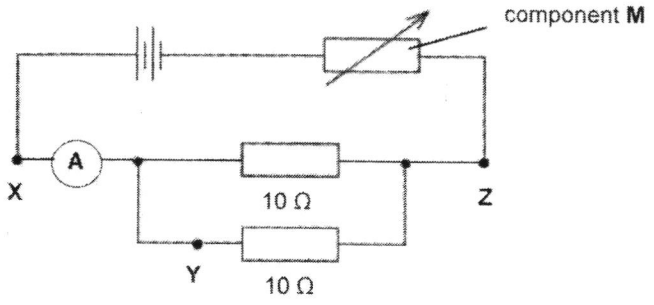



**Fig B3.1**

**(a)** Name component **M**.

variable resistor

.....[1]

**(b)** State the current flowing through **Y**.

1.5A

.....[1]

**(c)** Calculate the total effective resistance of the two 10 Ω resistors.

$\frac{1}{R} = \frac{1}{10} + \frac{1}{10}$

$\frac{1}{R} = \frac{2}{10}$

$R = 5\,\Omega$ //

resistance : 5 Ω [1]

**(d)** Calculate the potential difference across each 10 Ω resistor.

$V = I \times R$

$= 1.5 \times 10$

$= 15\,V$

potential difference : 15 V [1]

**(e)** Explain what will happen to the current flowing through the ammeter if another 10 Ω resistor is connected in parallel to the two other resistors.

The current will increase.

The total resistance of the circuit will decrease when another resistor is added in parallel. Since resistance is inversely proportional to current, this will result in total current increase. [1]

B4 (a) Fig B4.1 shows a section through a blood vessel in the tissue cells of the hand.

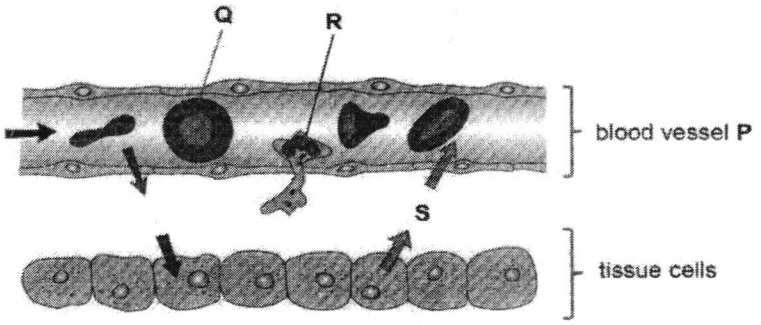



Fig B4.1

Identify P, Q, R and S.

P: capillary Q: red blood cell

R: white blood cell S: carbon dioxide [2]

(b) Fig B4.2 shows a section of the human heart.

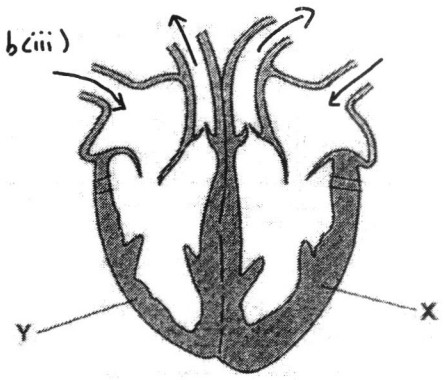



Fig B4.2

(i) Explain why the wall at **X** is thicker than the wall at Y.

The blood pressure in the left ventricle is much higher than that in the right ventricle. The muscular wall X at the left ventricle must be thicker than the muscular wall Y at the right ventricle in order to withstand the higher pressure of the blood.

[2]

(iii) On Fig B4.2, use 4 arrows to show the direction of blood flow in and out of the heart. [2]

**B5** Fig B5.1 shows the male and female reproductive systems.

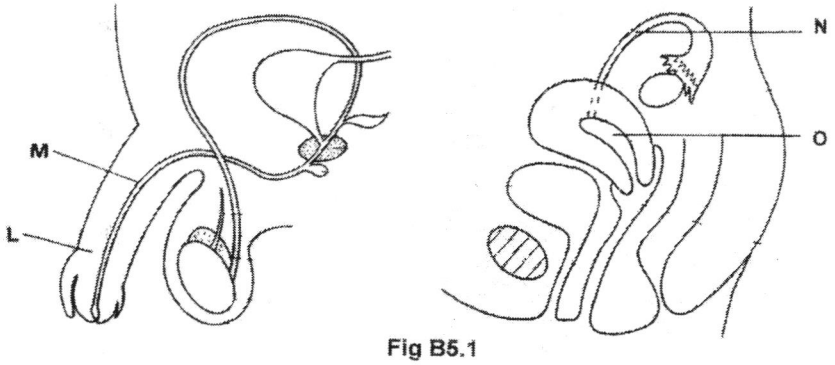



Fig B5.1

**(a)** **(i)** Identify parts **L** to **O**.

L: penis M: urethra

N: oviduct O: uterus [4]

**(ii)** Name the organ that produces the male sex hormones.

testis [1]

**(b)** Fig B5.2 below shows the calendar of August and September 2019. It was used to track the menstrual cycle of a female. She had the first day of menstruation on 4th August (bolded and with *).

| August 2019 | | | | | | |
|---|---|---|---|---|---|---|
| **Sun** | **Mon** | **Tue** | **Wed** | **Thu** | **Fri** | **Sat** |
| | | | | 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 |

| September 2019 | | | | | | |
|---|---|---|---|---|---|---|
| **Sun** | **Mon** | **Tue** | **Wed** | **Thu** | **Fri** | **Sat** |
| 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 | | | | | |

(iii)

Fig B5.2

(i) Assuming the female has a 28-day menstrual cycle, state the range of dates in August she should avoid sexual intercourse to prevent pregnancy.

14 August to 20 August [1]

(ii) Explain your answer in (i).

Ovulation is likely to occur on the 14th day of the cycle, which is 17 August. The sperms can survive in the womb and oviduct for around 3 days, and the released egg can survive for around 2 to 3 days, so the 11th to 17th day of the cycle will be the unsafe period. [2]

(iii) Circle the date of the start of the next menstruation in September. [1]

(iv) State what happens to the uterine lining after the fertile period if she gets pregnant?

The uterine lining remains thickened, and will not break down. [1]

**End of Section B**

**Section C [40 marks]**

Answer **C1 and any three** questions in the space provided.

**C1** Table C1.1 shows the melting and boiling points of some elements in Group VII of the periodic table. Group VII elements have 7 valence electrons.

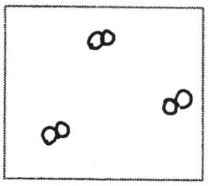
| element | melting point/ °C | boiling point/ °C | state at room temperature |
|---|---|---|---|
| X | -110 | -34 | gas |
| bromine | -7 | 59 | liquid |
| iodine | 114 | 184 | solid |

**Table C1.1**

**(a)** Complete Table C1.1 to show the physical states of the elements at room temperature.

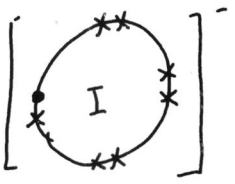
**[2]**

**(b)** In the box below, draw the arrangement of molecules of bromine at 60°C.



**[1]**

**(c)** Draw the 'dot and cross' diagram of an iodide ion. Show only the outermost electrons.




x. electron of iodine
• electron from another atom

**[2]**

Fig C1.2 shows the mass spectrometry of isotopes of element **X**. Isotopes are atoms of the same element with the same number of protons but different number of neutrons in the nucleus. Mass spectrometry is a technique that analyses the relative abundance of isotopes in the air.

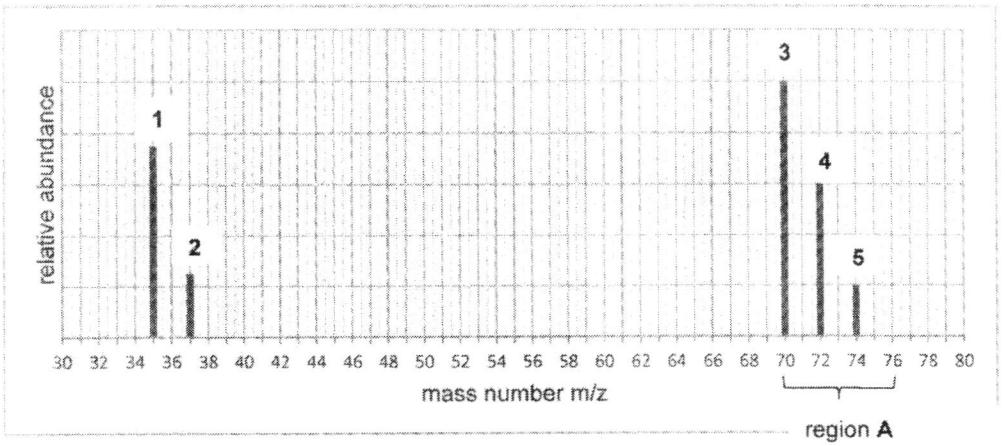



**Fig C1.2**

(d) (i) With reference to Fig C1.2, complete Table C1.3 showing the mass number of the substance at the respective peaks.

| peak number | mass number m/z |
|---|---|
| 1 | 35 |
| 2 | 37 |
| 3 | 70 |
| 4 | 72 |
| 5 | 74 |

**Table C1.3** **[2]**

(ii) Hence, deduce the identity of element X.

Chlorine ..... **[1]**

(e) Using your knowledge of atoms and molecules, explain why there are 3 peaks shown region **A**.

Chlorine exists as diatomic molecules. There are two isotopes of chlorine with atomic mass 35 and 37.

Peak number 3 is due to two Cl-35 atoms chemically bonded; peak number 4 is due to one Cl-35 and one Cl-37 chemically bonded; peak number 5 is due to two Cl-37 chemically bonded. **[2]**

**C2** A solar power station is designed for use in desert countries. The flow chart in Fig C2.1 shows the steps involved in the production of electricity.

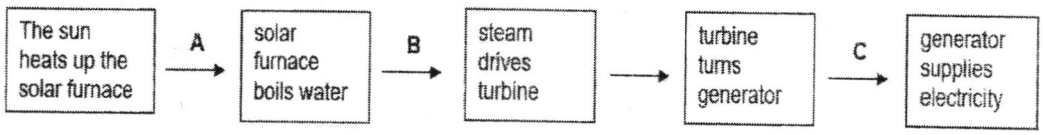



**Fig C1.1**

**(a) (i)** With reference to Fig C2.1, list the energy conversion that takes place at **A**, **B** and **C** in process of electricity generation as shown in the flow chart.

**A**: heat energy of sun to heat energy of water ..... **[1]**

**B**: heat energy of water to kinetic energy of steam ..... **[1]**

**C**: kinetic energy of turbine to electrical energy ..... **[1]**

**(ii)** Suggest one advantage of using the solar power station in the production of electricity.

It is a renewable source of energy, and will not run out. ..... **[1]**

The solar furnace consists of many mirrors as shown in Fig C2.2.

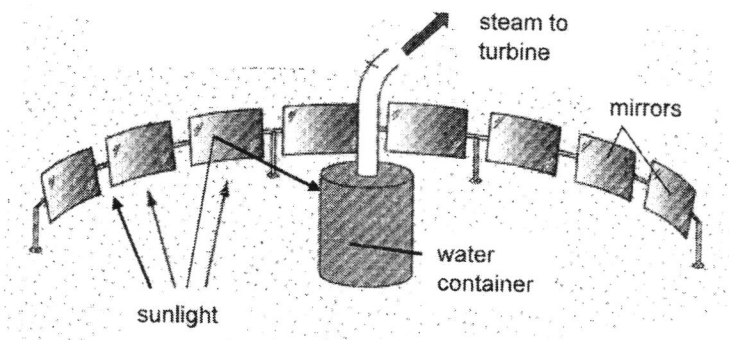



**Fig C2.2**

**(b) (i)** Suggest the type of mirrors used in the solar furnace.

Shiny, smooth mirrors ..... **[1]**

(ii) Explain your answer in (b)(i) and how it is important in stages **A** and **B** of Fig C2.1.

The shiny smooth surfaces of the mirrors are good reflectors and poor absorbers of radiant heat. More of the radiant heat from the sun will be able to be reflected towards the solar heater, enabling the solar heater to gain heat faster to heat up the water into steam.

**[2]**

(c) Using The Particulate Nature of Matter, describe the arrangement and movement of the water molecules when water is heated to steam in the process of electricity generation.

During the change of state of water from liquid to gaseous steam, the arrangement of the water molecules changes from irregular and close together to irregular and far apart. The movement of the water molecules changes from moving and sliding over one another to moving at high speed in all directions.

**[3]**

**C3** Shane cut and weighed five similar-sized potato strips. He placed each strip in salt solution of different concentrations for 60 minutes. He then re-weighed each potato strip and tabulated the results in Table C3.1.

| salt concentration/ mol/dm$^3$ | mass of potato/ g | | change in mass (final- initial)/ g |
|---|---|---|---|
| | initial | final | |
| 0.0 | 6.00 | 6.80 | +0.80 |
| 0.2 | 6.00 | 6.50 | +0.50 |
| 0.4 | 6.00 | 6.18 | +0.18 |
| 0.6 | 6.00 | 5.90 | -0.10 |
| 0.8 | 6.00 | 5.60 | -0.40 |
| 1.0 | 6.00 | 5.35 | -0.65 |

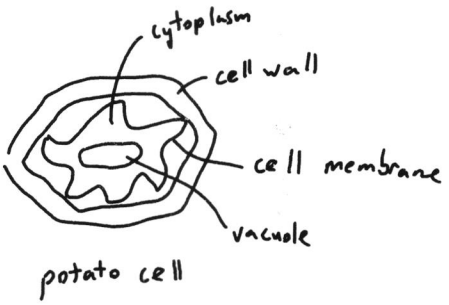
**Table C3.1**

**(a)** Complete Table C3.1 for the values of the change in mass. **[2]**

**(b)** **(i)** Describe the appearance of a cell in the potato strip placed in the 1.0 mol/dm$^3$ salt solution under the microscope.

The cell appears shrivelled, as plasmolysis occurred, resulting in the cell membrane moving away from the cell wall. **[1]**

**(ii)** In the space below, draw and label the cell you described in (b)(i).




potato cell

**[2]**

Shane plotted a graph of change in mass against concentration of salt solution graph as shown in Fig C3.2 below.

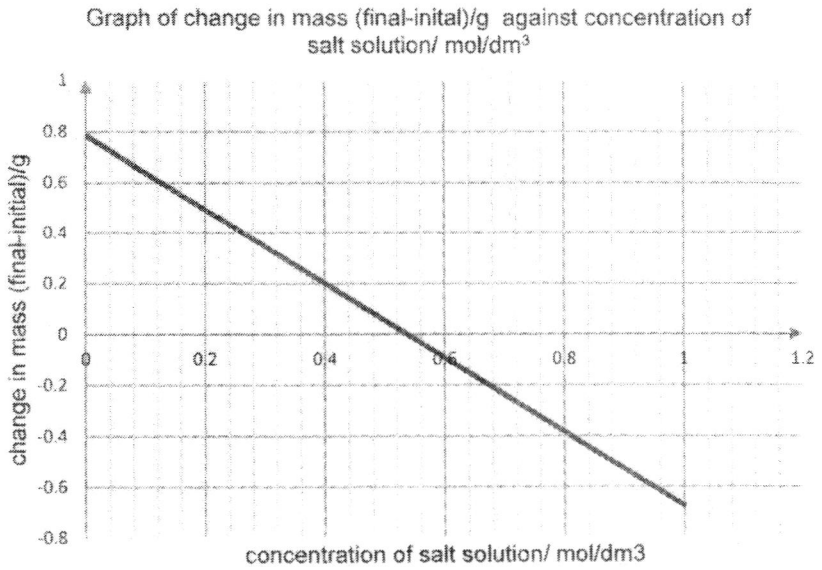



**Fig C3.2**

**(c) (i)** From the graph, deduce the concentration of the potato strip which has a similar water potential as the salt solution.

0.54 mol/dm$^3$ **[1]**

**(ii)** Explain your answer in (c)(i).

At this concentration, the change in mass of the potato strip is zero.

This means that there net flow of water in and out of the strip is zero, so water potential in the solution and potato strip must be the same. **[1]**

**(d)** Explain why the mass changed when the potato strips were added to 0.2 mol/dm$^3$ of salt solution.

At this concentration, the water potential in the salt solution is higher than in the potato strip.

Osmosis occurs, with water molecules moving from the salt solution into the potato strip. The amount of water in the strip increase, causing an increase in mass. **[2]**

**(e)** Suggest one way to improve the accuracy of this experiment.

Ensure temperature of the salt solutions remain the same in all the experiments. **[1]**

**C4** Fig C4.1 is a simplified diagram of the human alimentary canal.

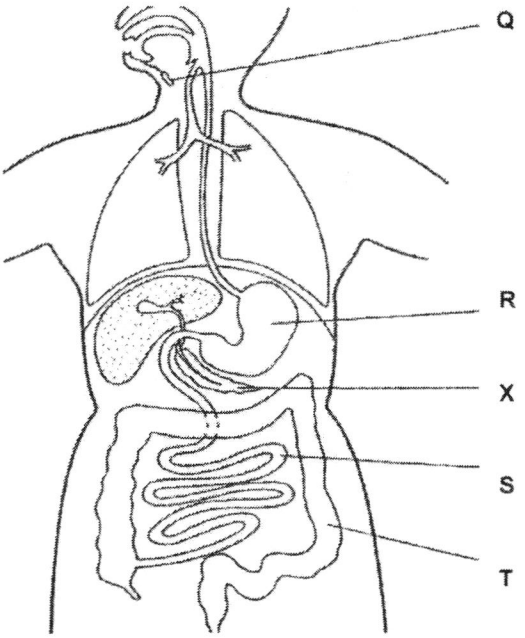



**Fig C4.1**

**(a)** Identify **Q** to **T**.

Q: salivary gland R: stomach

S: small intestine T: large intestine [4]

Some fluid from organ **X** was retrieved and added to a fat sample. Fig C4.2 shows the fate of one fat molecule in this fluid.

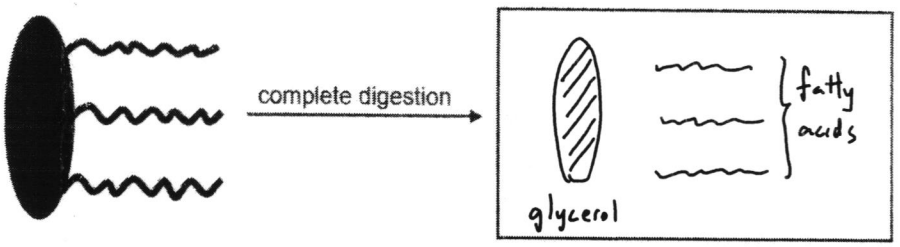



**Fig C4.2**

**(b)** In the box on the right of Fig C4. 2, draw and label the products that are formed upon complete digestion of the fat molecule. [2]

(c) The activity of enzymes from organ **X** on fats was investigated by measuring the amount of products formed over time. This experiment was carried out at 15 °C and a graph was plotted as shown in Fig C4.2.

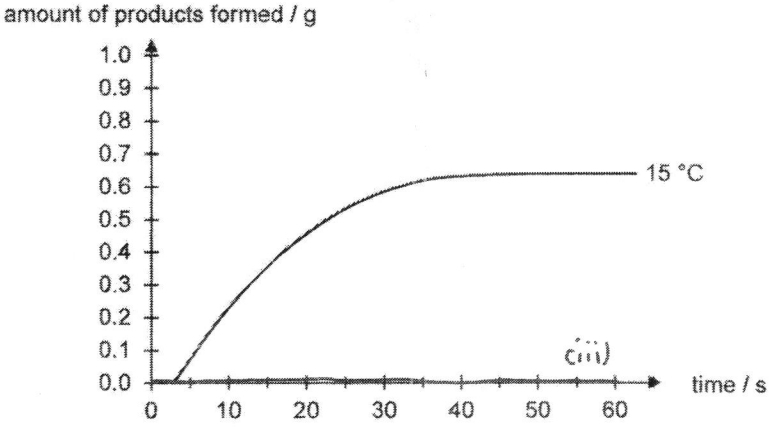



**Fig C4.2**

(i) With reference to Fig C4.2, describe the graph.

Products start to form after about 3 seconds. The amount of products increase at a decreasing rate over time, until around 40 seconds when the amount of products stop increasing and remain constant. **[2]**

(ii) Explain the shape of the graph from 40 to 60 seconds.

From 40 seconds onwards, the fats was fully digested, so digestion has stopped and no more products are formed. **[1]**

(iii) Add a line to the graph to show the amount of products formed over time when the experiment was repeated using protease. **[1]**

**C5** Mrs Tay bought an electric iron with an operational voltage of 240 V and a current of 8 A flowing through it. When she tried to plug the electric iron into the main switch, it did not work. Fig C5.1 shows a plug with its cover removed while Fig C5.2 shows the wires in the iron.

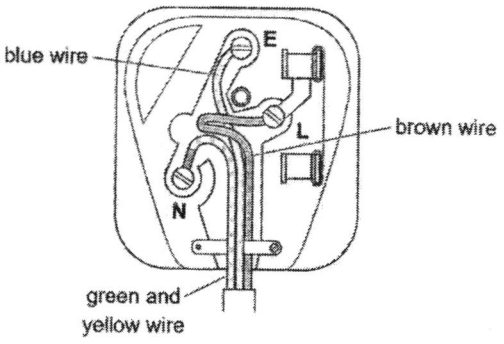



Fig C5.1

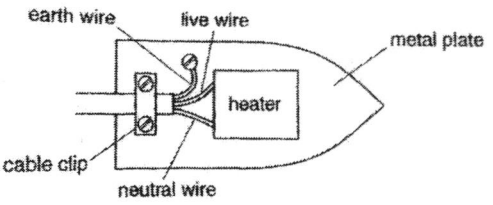



Fig C5.2

**(a)** **(i)** With reference to Fig C5.1, state **two** mistakes made in the wiring of this plug.

There is no fuse connected to the live wire.

The blue wire and green and yellow wire are connected wrongly.
The blue wire should be connected to N, and the green and yellow wire connected to E.

**[2]**

**(ii)** Suggest a suitable current rating for the fuse in the plug.

10 A fuse **[1]**

After fixing the plug, Mrs Tay also discovered that the earth wire in the iron was disconnected.

**(b)** **(i)** State whether the iron is still able to work.

Yes, the iron can still work.

**[1]**

**(ii)** Describe and explain the protective function of the earth wire in the event where the live wire touches the metal casing of the iron.

When the live wire touches the metal casing of the iron, the iron will become "live".

The earth wire will conduct the current from the "live" casing to the ground.

This will ensure that the user will not get electrocuted if he touch the casing.

**[3]**

Table C5.3 shows the electrical appliances that can be found in Mrs Tay's house, their usage time in hours per day and their power rating.

| electrical appliance | usage time in hours per day | power rating in watts |
|---|---|---|
| air-conditioner | 7 | 1500 |
| ceiling fan | 4 | 100 |
| lighting | 4 | 180 |
| television | 3 | 220 |

**Table C5.3**

(c) If Mrs Tay's electrical bill for 30 days is $184.20, calculate the cost of each unit of electricity per kWh. Show your working clearly.

Total electrical energy used = $[7\times1.5+4\times0.1+4\times0.18+3\times0.22]\times30$

$= 368.4$ kWh

$$\text{Unit cost} = \frac{184.20}{368.4}$$

$= 0.50$

Cost of each unit of electricity per kWh = $\$0.50$ **[3]**

**END OF PAPER**