

FOR OFFICIAL USE

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**3220/401**



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NATIONAL  
QUALIFICATIONS  
2010

FRIDAY, 28 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 1–5, write down, in the space provided, the letter corresponding to the answer you think is correct. There is only **one** correct answer.
- For questions 6–19, 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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Marks

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1. Optical fibres used in telecommunication systems are made from

- A copper
- B cotton
- C water
- D glass
- E aluminium.

Answer

1

2. The three colours of light that mix to produce all the colours seen on a TV screen are

- A red, green and blue
- B red, yellow and blue
- C magenta, green and cyan
- D magenta, yellow and cyan
- E green, yellow and blue.

Answer

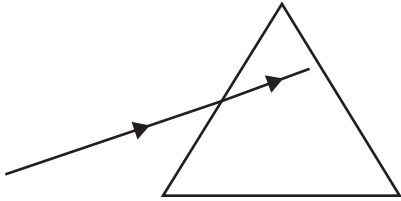
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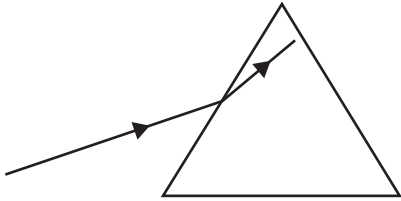
Marks

3. Which of the following diagrams shows the correct path of a ray of blue light as it passes from air into a glass prism?

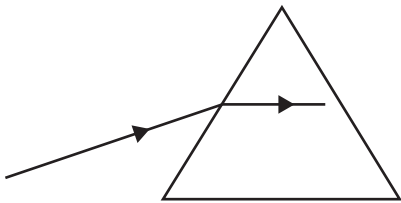
A



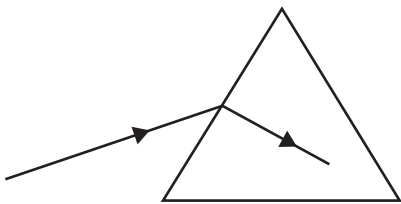
B



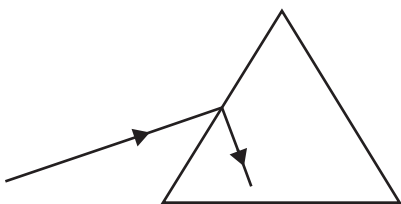
C



D



E



Answer

1

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1		
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4. A stethoscope is used to
- A measure body temperature
  - B correct long sight
  - C treat skin diseases
  - D listen to sounds within the body
  - E produce an image of the inside of the body.

Answer

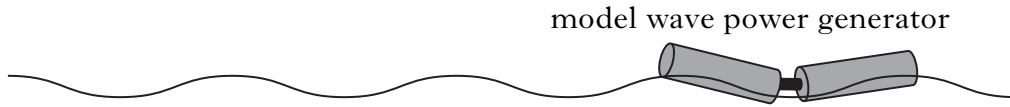
5. Which one of the following sources of energy is renewable?
- A uranium
  - B hydroelectric
  - C coal
  - D oil
  - E gas

Answer

[Turn over

Marks

6. The diagram shows part of a water tank used to test a model wave power generator.



A wave power generator uses waves to generate electricity.

- (a) (i) A machine in the tank produces 20 waves in 10 seconds.  
Calculate the frequency of the waves.

*Space for working and answer*

1

- (ii) The wavelength of the waves in the tank is 1.2 metres.  
Calculate the speed of the waves in the tank.

*Space for working and answer*

2

- (b) The amplitude of the waves in the tank is 0.15 metres.  
Calculate the maximum vertical distance the wave power generator moves through.

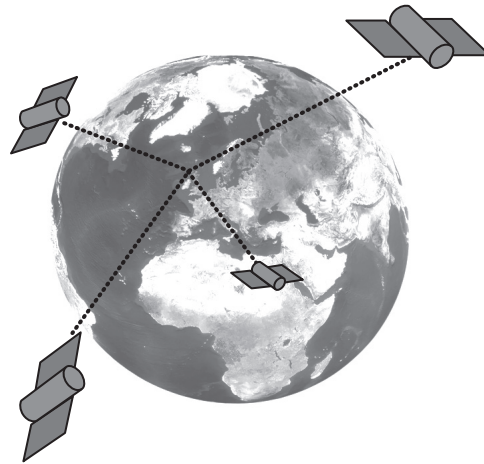
*Space for working and answer*

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7. A satellite navigation system receives radio signals transmitted by satellites in orbit around the Earth.



The satellite navigation system finds its location by calculating the distance the transmitted signals travel.

(a) In addition to the speed of the signals, what other quantity must be known to calculate distance?

..... 1

(b) Complete the passage below using words from the following list.

**greater sound light energy height mass less**

Radio signals are waves which transfer ..... The radio signals travel at the speed of light, which is ..... than the speed of sound. The period of a satellite orbit depends on its ..... above the Earth.

3

(c) A curved reflector is often used to make the signals received from a satellite stronger. Complete the diagram to show the effect of a curved reflector on the transmitted signals.



2

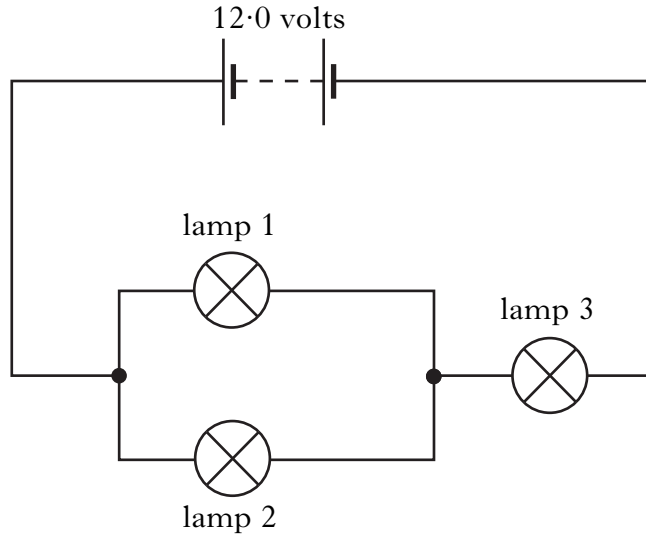




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8. (continued)

(b) The lamps are now connected as shown in circuit 2. The 12.0 volt battery supplies a current of 0.40 ampere to this circuit.



Circuit 2

(i) Complete the table to show the current in each lamp and the voltage across each lamp.

	Lamp 1	Lamp 2	Lamp 3
Voltage (volts)			8.0
Current (amperes)			0.4

2

(ii) Calculate the power dissipated in lamp 3.

*Space for working and answer*

2

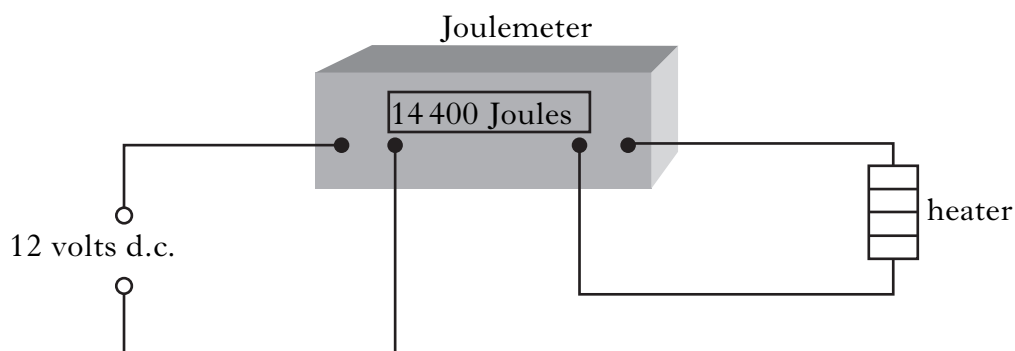
(iii) State the **useful** energy change in this lamp.

.....

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9. The electrical energy used by a 48 watt heater is measured with a joulemeter as shown. The time taken to supply this energy is measured with a timer.



- (a) The energy supplied is displayed on the joulemeter.  
(i) Calculate the time taken to supply this energy.

*Space for working and answer*

- (ii) The power supply provides direct current.  
Explain what is meant by direct current.

.....

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<b>1</b>		

**9. (continued)**

(b) Some household appliances are shown in the table.

(i) Complete the table using the correct power ratings from the list below.

- 60 watts**
- 2800 watts**
- 8000 watts**

<i>Appliance</i>	<i>Power (watts)</i>
Kettle	
Bedside lamp	
Cooker	

(ii) Some appliances have an earth wire.

State the purpose of the earth wire.

.....

.....

**[Turn over**

Marks

10. A student uses a sound level meter to measure some sound levels.  
The student records the results in the table.

<i>Source of sound</i>	<i>Sound level (decibels)</i>
school bell at 1 metre	100
inside a classroom	60
normal conversation	50
whisper	20

- (a) (i) Humans can only hear sounds above a certain sound level.  
What is the value of this sound level in decibels?

..... 1

- (ii) When one source of sound is twice as loud as another, the sound level increases by 10 decibels.

Which one of the **above sources** is twice as loud as the level of a normal conversation?

..... 1

- (b) The student measures the sound levels from earphones connected to an MP3 player.



Sound levels up to 102 decibels are measured.

Explain why the student should reduce the sound level to below 80 decibels before wearing the earphones.

..... 1

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**10. (continued)**

(c) The student now measures the range of sound frequencies that humans can hear.

(i) What name is given to high frequency sounds beyond the range of human hearing?

..... **1**

(ii) Give **one** example of a use of these high frequency sounds in medicine.

..... **1**

**[Turn over**

*Marks*

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**11.** Read the following passage.

In a hospital, a new digital X-ray imaging system is being used to replace photographic film. In the digital system, X-rays are detected by sensors and an image displayed on a computer screen.

Photographic film, which contains silver, is expensive and hazardous chemicals are used to develop the film. The digital system is less expensive, does not use hazardous chemicals and the X-ray image is obtained in a shorter time.

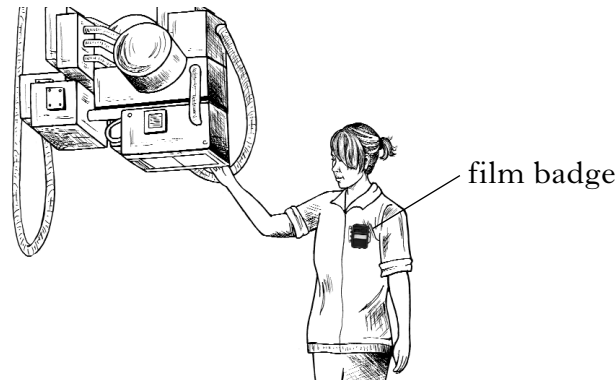
(a) Using information **given in the passage** state **two** advantages of the digital X-ray imaging system.

Advantage 1 .....

Advantage 2 .....

**2**

(b) (i) Hospital staff who operate X-ray machines wear film badges.



A film badge contains photographic film sealed in a plastic holder. Light cannot enter the film badge.

What effect does X-ray radiation have on photographic film?

.....

**1**

(ii) Suggest a reason why hospital staff wear film badges.

.....

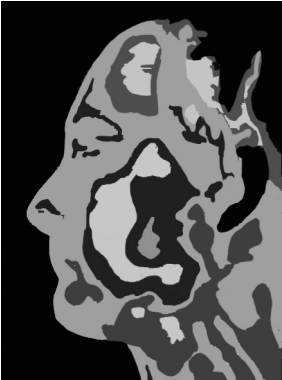
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**11. (continued)**

- (c) Another imaging system makes use of the invisible heat rays given out by the human body. The images produced by this system are called thermograms.



State the radiation used to make thermograms.

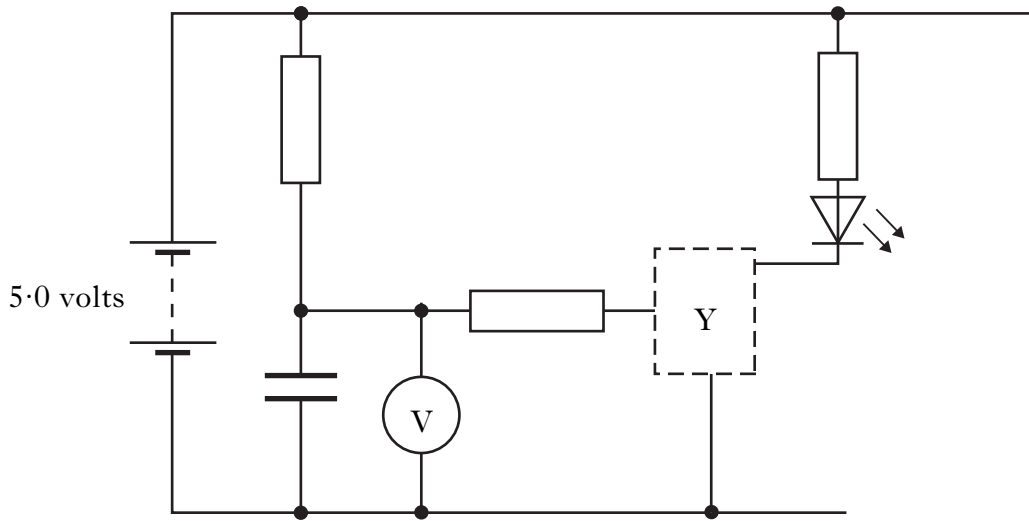
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12. (a) The circuit below can be used to light an LED after a short time delay. The capacitor is charged using the 5.0 volt supply.



- (i) State what happens to the voltage across the capacitor when it charges.

.....

1

- (ii) Component Y is a transistor.  
Draw the symbol for a transistor.

*Space for drawing*

1

- (iii) State the function of the transistor in this circuit.

.....

1

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(i)		
(ii)		
(iii)		

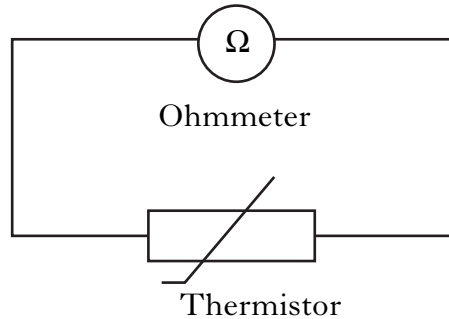


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12. (continued)

- (b) The circuit below is used to monitor temperature changes in a liquid. The thermistor is immersed in the liquid.

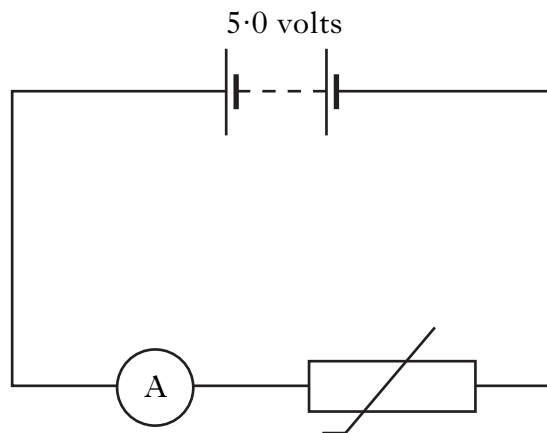


- (i) State what happens to the reading on the ohmmeter as the liquid cools.

.....

1

- (ii) The thermistor is now connected to a battery and an ammeter as shown.



Calculate the current in the circuit when the resistance of the thermistor is 1000 ohms.

*Space for working and answer*

2

[Turn over

Marks

13. Two identical LEDs are connected as shown in the circuit below.

5 volts

One LED fails to light. The circuit is complete and none of the components are faulty.

(a) (i) Explain why one LED does not light.

.....

1

(ii) Explain why the series resistor R is needed.

.....

.....

1

(b) The table shows energy conversions that can take place in electronic output devices.

(i) Complete the table.

<i>Energy in</i>	<i>Output device</i>	<i>Energy out</i>
electrical		sound
electrical	LED	light
electrical		kinetic
electrical	heater	heat

1

(ii) Output devices can be analogue or digital.

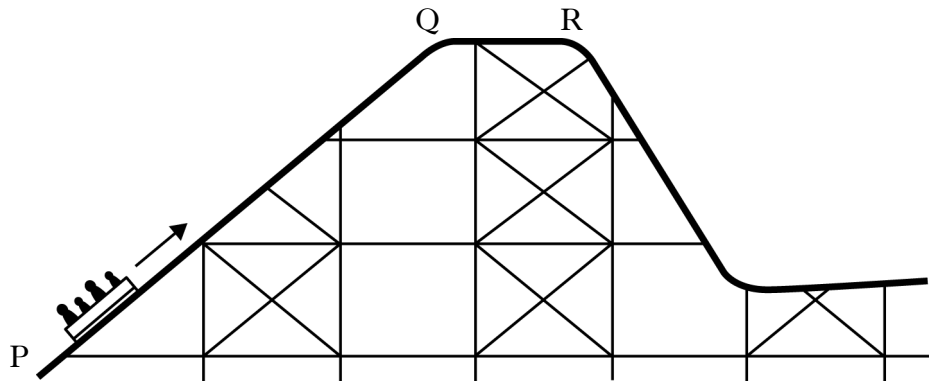
Name **one** digital output device.

.....

1

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14. A carriage on a roller coaster is pulled up the first slope.



- (a) The carriage is pulled up the slope from P to Q at a constant speed.  
What can be said about the forces acting on the carriage as it is pulled up the slope?  
.....
- (b) The carriage is released from rest at R. After a time of 2.5 seconds, the carriage has reached a speed of 14 metres per second.  
Calculate the acceleration of the carriage.

*Space for working and answer*

- (c) The carriage travels a total distance of 720 metres in a time of 100 seconds.  
Calculate the average speed of the carriage.

*Space for working and answer*

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1		
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15. A passenger at an airport pulls a suitcase towards the check-in desk.



(a) The suitcase has been designed to reduce the effects of friction when it is pulled.

(i) Explain how the suitcase has been designed to reduce friction.

.....

1

(ii) Why is it important to reduce the force of friction on the suitcase?

.....

1

(b) The suitcase is pulled for a distance of 15 metres using a force of 20 newtons.

Calculate the work done in pulling the suitcase.

*Space for working and answer*

2

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## 15. (continued)

- (c) (i) At the check-in desk, the suitcase is lifted through a vertical height of 0.4 metres onto a scale. The reading on the scale is 16 kilograms.

Calculate the gravitational potential energy gained by the suitcase when it is lifted onto the scale.

*Space for working and answer*

2

- (ii) The maximum weight allowed for a suitcase is 150 newtons. Is the weight of the suitcase within the weight limit? You **must justify** your answer with a calculation.

*Space for working and answer*

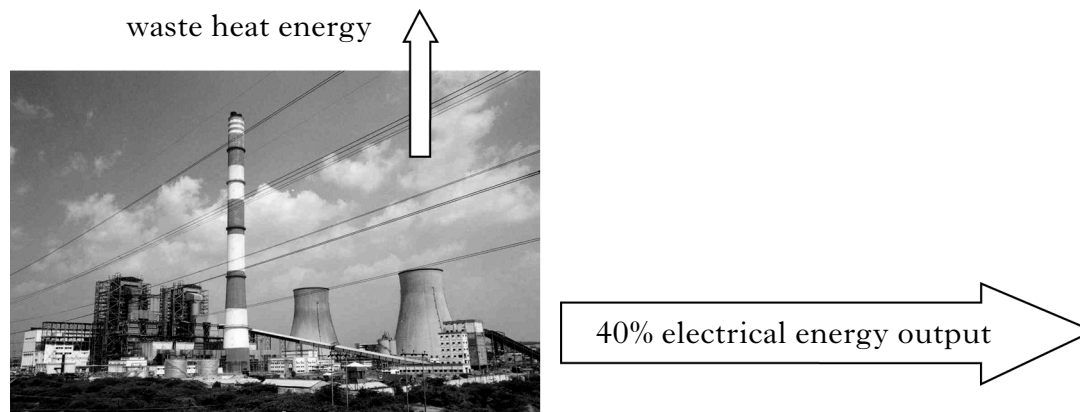
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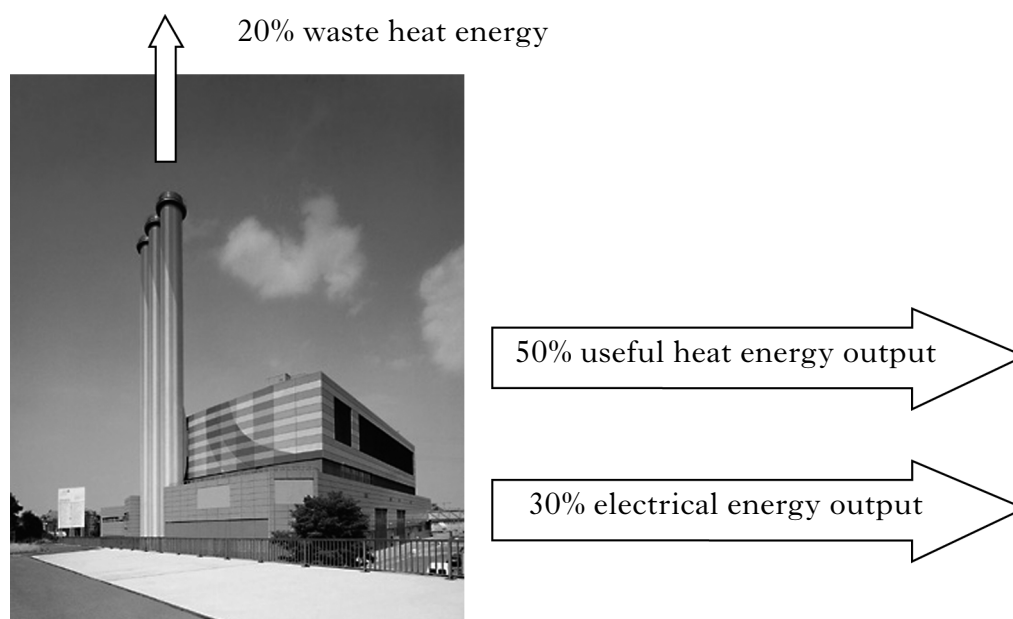
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16. A thermal power station has an efficiency of 40%. A combined heat and power station is more efficient; it uses heat to produce hot water for homes as well as generating electrical energy. The energy output for each power station is shown in the diagrams below.



*Thermal power station*



*Combined heat and power station*

- (a) (i) Calculate the percentage of waste heat for the **thermal power station**.

*Space for working and answer*

1

Marks

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1	
	1
	1

16. (a) (continued)

- (ii) Calculate the total percentage useful energy output of the **combined heat and power station**.

*Space for working and answer*

- (b) A combined heat and power station saves energy in the power industry.

- (i) Describe **one** method of saving energy in the home.

.....

- (ii) Describe **one** method of saving energy in transport.

.....

[Turn over

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17. Electrical power is distributed by the National Grid system. Transformers are used in this grid system.



- (a) State why transformers are used in the grid.

.....

1

- (b) The voltages required at various stages of the grid system are shown.

<i>Stage</i>	<i>Voltage (volts)</i>
Super Grid	400 000
National Grid	132 000
Heavy industry	33 000
Light industry	11 000
Homes	230

A transformer transfers power from the National Grid to heavy industry. The primary coil of the transformer has 6000 turns.

- (i) State the voltage input at the primary coil.

.....

1

- (ii) State the voltage output at the secondary coil.

.....

1

- (iii) Calculate the number of turns in the secondary coil.

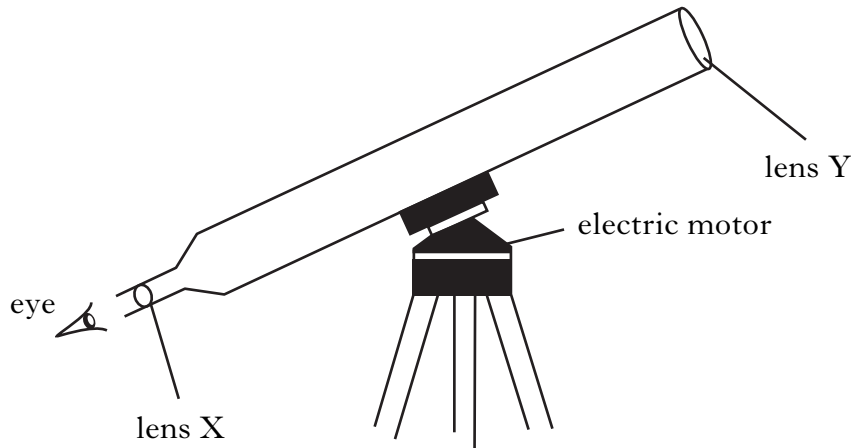
*Space for working and answer*

2



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18. An astronomer uses a refracting telescope to study the Moon.



(a) The telescope has two convex lenses.

Name each of the lenses.

lens X .....

lens Y .....

2

(b) An electric motor turns the telescope to keep it pointing at the Moon.

Suggest a reason why the telescope must turn to keep it pointing at the Moon.

.....

.....

1

(c) Put the following in order of increasing size.

**galaxy                  solar system                  planet                  universe**

*smallest*

.....



.....

.....

*largest*

.....

2

[Turn over



<i>Marks</i>	K&U	PS
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<b>1</b>		

**19. (continued)**

(c) Some spacecraft go into orbit around the Earth after they are launched.

(i) Name the force that acts downwards on a spacecraft in orbit.

.....

(ii) Name the force that causes the spacecraft to heat up when it re-enters the Earth’s atmosphere.

.....

*[END OF QUESTION PAPER]*

**ADDITIONAL SPACE FOR ANSWERS**

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

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