

FOR OFFICIAL USE

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NATIONAL
QUALIFICATIONS
2009

TUESDAY, 26 MAY
9.00 AM – 10.30 AM

PHYSICS
STANDARD GRADE
General Level

Fill in these boxes and read what is printed below.

Full name of centre

Town

Forename(s)

Surname

Date of birth

Day Month Year

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Scottish candidate number

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Number of seat

Reference may be made to the Physics Data Booklet.

- All questions should be answered.
- The questions may be answered in any order but all answers must be written clearly and legibly in this book.
- For questions 1–6, write down, in the space provided, the letter corresponding to the answer you think is correct. There is only **one** correct answer.
- For questions 7–20, write your answer where indicated by the question or in the space provided after the question.
- If you change your mind about your answer you may score it out and replace it in the space provided at the end of the answer book.
- If you use the additional space at the end of the answer book for answering any questions, you **must** write the correct question number beside each answer.
- 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.

Use **blue** or **black ink**. Pencil may be used for graphs and diagrams only.



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1. What is the frequency of a wave, if 20 crests pass a point in two seconds?

- A 0.1 hertz
- B 2 hertz
- C 10 hertz
- D 20 hertz
- E 40 hertz

Answer

1

2. How long does a geostationary satellite take to orbit the Earth?

- A 1 hour
- B 1 day
- C 1 week
- D 1 month
- E 1 year

Answer

1

3. Which of the following will **not allow** the transmission of sound waves?

- A Brick
- B Vacuum
- C Water
- D Air
- E Wood

Answer

1

4. Which of the following statements is **always** true about the structure of the atom?

- A It has more electrons than protons.
- B It has more protons than neutrons.
- C It has an equal number of protons and electrons.
- D It has more neutrons than protons.
- E It has an equal number of neutrons and electrons.

Answer

1

Marks

5. Which of the following is a digital output device?

- A Solenoid
- B Loudspeaker
- C Motor
- D Lamp
- E Microphone

Answer

1

6. In which of the following would a voltage **not** be induced in a coil of wire?

- A Rotating the coil of wire near to a magnet
- B Rotating a magnet near to the coil of wire
- C Holding a magnet stationary within the coil of wire
- D Moving a magnet in and out of the coil of wire
- E Moving the coil of wire between the poles of a magnet

Answer

1

[Turn over

Marks

7. A student listens to his radio using headphones.



- (a) State the main energy transformation that takes place in the headphones.

.....

1

The table shows the frequencies for different radio stations.

<i>Radio Station</i>	<i>Frequency</i> (mega hertz)
Forth 1	97.3
Real Radio	101.0
Radio Borders	103.1
Isles	103.0
Central Scotland FM	103.1
Radio Scotland	95.0

- (b) Explain why the radio stations Radio Borders and Central Scotland FM are allowed to transmit at the same frequency.

.....

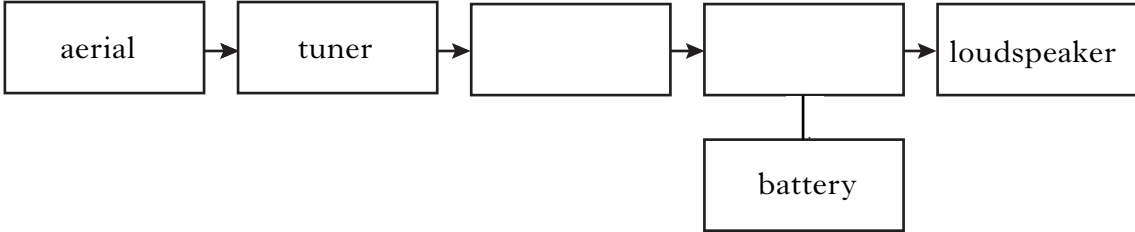
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7. (continued)

(c) The block diagram shows some of the main parts of a radio receiver.



(i) Complete the block diagram by filling in the missing labels.

1

(ii) What is the purpose of the tuner?

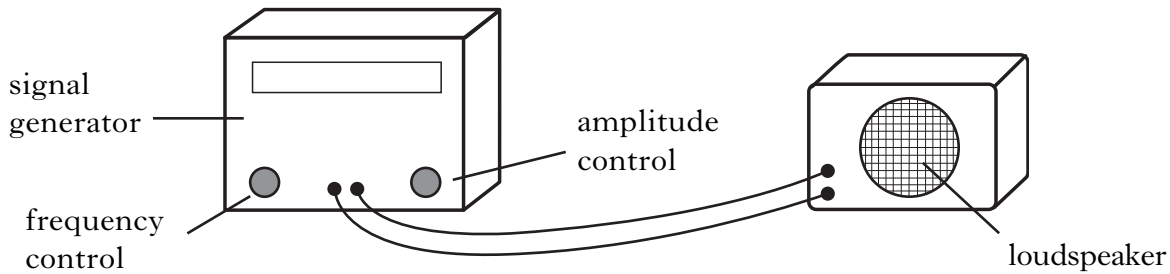
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8. An experiment is set up to investigate sound waves.
A signal generator is connected to a loudspeaker.
The signal generator has a frequency control and an amplitude control.



- (a) Complete the sentence below by circling the correct answer.

The $\left\{ \begin{array}{l} \text{amplitude} \\ \text{frequency} \end{array} \right\}$ control is used to adjust the loudness of the sound wave. **1**

- (b) The controls of the signal generator are set up to produce a sound wave from the loudspeaker.

An oscilloscope is now connected across the loudspeaker.

The oscilloscope trace is shown in Figure 1.

Complete Figure 2 to show the trace obtained when the frequency is **doubled**, but the amplitude remains unchanged.

The oscilloscope controls are unchanged.

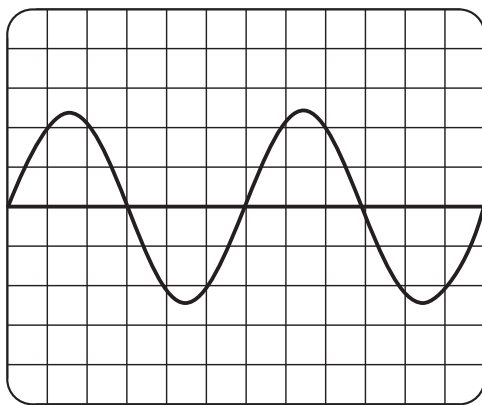


Figure 1

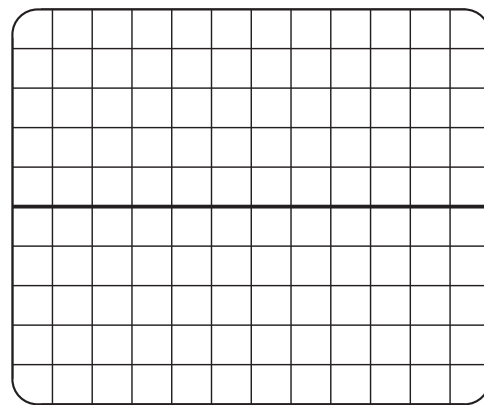


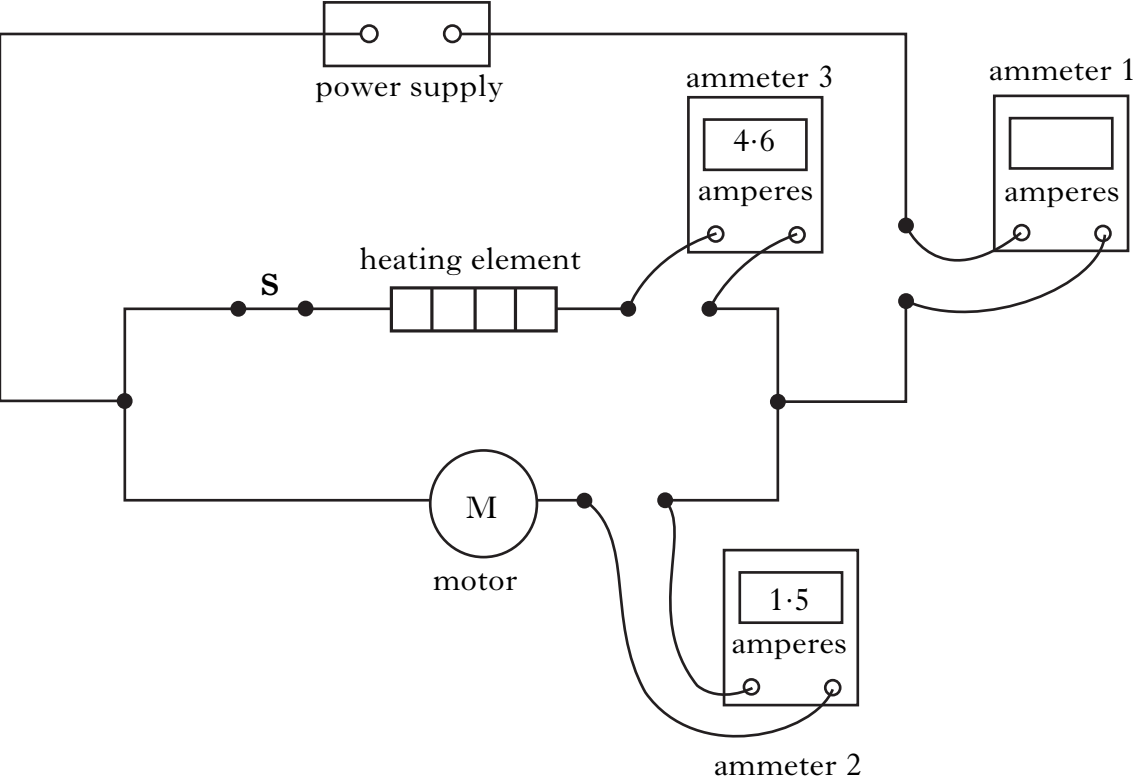
Figure 2

2

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9. A design engineer uses three ammeters to measure the current, in amperes, at various points in the circuit of a model-sized electrical fan heater.



(a) Calculate the reading on ammeter 1.

Space for working and answer

(b) What happens to the reading on ammeter 1 when switch S is opened?

.....

(c) The full size mains fan heater has a rating plate for UK supply stating its operating voltage and frequency.

Complete parts (i) and (ii) below by circling the correct answers.

(i) The voltage is $\left\{ \begin{matrix} 110 \\ 230 \\ 325 \end{matrix} \right\}$ volts $\left\{ \begin{matrix} \text{a.c.} \\ \text{d.c.} \end{matrix} \right\}$.

(ii) The mains frequency is $\left\{ \begin{matrix} 50 \\ 60 \\ 115 \end{matrix} \right\}$ hertz.

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10. Party lights consist of 16 identical light bulbs connected in series. They operate from a 24 volt power supply. The current in the circuit is 1.25 amperes.

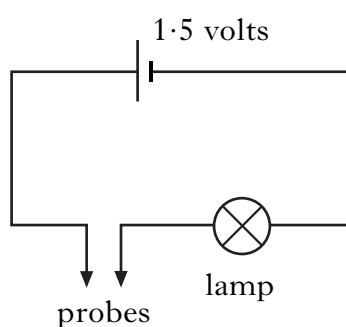
(a) Calculate the total resistance of the bulbs in the circuit.

Space for working and answer

(b) Calculate the voltage across each light bulb.

Space for working and answer

(c) A fault occurs in the circuit and a continuity tester is needed to find the fault. The circuit diagram for the continuity tester is shown.



(i) Describe how the continuity tester could be tested to make sure that it is working.

.....

(ii) The continuity tester is found to be faulty.

State one possible reason why it is not working.

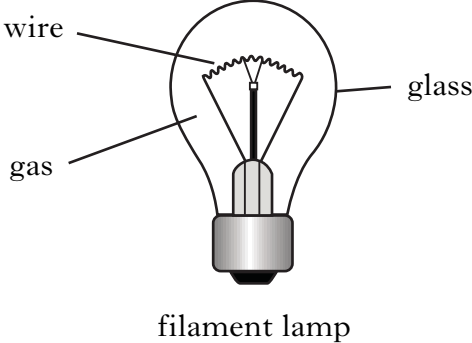
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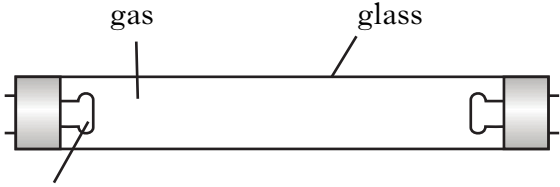
Marks

10. (continued)

(d) Conventional filament lamps are now being replaced by discharge tubes.



filament lamp



discharge tube

(i) State where the energy transformation occurs in:

(A) the filament lamp;

.....

1

(B) the discharge tube.

.....

1

(ii) State why discharge tubes are replacing conventional filament lamps.

.....

1

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11. (continued)

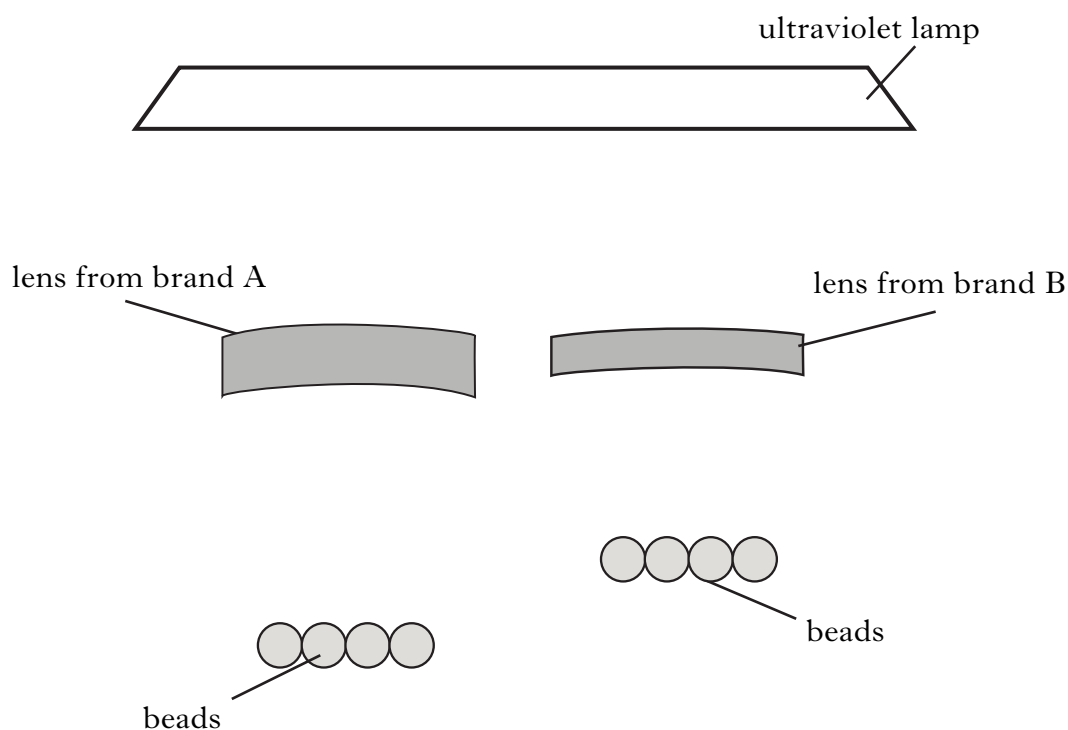
(e) A student sets up the following experiment to compare how two different brands of sunglasses protect from ultraviolet radiation.

The student uses beads which change colour when exposed to ultraviolet radiation.

The student covers one set of beads with a lens from brand A and another with a lens from brand B.

The ultraviolet lamp is switched on for 30 minutes.

The apparatus is set up as shown.



(i) Give **one** reason why this test is not a fair one.

.....

1

(ii) Why can exposure to ultraviolet radiation be harmful to humans?

.....

1

[Turn over

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12. An orchestra uses many different musical instruments.



The table lists the lowest and highest sound frequencies for some of these instruments.

<i>Musical Instrument</i>	<i>Lowest Frequency (hertz)</i>	<i>Highest Frequency (hertz)</i>
Acoustic Guitar	73	1174
Piano	28	4186
Flute	261	2637
Trumpet	165	1046
Violin	196	3520
Cello	65	660
Piccolo	523	4000

(a) (i) Which instrument in the table produces the longest wavelength?

..... **1**

(ii) Calculate the wavelength for the lowest frequency of a piccolo.
(The speed of sound in air is 340 metres per second.)

Space for working and answer

2

(b) During one concert performance the sound level was measured.

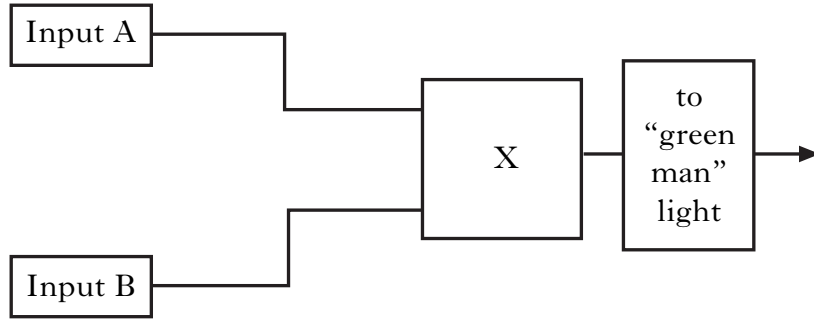
State the unit of sound level measurement.

..... **1**

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14. A pedestrian crossing at a set of traffic lights has an electronic control system to operate the “green man” light. Part of the system is shown.



Input A is from the traffic lights and gives a logic 1 when the red light only is on, and a logic 0 at other times.

Input B is operated by pedestrians when they want to cross.

(a) State a suitable input device to be used by the pedestrians to activate the “green man” light.

.....

1

(b) The “green man” light comes on when the red traffic light, only, is on and the crossing is operated by a pedestrian. What type of logic gate should be used at position X?

.....

1

(c) The “green man” light consists of a number of LEDs.

(i) Draw the symbol for an LED.

Space for symbol

1

(ii) Why does each LED need a series resistor?

.....

1

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14. (continued)

(d) The “green man” light has to stay on long enough for the pedestrian to cross.

This crossing has a display to show pedestrians the number of seconds the “green man” light will remain on.

State an output device that could be used to display this time.

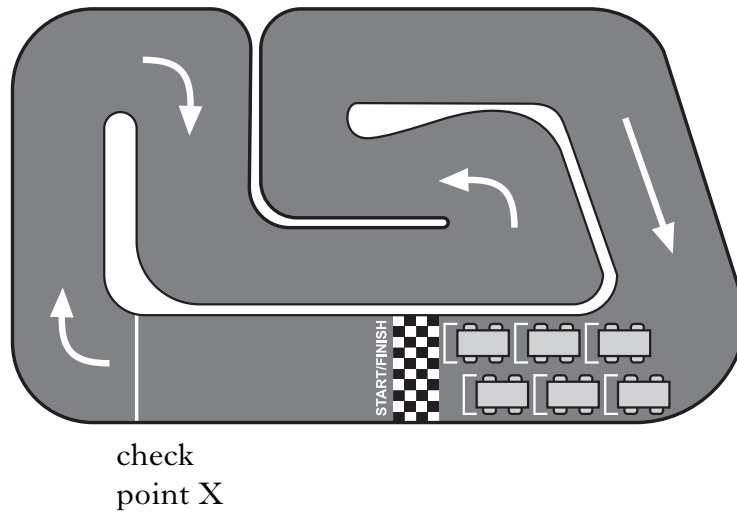
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15. An indoor kart track hosts a racing competition.



(a) Describe how to find the average speed of a kart for one complete lap of the track.

You must state the measurements that are made and how they are used.

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3

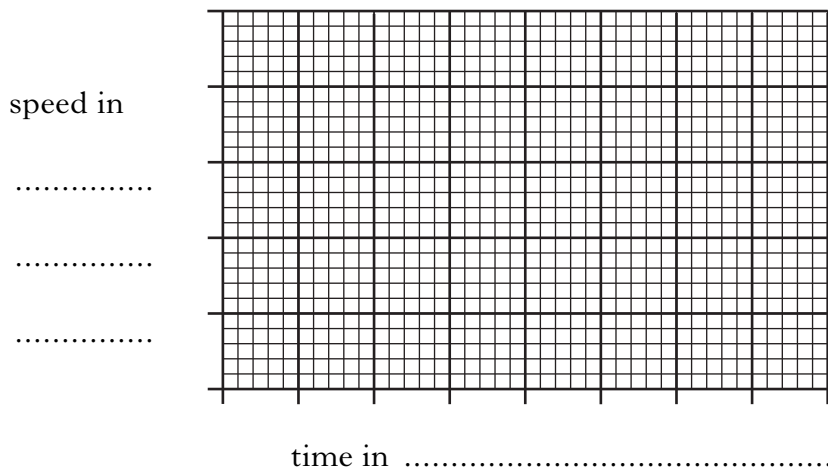
(b) The speed of a kart and driver is recorded from the start of the race.

The kart starts from rest and accelerates uniformly until it reaches check point X. Its speed at X is 12 metres per second.

The time taken to reach X is 4 seconds.

(i) Draw a speed-time graph for the motion of the kart from the start until it reaches check point X.

Units and numerical values must be shown on both axes.



3

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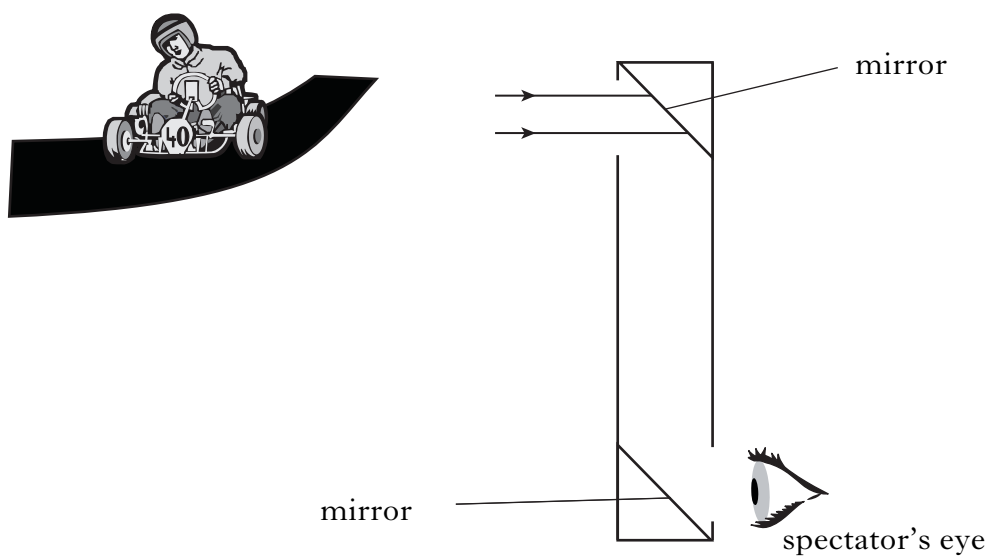
15. (b) (continued)

- (ii) Calculate the acceleration of the kart between the start and check point X.

Space for working and answer

2

- (c) Some spectators at the race track are finding it difficult to see the race. One spectator uses a periscope. A periscope can be made from a cardboard tube with two plane mirrors as shown.



Complete the diagram to show how the rays of light travel through the periscope to the spectator's eye.

1

[Turn over

Marks

16. A climber of weight 550 newtons takes 40 seconds to reach the top of a 20 metre high climbing wall.



- (a) What is the minimum upward force she exerts while climbing the wall?

.....

1

- (b) Calculate the minimum work done by the climber to reach the top of the wall.

Space for working and answer

2

- (c) Calculate her power during this climb.

Space for working and answer

2

- (d) Explain why the climber uses chalk on her hands as she climbs the wall.

.....

1

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17. A house is designed to conserve as much energy as possible.



(a) Heat energy can be lost from the house by a variety of means. Insulation is used to reduce heat loss.

Match the correct type of insulation given in the word bank with each type of heat loss.

Use each answer once only.

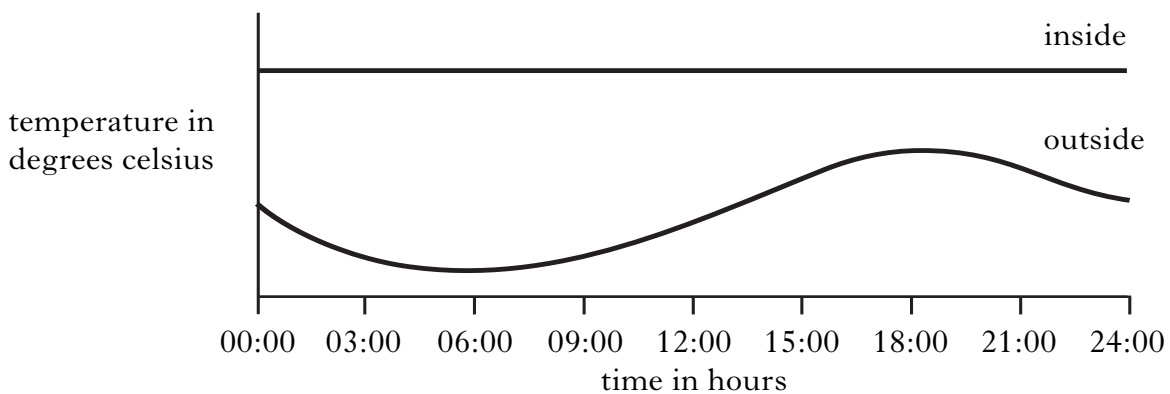
foil-backed plasterboard	double glazing	loft insulation
---------------------------------	-----------------------	------------------------

<i>Type of heat loss</i>	<i>Correct insulation</i>
Conduction	
Convection	
Radiation	

2

The temperature in the house is kept at a constant value while the temperature outside changes.

The graph shows the temperature inside the house and the temperature outside the house over a 24 hour period.



(b) Write down the time at which heat loss from the house is greatest.

.....

1

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18. (continued)

(c) A nuclear power station with a power output of 1.5 gigawatts could be replaced by pumped hydroelectric power stations.

(i) Some of the stages in a nuclear power station are shown.



At what stage is the main energy transformation:

(A) kinetic → electrical;

.....

1

(B) nuclear → heat?

.....

1

A pumped hydroelectric power station produces 0.25 gigawatts of power.

(ii) Give **one** advantage of a pumped hydroelectric station over a normal hydroelectric station.

.....

.....

1

(iii) How many pumped hydroelectric stations would be needed to replace the nuclear power station?

Space for working and answer

1

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19. (a) State an optical device that can split white light into different colours.

.....

1

- (b) Astronomers can use the peak wavelength of light emitted by stars to provide information about their temperature. The peak wavelength corresponds to a particular colour.

Information about three stars is given in the table.

<i>Star</i>	<i>Colour of peak wavelength in visible spectrum</i>
Rigel	Blue
Betelgeuse	Red
Sun	Green

The shorter the peak wavelength, the hotter the star is.

- (i) Which star is hottest?

.....

1

- (ii) Is the sun hotter, colder or the same temperature as Betelgeuse?

.....

1

- (c) Telescopes can detect visible light waves.

Name **one** other type of wave that can be detected using a telescope.

.....

1

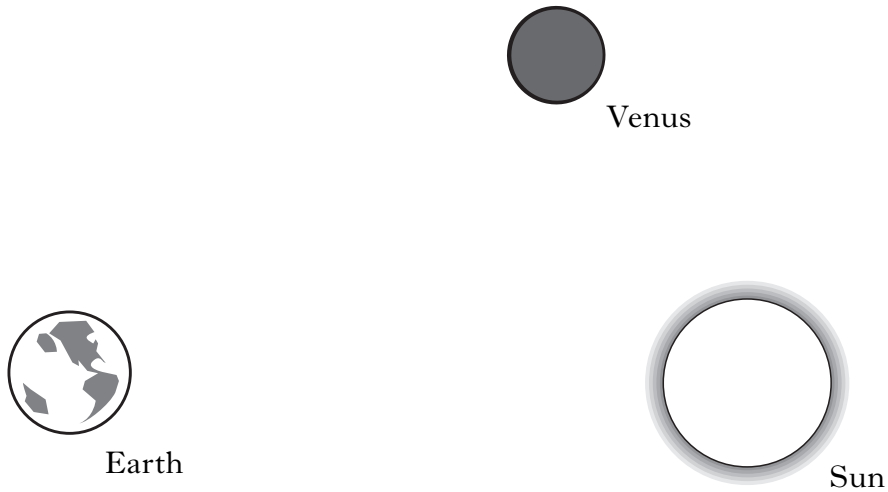
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19. (continued)

(d) The planet Venus is often seen in the evening and morning close to the horizon.

Draw light rays on the diagram to show how observers on Earth are able to see Venus.

You must put arrows on the rays to show their direction.



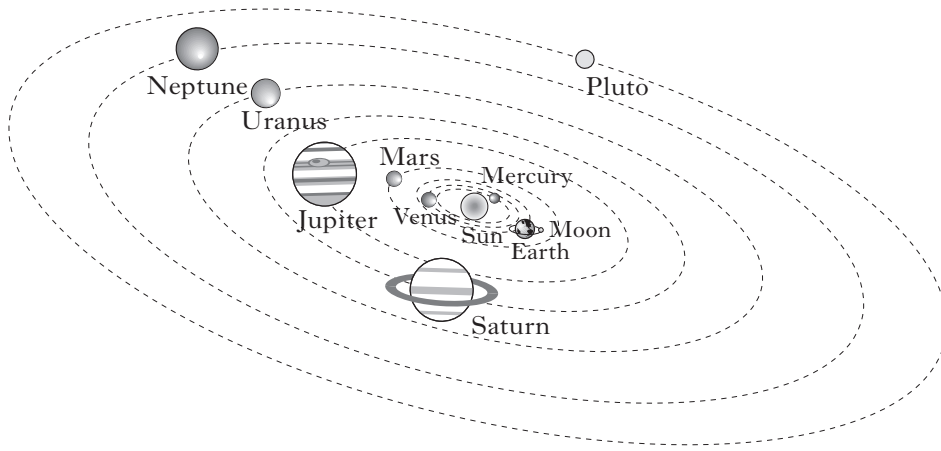
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20. Astronomers study space.



Complete the sentences by circling the correct answers.

(a) The Earth is a $\begin{cases} \text{planet} \\ \text{moon} \\ \text{star} \end{cases}$ which orbits the Sun. The Earth has one natural

satellite called the $\begin{cases} \text{International Space station} \\ \text{Hubble telescope} \\ \text{Moon} \end{cases}$.

1

(b) The Sun is at the centre of our $\begin{cases} \text{solar system} \\ \text{universe} \\ \text{galaxy} \end{cases}$. Light from the Sun takes

about $\begin{cases} \text{8 seconds} \\ \text{4.3 years} \\ \text{8 minutes} \end{cases}$ to travel to the Earth.

1

(c) The nearest star to the Earth is $\begin{cases} \text{Sirius} \\ \text{Mars} \\ \text{the Sun} \end{cases}$.

All of space is known as the $\begin{cases} \text{Milky Way} \\ \text{solar system} \\ \text{universe} \end{cases}$.

1

[END OF QUESTION PAPER]

ADDITIONAL SPACE FOR ANSWERS

Make sure you write the correct question number beside each answer.

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Make sure you write the correct question number beside each answer.

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