Candidate Name	Centre Number	Candidate Number

WELSH JOINT EDUCATION COMMITTEE

General Certificate of Secondary Education

CYD-BWYLLGOR ADDYSG CYMRU

Tystysgrif Gyffredinol Addysg Uwchradd

200/02

SCIENCE: PHYSICS

HIGHER TIER (Grades D-A*)

A.M. FRIDAY, 15 June 2007

(2 hours 30 minutes)

For Examiner's use only	
Total Marks	

ADDITIONAL MATERIALS

In addition to this paper you may require a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

You are reminded to show all working. Credit is given for correct working even when the final answer given is incorrect.

No certificate will be awarded to a candidate detected in any unfair practice during the examination.

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

1. *(a)* Three core mains electric cable contains a **live**, a **neutral** and an **earth** wire, each covered in coloured plastic.

(i) Give a reason why the wires are covered in plastic. [1]

.....

(ii) State which wire should be connected to the fuse. ..... [1]

(iii) State which wire is covered in brown plastic. ..... [1]

(iv) Explain how the earth wire provides protection for the user from electric shocks. [2]

.....

.....

.....

(b) Some electric appliances use a cable which does not have an earth wire.

(i) State which **one** of the following appliances can safely use this type of cable. [1]

.....

iron

hairdryer

electric fire

(ii) Give a reason for your answer. [1]

.....

7

2. On a bright summer day, a solar panel, mounted on the roof of a house, receives 3 000 J of energy every second from the Sun.
1 200 J of this energy is transferred every second to heat water in a storage tank.

(i) Use the information above to find how much of the Sun's energy, which falls on the solar panel, is wasted every second. [1]

wasted energy every second = ... J

(ii) Use the equation

$$\text{efficiency} = \frac{\text{useful energy transferred}}{\text{input energy}} \times 100\%$$

to calculate the efficiency of the solar panel. [2]

efficiency = ... %

(iii) Give **two** reasons why the solar panel only makes a small contribution to the energy supply of this house. [2]

1. .....

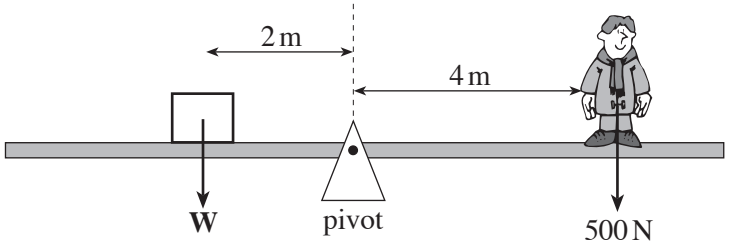
.....

2. .....

.....

5

3. The diagram shows a child balanced by a weight **(W)** on a see-saw.



(a) (i) Write down, in words, an equation connecting **force**, **perpendicular distance** and **moment**. [1]

.....

.....

(ii) Calculate the clockwise moment of the child about the pivot. [2]

moment = ... Nm

(b) When the see-saw is balanced, what can you say about the anticlockwise moment of **W** about the pivot? [1]

.....

(c) When the child moves towards the pivot

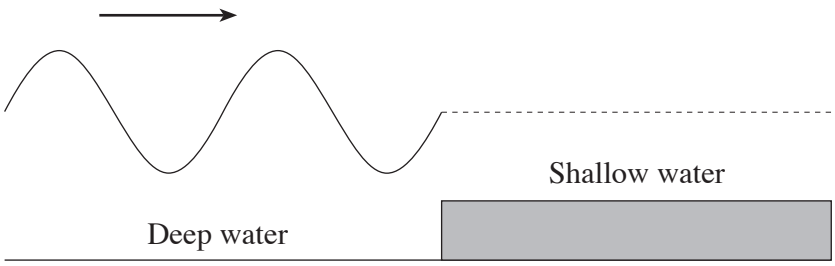
(i) state which way the see-saw moves, ... [1]

(ii) explain why the see-saw moves. [1]

.....

6

4. The diagram shows waves travelling from deep water into shallow water.



(a) (i) **Add an arrow** labelled **A** to the diagram, to show the amplitude of the wave. [1]

(ii) **Add an arrow** labelled **W** to the diagram, to show the wavelength of the wave. [1]

(b) As the wave travels into the shallow water, its wavelength gets shorter and its amplitude decreases.
Use this information to **complete the diagram** to show the waves in shallow water. [2]

4

5. *(a)* People once thought that the Earth was at the centre of the Solar System. They thought that all the planets and the Sun orbited the Earth.
State **two** ways in which this is different from the present-day model of the Solar System.[2]

1. .....

.....

2. .....

.....

(b) The Universe consists of billions of galaxies.
Most scientists accept the "Big Bang" as the model of the formation of the Universe.

(i) State what the "Big Bang" model says is happening to the Universe. [1]

.....

(ii) State what the "Big Bang" model says is happening to the billions of galaxies in the Universe. [1]

.....

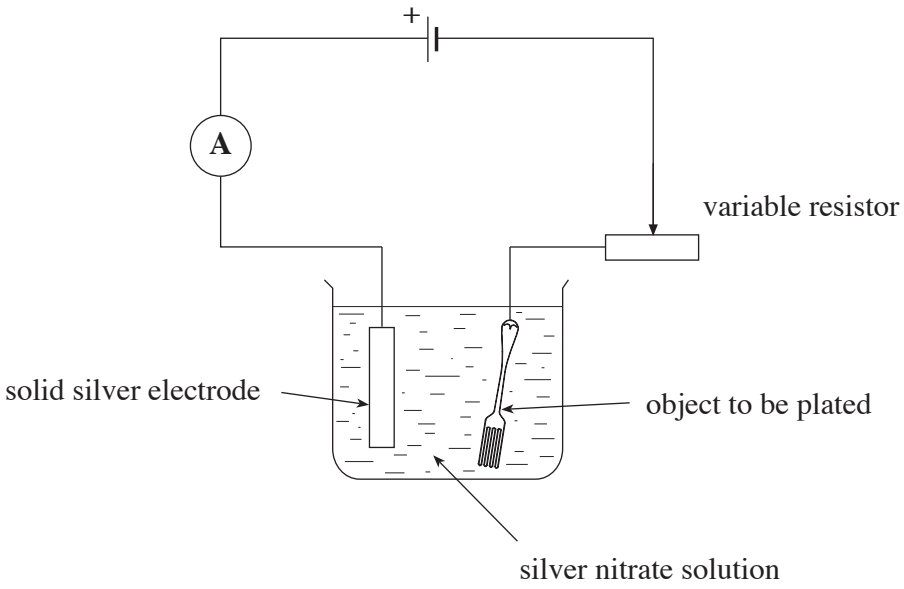
(iii) The "Big Bang" model of the Universe is supported by observations of the **red shift of light** from distant galaxies.
State what is meant by the **red shift of light**. [1]

.....

.....

5

6. The circuit below is one used for the silver plating of cutlery.



(a) (i) **Mark on the diagram** the direction of the current in the circuit. [1]

(ii) Explain carefully how the current is carried through the wire of the circuit. [2]

.....

.....

(b) The silver nitrate solution contains positive silver ions and negative nitrate ions.
Explain carefully how the current is carried, by the ions, through the silver nitrate solution.
[2]

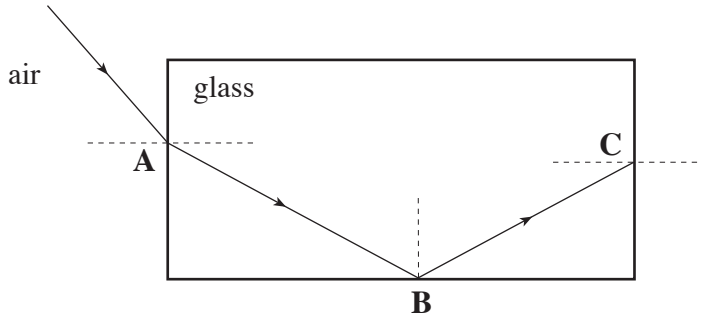
.....

.....

.....

5

7. The diagram shows a ray of light entering and travelling through a glass block.



(a) (i) **Mark on the diagram** with *i*, the angle of incidence at **A**. [1]

(ii) State what happens to the light at **A** as it passes from air into the glass. [1]

.....

(iii) Give a reason why this change happens. [1]

.....

(b) (i) State what happens to the light at **B**. ..... [1]

(ii) Give a reason why the light does not pass out of the block at **B**. [1]

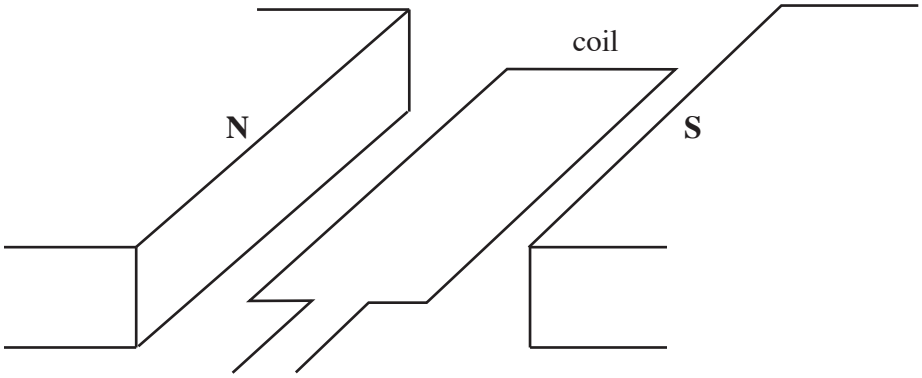
.....

.....

(c) **Add a line** to the diagram to show the path of the light as it passes out of the block at **C**. [1]

6

8. The diagram shows a simple generator of electricity.



(a) Explain why a voltage is produced when the coil spins. [2]

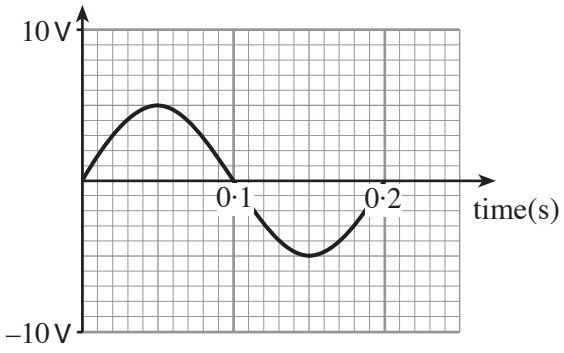
.....

.....

.....

(b) When this coil spins at a steady speed, the voltage produced is shown in the diagram **A**.

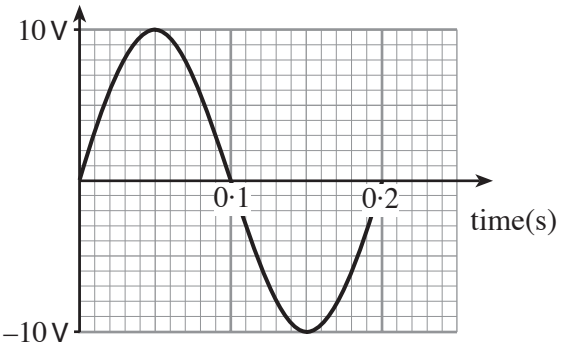
A



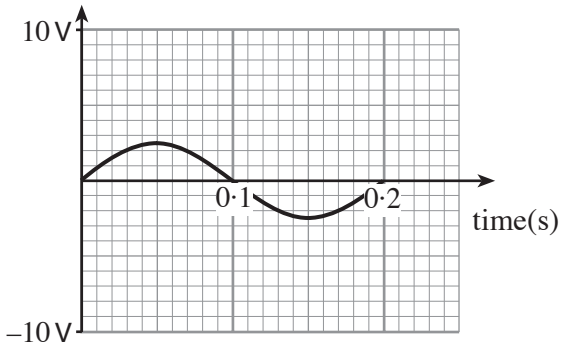
Write down the number of spins of the coil in 1 s. ..... [1]

(c) The following diagrams show voltages produced after making changes to the coil.

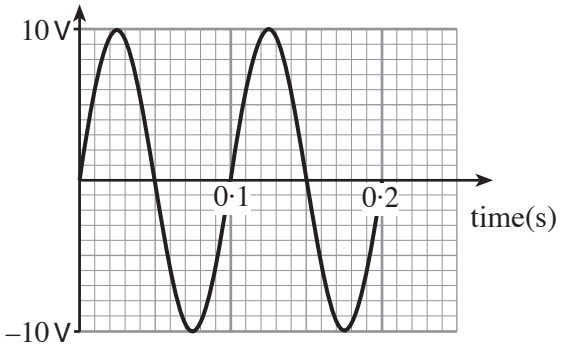
B



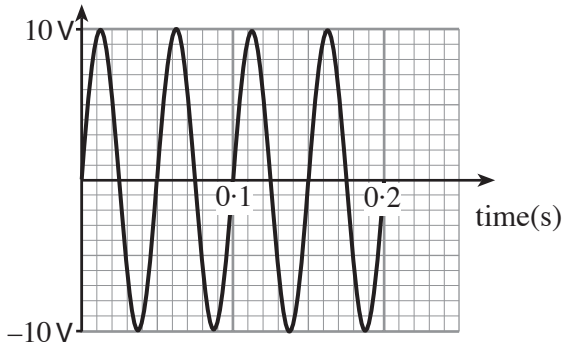
C



D



E



(i) State which diagram, **B**, **C**, **D** or **E**, would be produced if the number of turns of wire on the coil were doubled. [1]

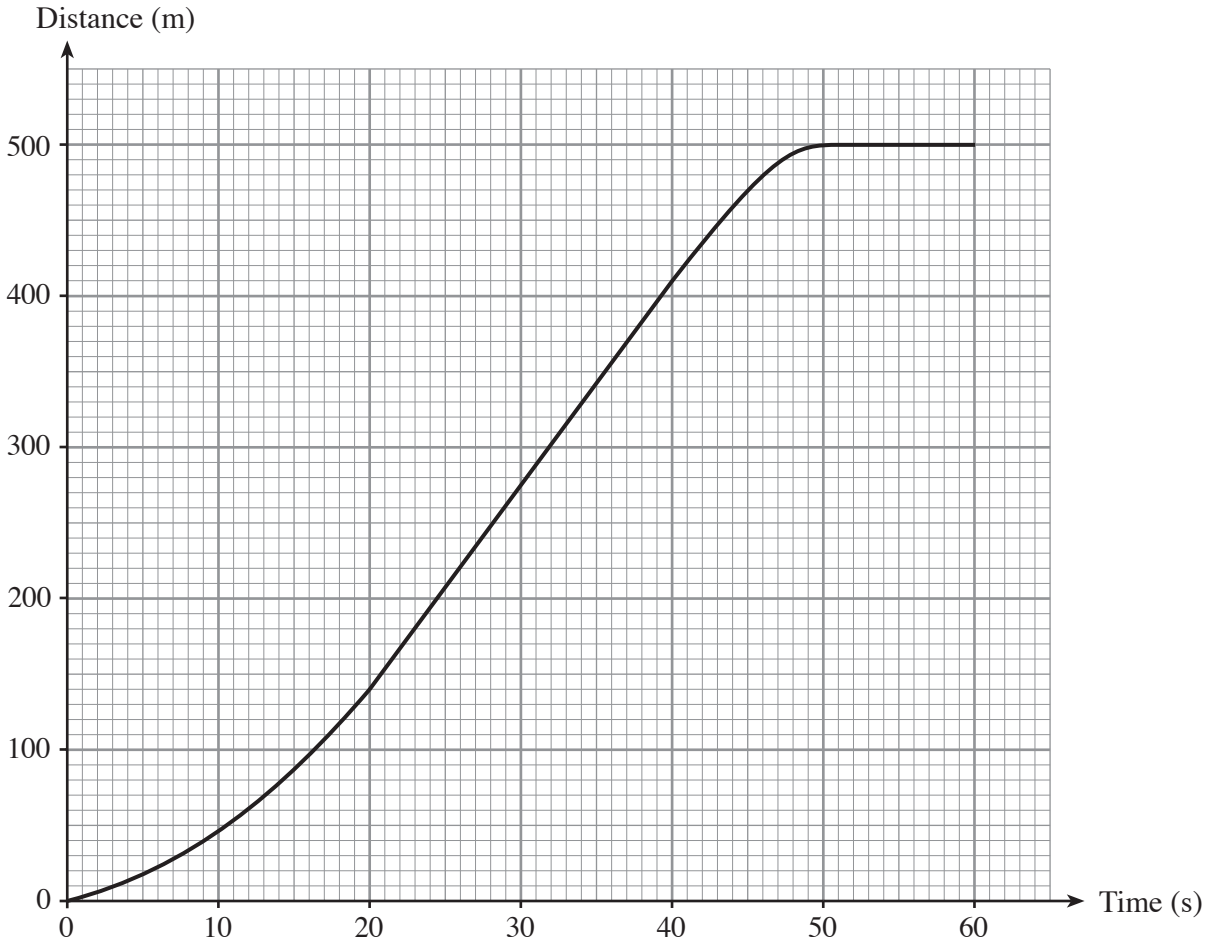
.....

(ii) State which diagram, **B**, **C**, **D** or **E**, would be produced by the original coil if it were spun twice as fast. [1]

.....

5

9. A cyclist travelled along a straight level road. The graph shows how the distance travelled by the cyclist changes with time.



(a) Write, **in words**, the equation connecting **distance**, **time** and **speed**. [1]

.....

.....

(b) **Use your equation, together with information from the graph,** to calculate the cyclist's average (mean) speed:

(i) during the first 20 seconds,

average speed = ... m/s

(ii) between 40 s and 60 s.

average speed = ... m/s
[3]

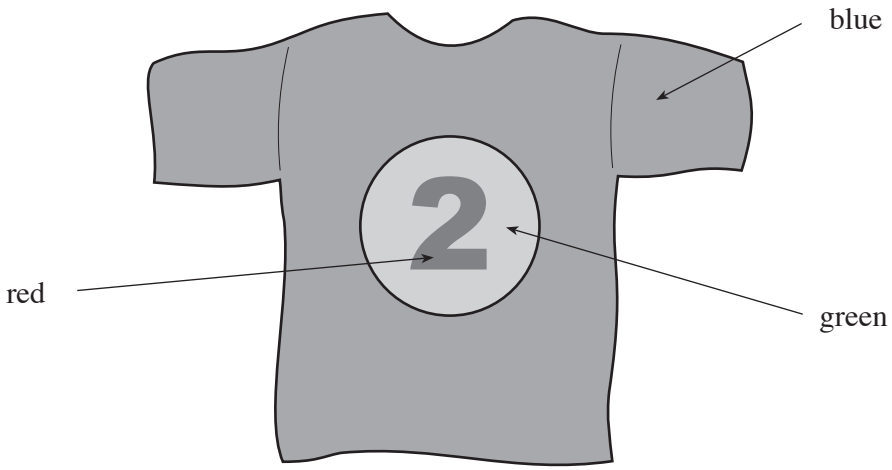
(c) **Use the graph** to explain why the average speed between 40 s and 60 s is less than the average speed during the first 20 s. [2]

.....

.....

6

10. The colours of a tee-shirt, in daylight, are shown in the diagram.



Describe the appearance of the tee-shirt when

(i) it is looked at through a red filter; [2]

.....

.....

(ii) blue light shines on it; [2]

.....

.....

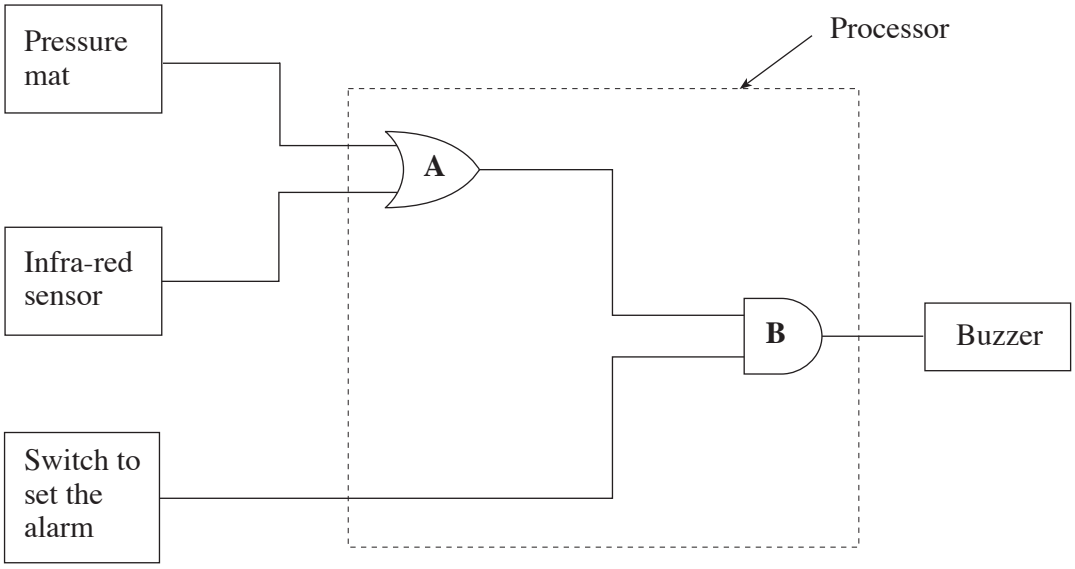
(iii) yellow stage lighting shines on it. [2]

.....

.....

6

11. A block diagram of an alarm circuit is shown below.



(a) The processor consists of two logic gates, **A** and **B**.

(i) State the purpose of the processor. [1]

.....

.....

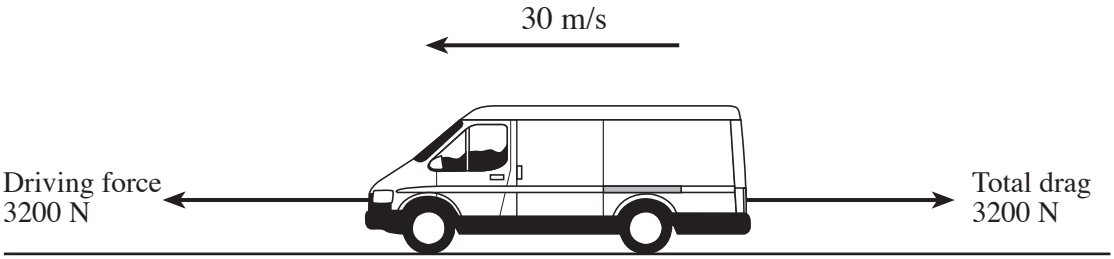
(ii) Name the logic gates, **A** and **B**. [2]

A ..... **B** .....

(b) When the alarm is set (logic **1**), the buzzer sounds if someone steps on the pressure mat (logic **1**) or if the infra-red sensor detects movement (logic **1**).
Complete the truth table below for the system. [2]

Switch to set alarm	Infra-red sensor	Pressure mat	Output of **A**	Output of **B**	Buzzer
0	1	0	1	0	0
1	0	0	0	0	0
0	0	1	.....	.....	.....
1	0	.....	.....	.....	1
1	1	1	1	1	1

12. The diagram shows the forces acting on a van, of mass 1000 kg, moving at a constant speed of 30 m/s.



The driving force is reduced and the van decelerates at 1·2 m/s^2 until it reaches a new constant speed of 18 m/s.

(a) (i) Write down, in words, an equation connecting **mass**, **acceleration** and **force**. [1]

.....

.....

(ii) Calculate the resultant decelerating force on the van. [2]

resultant force = ... N

(iii) Calculate the new driving force on the van when moving at the new constant speed of 18 m/s. [1]

driving force = ... N

(b) Explain, in terms of the forces acting, why the van reaches a new constant speed of 18 m/s. [2]

.....

.....

.....

13. Read the following passage carefully before answering the questions that follow.

The electromagnetic spectrum is a family of radiation which includes infra-red radiation and visible light. Electromagnetic (e-m) radiation travels as a transverse wave. Its speed in a vacuum is 3×10^8 m/s.
Hot objects give off e-m radiation. The higher the temperature of the object, the greater its energy and the higher the frequency of the emitted radiation.
At around 800°C, an object gives out mainly infra-red radiation and a small amount of visible light. The object glows dull red – it is "red hot".
At 1200°C an object emits all parts of the infra-red and visible spectrum. The object is now "white hot". At even higher temperatures, the object is still white hot but also emits high frequency radiation which causes skin damage.

(a) (i) State which is at the higher temperature: the wire element of an electric fire or the filament of an electric lamp. [1]

.....

(ii) Give a reason for your answer. [1]

.....

.....

(b) (i) Name a type of e-m radiation with a frequency less than that of infra-red. [1]

.....

(ii) Identify the radiation referred to in the last sentence of the passage. [1]

.....

(iii) Explain why the high frequency end of the e-m spectrum is more dangerous than the low frequency end. [2]

.....

.....

(c) (i) Write, in words, the equation connecting **wavelength**, **wave speed** and **frequency**. [1]

.....

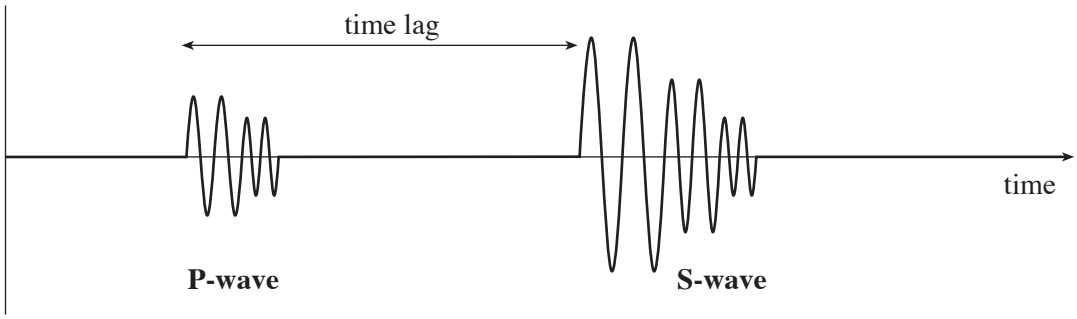
.....

(ii) Calculate the wavelength, in a vacuum, of the e-m radiation which has a frequency of $1{\cdot}5 \times 10^{13}$ Hz. [2]

wavelength = ... m

14. An earthquake produces seismic waves that travel through the Earth. **P-waves** and **S-waves** are two types of seismic wave. Monitoring stations are able to detect the waves produced by an Earthquake that occurs anywhere in the world.

The diagram shows a typical signal received at a monitoring station.



(a) (i) Explain why the two waves are received at different times. [1]

.....

.....

(ii) Explain what the "time lag" between the two sets of seismic waves tells scientists about the Earthquake. [1]

.....

.....

(b) Explain how the study of **P** and **S** waves in seismic records suggests that the Earth has a layered structure. [3]

.....

.....

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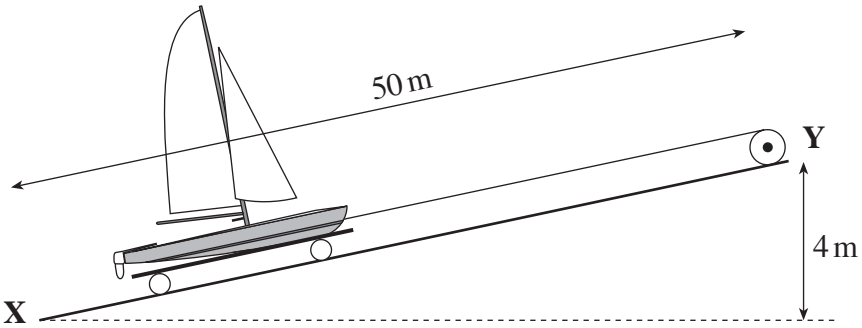
.....

.....

5

15. The diagram shows a winch at **Y**, which is used to pull a yacht, at **X**, 50 m up the slipway through a vertical height of 4 m.



(a) (i) Complete the equation connecting **height** (*h*), **mass** (*m*), **potential energy** and **gravitational field strength** (*g*). [1]

Potential Energy =

(ii) Calculate the gain in potential energy of the yacht when it is pulled up to the top of the slipway. [2]
[Mass of yacht = 1500 kg; gravitational field strength = 10 N/kg]

gain in potential energy = ... J

(b) (i) Write down, in words, an equation connecting **force**, **work done** and **distance**. [1]

.....

.....

(ii) A frictional force of 1000 N acts against the yacht as it is pulled up the slipway. Calculate the work done against this frictional force. [2]

work done = ... J

(c) (i) Calculate the total amount of work done by the winch in pulling the yacht up the slipway. [1]

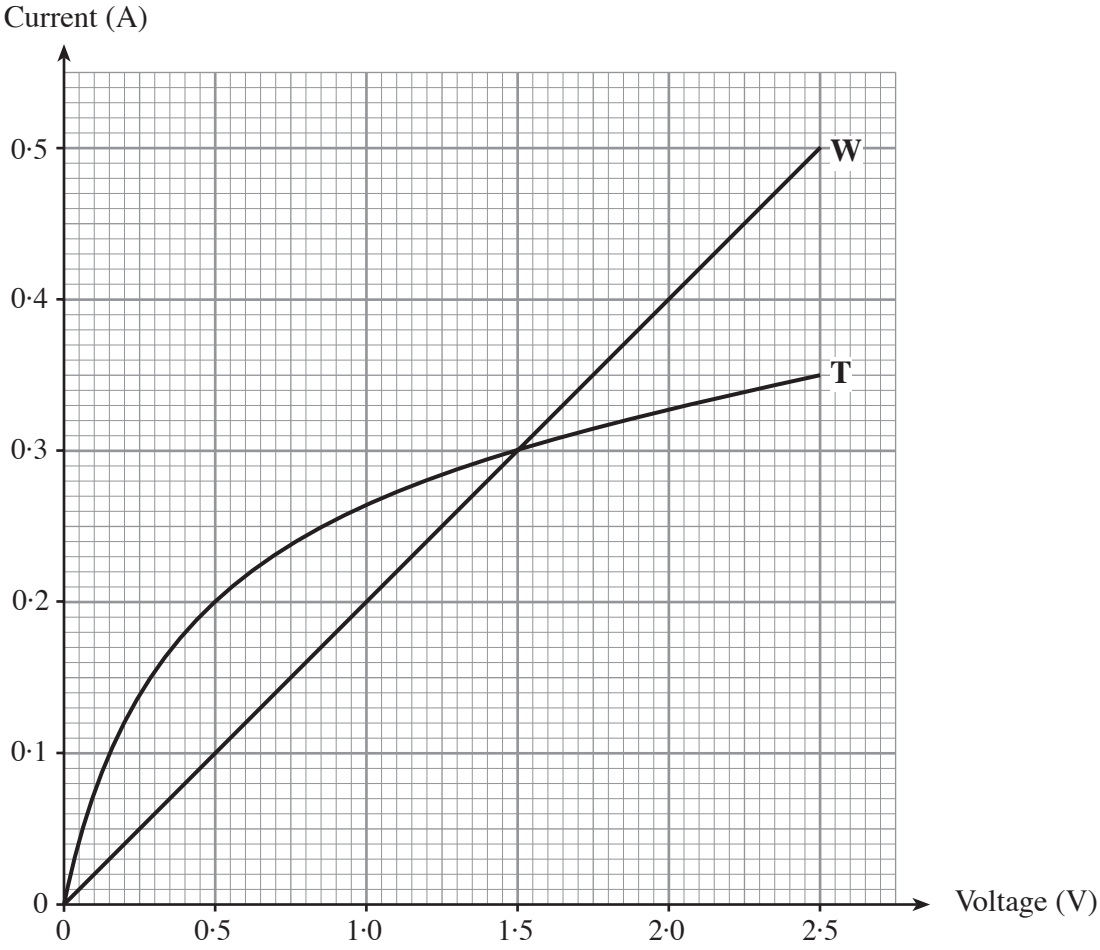
total work done = ... J

(ii) Calculate the force that must be applied by the winch in pulling the yacht up the slipway. [2]

force applied by winch = ... N

9

16. *(a)* The graph shows how the current depends upon the voltage for a torch bulb (**T**) and a long copper wire (**W**).



(i) How can you tell from the graph that the resistance of the wire remains constant as the voltage increases? [1]

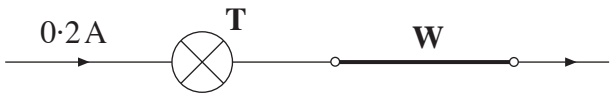
.....

.....

(ii) The resistance of the wire is 5**Ω**. Use the graph to find the current through the torch bulb, when the bulb has a resistance of 5**Ω**. [1]

current = ... A

(b) The torch bulb and wire are shown connected in series with a current of 0·2 A flowing through them.



(i) Write down, in words, an equation connecting **voltage**, **resistance** and **current**. [1]

.....

.....

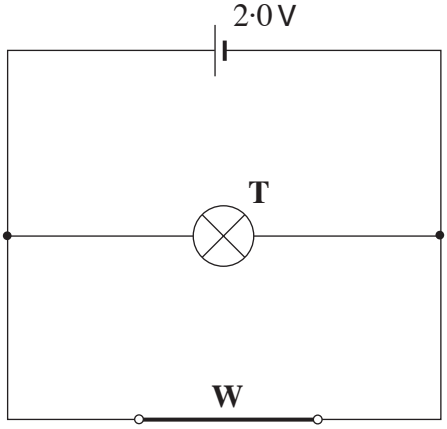
(ii) Use data from the graph to calculate the resistance of the torch bulb in this arrangement. [2]

resistance = ... Ω

(iii) Use the graph to find the voltage required to drive a current of 0·2 A through the two in series. [2]

voltage = ... V

(c) The torch bulb and wire are shown connected in parallel. A voltage of 2·0 V is connected across them.



(i) Use data from the graph to find the resistance of the torch bulb in this arrangement.[2]

resistance of torch bulb = ... Ω

(ii) Calculate the combined resistance of the torch bulb and wire in this parallel arrangement. [3]

combined resistance = ... Ω

12

17. *(a)* Our Sun is considered to be in its stable period.
Explain, in terms of the forces acting on the Sun, what you understand by the "stable period". [3]

.....

.....

.....

.....

.....

(b) (i) Describe and explain the changes that occur when a star the size of our Sun comes to the end of its life. [3]

.....

.....

.....

.....

.....

.....

(ii) Describe and explain the changes that occur when a star, much more massive than our Sun, comes to the end of its life. [2]

.....

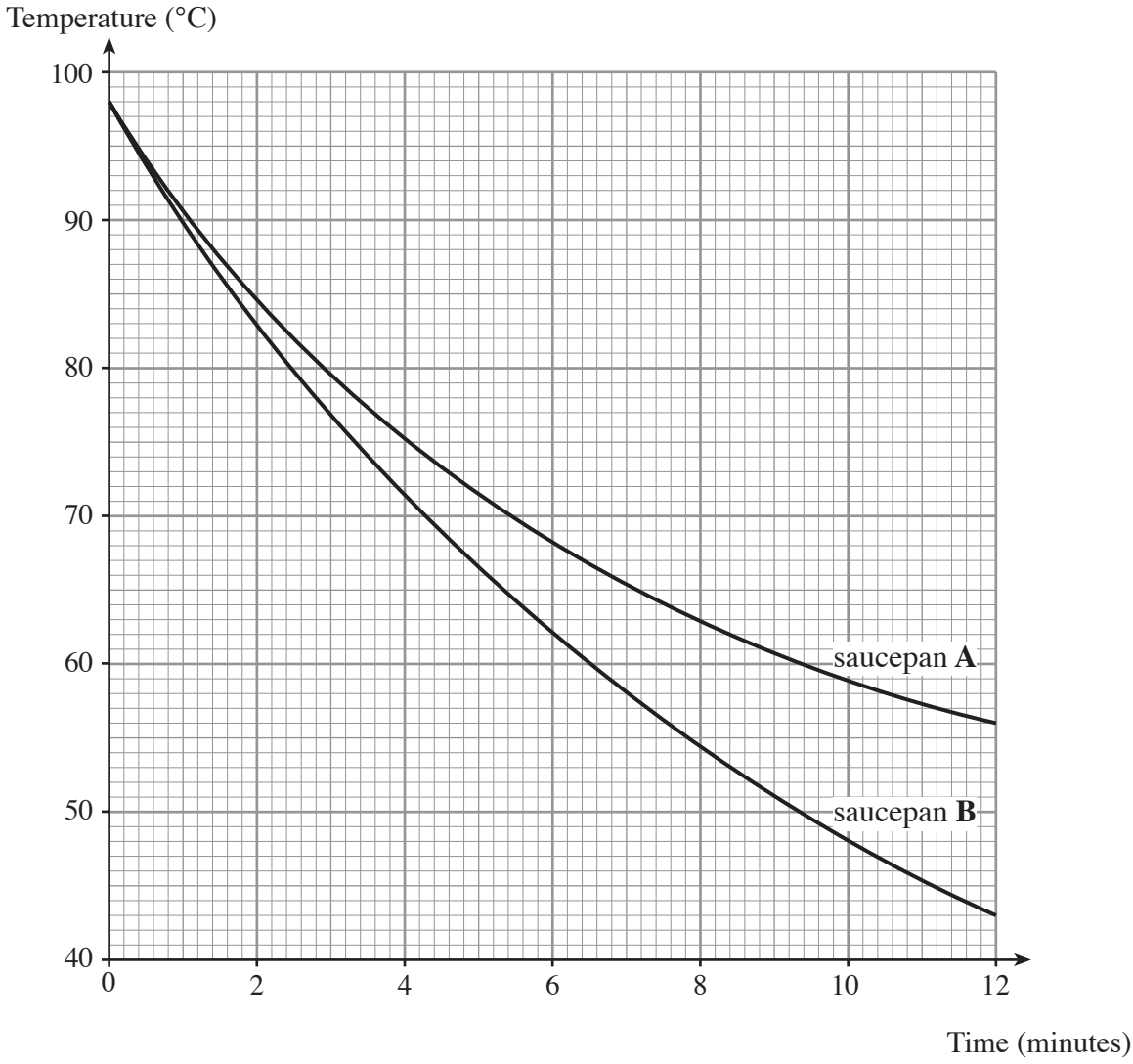
.....

.....

.....

8

18. Two identical saucepans, one black, the other silver, contain the same volume of hot water at the same temperature. They are allowed to cool under identical conditions. The cooling curves are shown below.



(a) (i) Describe the processes by which the water in both saucepans loses heat to the surroundings. [3]

.....

.....

.....

.....

.....

.....

(ii) Explain fully why the water in saucepan **B** loses more heat than the water in saucepan **A**. [2]

.....

.....

.....

.....

(b) Use the graph to find

(i) the temperature of the water in saucepan **A** after 6·6 minutes; ..... °C

(ii) the average temperature fall per minute of the water in saucepan **B** over the whole time of the experiment. [3]

temperature fall per minute = ... °C/min

(c) The average rate of heat energy loss by the water in saucepan **B** was 11 550 J per minute. Use the equation

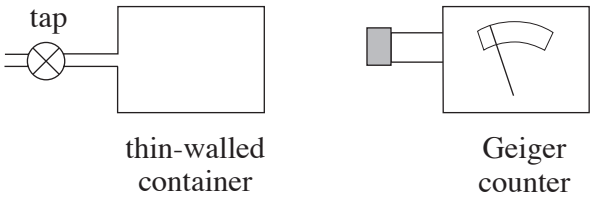
$$\text{Energy transferred (J)} = \text{mass (kg)} \times \text{specific heat capacity (J/kg°C)} \times \text{temperature change (°C)}$$

to calculate the mass of water in saucepan **B**. [3]
[specific heat capacity of water = 4200 J/kg°C]

mass of water = ... kg

11

19. The apparatus below was set up and the Geiger counter registered an average reading of **20 counts per minute**.



The thin-walled container was filled with a sample of a radioactive gas, the tap closed and the **activity** [the counts per minute] measured at 1 hour intervals.

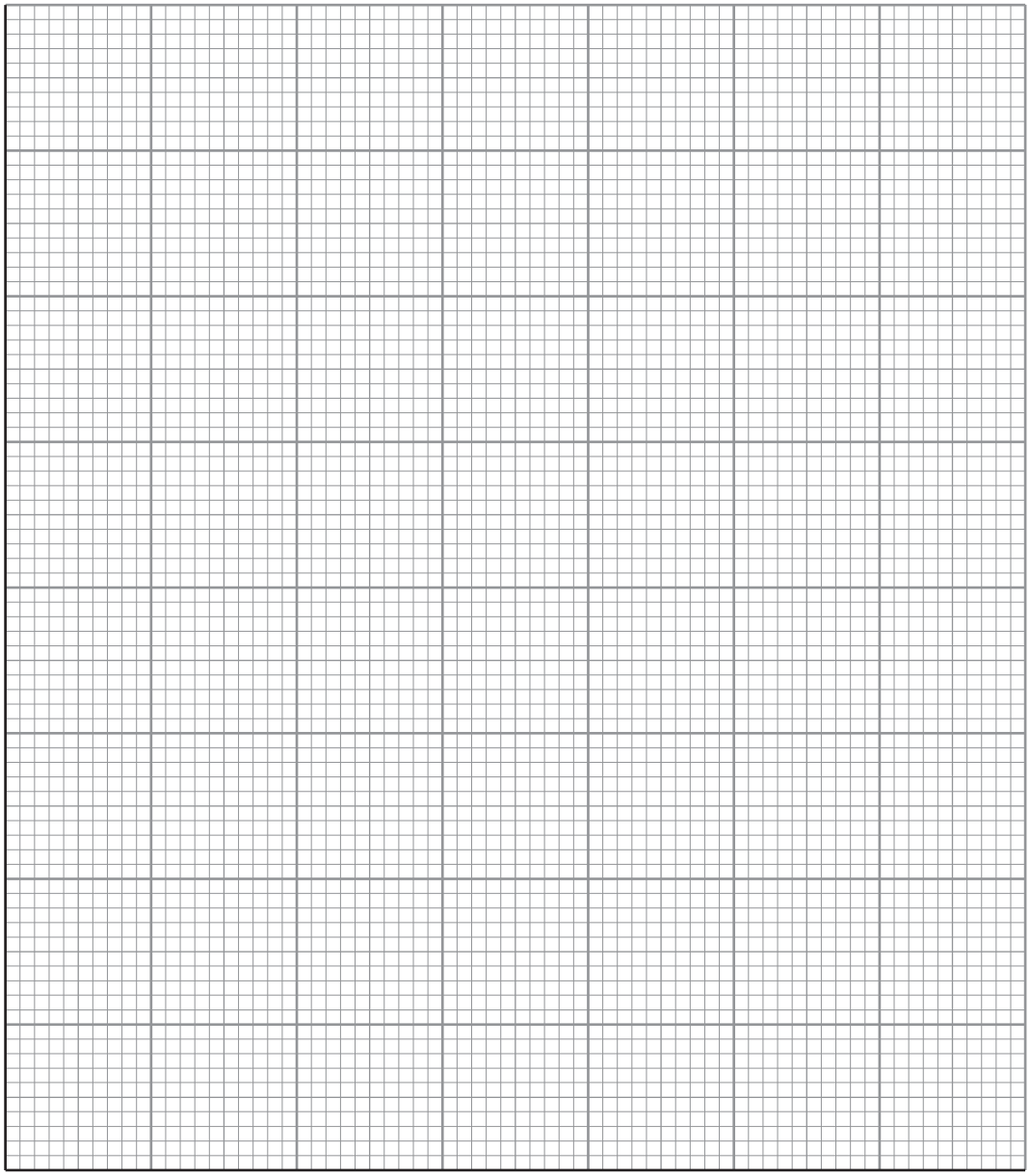
Time (hours)	0	1	2	3	4	5	6
Count rate (counts per minute)	100	81	66	55	46	40	35
Count rate from the gas (counts per minute)	.....	.....	.....	.....	.....	.....	.....

(a) (i) Explain what caused the count rate of **20 counts per minute** before the gas was introduced. [1]

.....

(ii) **Complete the table** to show the count rate due to the radioactive gas only. [1]

(iii) On the grid on the next page, plot a graph of **count rate for the gas** against **time**. [3]



(iv) Calculate the half-life of the gas, showing clearly how you arrived at your answer. [2]

half-life = ... hours

(b) The radioactive gas is thought to emit **either** α and γ radiation **or** β and γ radiation. Describe briefly an experiment that could determine which is correct. [5]

.....

.....

.....

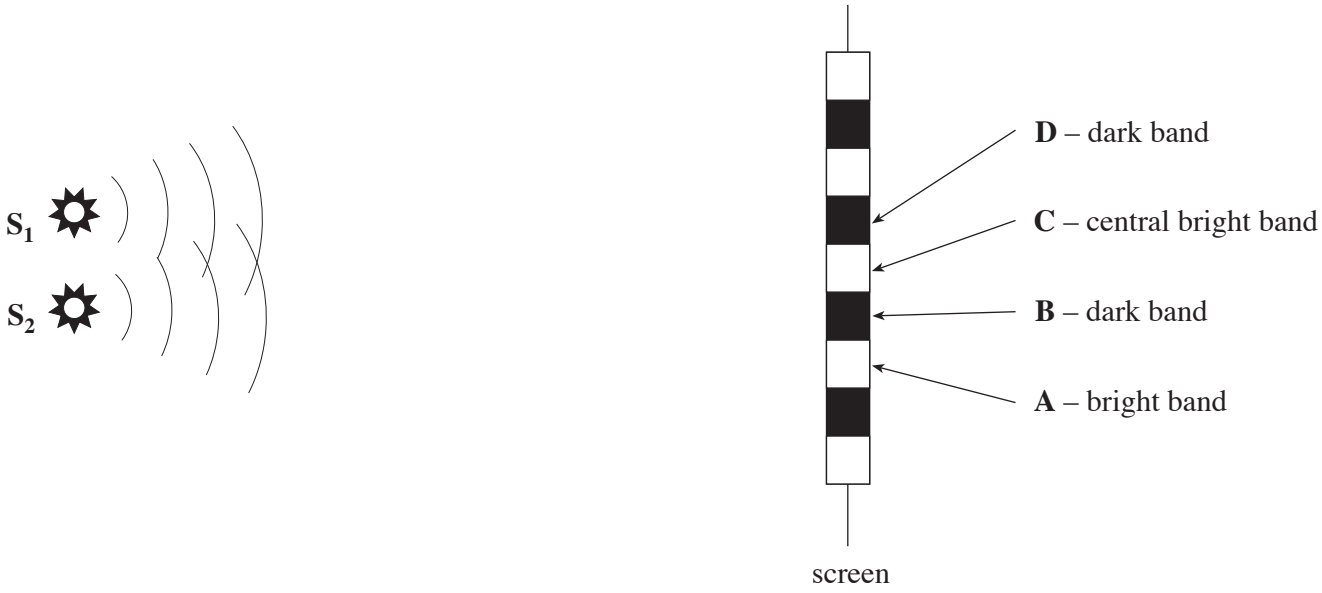
.....

.....

.....

12

20. The diagram shows two light sources, $\mathbf{S_1}$ and $\mathbf{S_2}$, which give out light of the same wavelength. An interference pattern, of alternating bright and dark bands of light is produced on the screen.



(a) At which point on the screen has light from $\mathbf{S_1}$ travelled the same distance as light from $\mathbf{S_2}$?

..... [1]

(b) (i) A dark band is formed at **B**.
Name this effect and explain why it occurs. [3]

.....

.....

.....

.....

.....

(ii) A bright band is produced at **A**.
Name this effect and explain why it occurs. [3]

.....

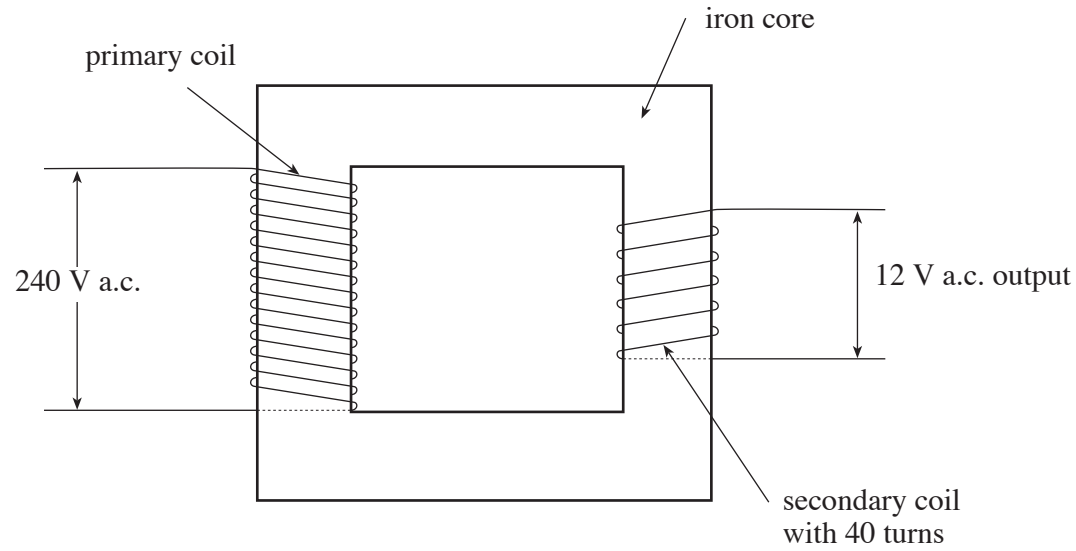
.....

.....

.....

.....

21. The diagram shows a mains transformer which operates a 12 V, 48 W fish tank heater.



(a) (i) State what the alternating voltage, applied to the primary coil, produces in the iron core. [1]

.....

(ii) Explain how this causes an alternating voltage to be produced in the secondary coil. [2]

.....

.....

.....

(iii) Explain why the transformer will not work when a d.c. voltage is applied to the primary coil. [1]

.....

(b) (i) Write down the equation connecting the number of turns on each of the coils ($N_{primary}$, $N_{secondary}$) and the voltage across each of the coils ($V_{primary}$, $V_{secondary}$). [1]

.....

.....

(ii) Use the equation, together with data given on the diagram, to calculate the number of turns on the primary coil. [2]

$N_{primary}$ = ... turns

(c) The output power from the transformer is 48 W. The transformer is 100% efficient.

(i) What is the input power to the primary coil? [1]

input power = ... W

(ii) Write down, in words, an equation connecting **voltage**, **current** and **power**. [1]

.....

.....

(iii) Calculate the current flowing in the primary coil. [2]

current = ... A

11