

--	--	--	--	--	--

K & U	PS

Total Marks

**3220/401**NATIONAL  
QUALIFICATIONS  
2008FRIDAY, 23 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

--	--	--	--	--	--

Scottish candidate number

--	--	--	--	--	--	--	--

Number of seat

--

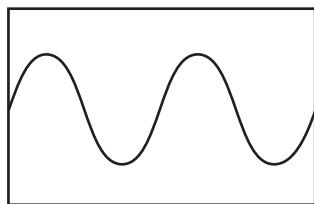
Reference may be made to the Physics Data Booklet.

- 1 All questions should be answered.
- 2 The questions may be answered in any order but all answers must be written clearly and legibly in this book.
- 3 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.
- 4 For questions 6–20, write your answer where indicated by the question or in the space provided after the question.
- 5 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.
- 6 Before leaving the examination room you must give this book to the invigilator. If you do not, you may lose all the marks for this paper.

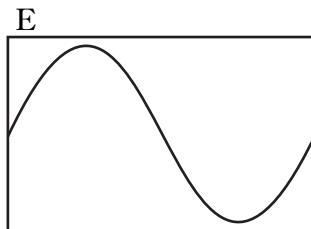
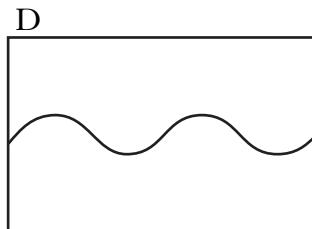
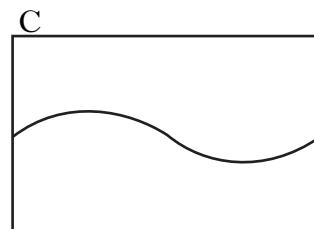
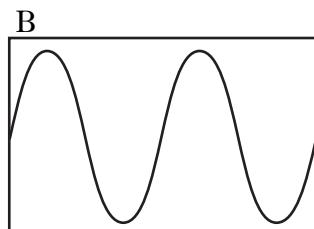
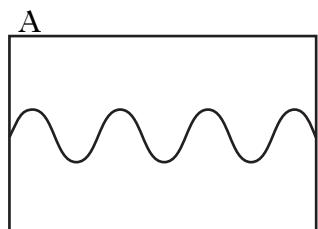


Marks

1. When a student whistles a note into a microphone connected to an oscilloscope, the following pattern is displayed.



Without changing the oscilloscope controls, another student whistles a quieter note of higher frequency into the microphone. Which of the following shows the pattern which would be displayed on the screen?

Answer 

1

2. The weather information satellite NOAA-15 has a period of 99 minutes and an orbital height of 833 kilometres.

The geostationary weather information satellite Meteosat has a period of 1440 minutes and an orbital height of 35 900 kilometres.

Which of the following gives the period of a satellite that has an orbital height of 20 000 kilometres?

- A 83 minutes
- B 99 minutes
- C 720 minutes
- D 1440 minutes
- E 1750 minutes

Answer 

1

K&U	PS

Marks

3. Which row in the table describes the correct configuration for an atom?

	<i>orbiting the nucleus</i>	<i>inside the nucleus</i>
A	protons only	electrons and neutrons
B	electrons and protons	neutrons only
C	neutrons and protons	electrons only
D	electrons only	neutrons and protons
E	neutrons only	electrons and protons

Answer

1

4. The time taken for light to reach us from the Sun is approximately

- A 1 second
- B 8 seconds
- C 1 minute
- D 8 minutes
- E 1 hour.

Answer

1

5. Two objects are dropped from the same height. Both objects fall freely.

Object X has a mass of 10 kilograms.

Object Y has a mass of 1 kilogram.

Object X accelerates at 10 metres per second per second.

The acceleration of object Y, in metres per second per second, is

- A 0·1
- B 1·0
- C 10
- D 100
- E 1000.

Answer

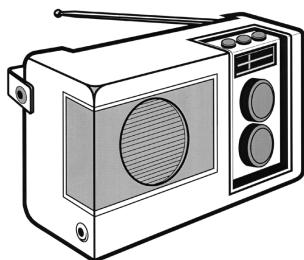
1

[Turn over

K&U	PS
-----	----

Marks

6. A student is listening to a radio.



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

**sound      amplifier      light      microphone**  
**aerial      battery      tuner      decoder      electrical**

The ..... of a radio receiver detects signals from many different stations and converts them into electrical signals.

The ..... selects one particular station from many.

The ..... increases the amplitude of these electrical signals.

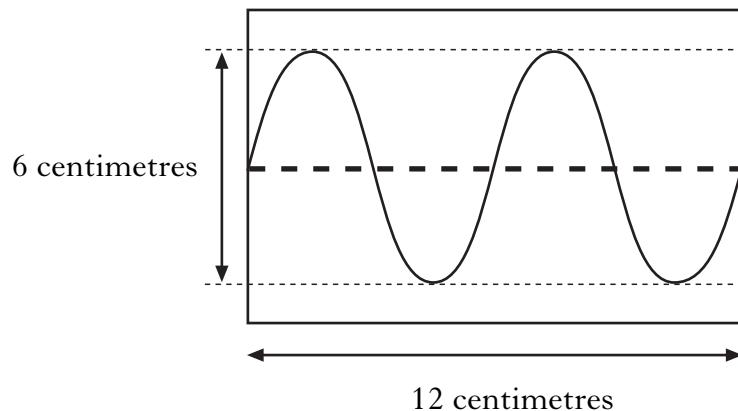
The energy required to do this is supplied by the .....

The loudspeaker in a radio receiver converts ..... energy into ..... energy.

3

6. (continued)

- (b) Electrical signals are displayed as waves on an oscilloscope.



- (i) Calculate the wavelength of the waves.

*Space for working and answer*

1

- (ii) Calculate the amplitude of the waves.

*Space for working and answer*

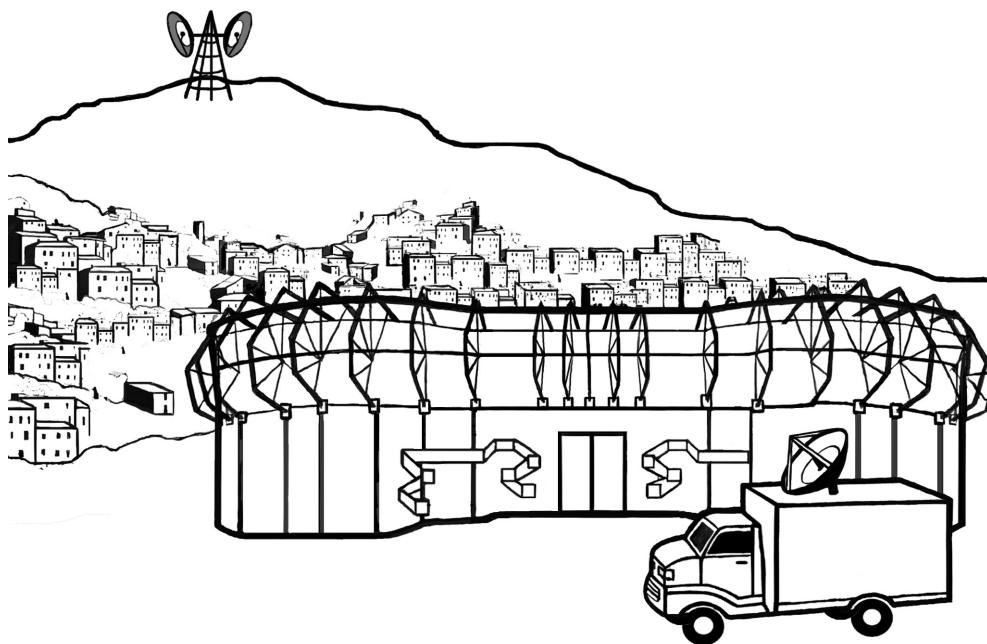
1

[Turn over]

Marks

7. A football match is being broadcast live from Dundee. Signals from the football stadium are transmitted to a television studio in Glasgow via a relay station on top of a nearby hill.

At the relay station, a curved reflector is placed behind a detector of the television signals.

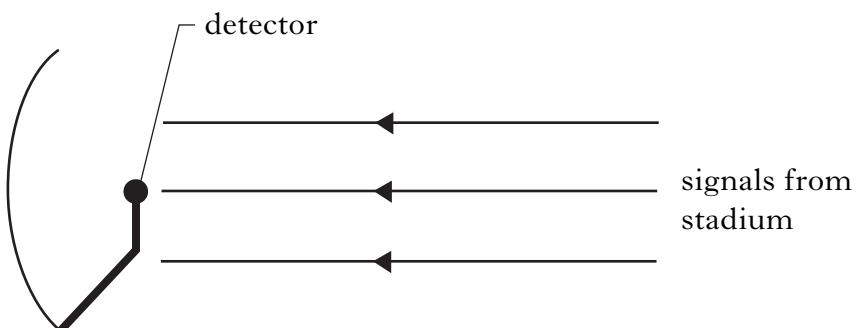


- (a) (i) State the purpose of the curved reflector.

.....

1

- (ii) Complete the diagram below to show the effect of the curved reflector on the signal at the relay station.

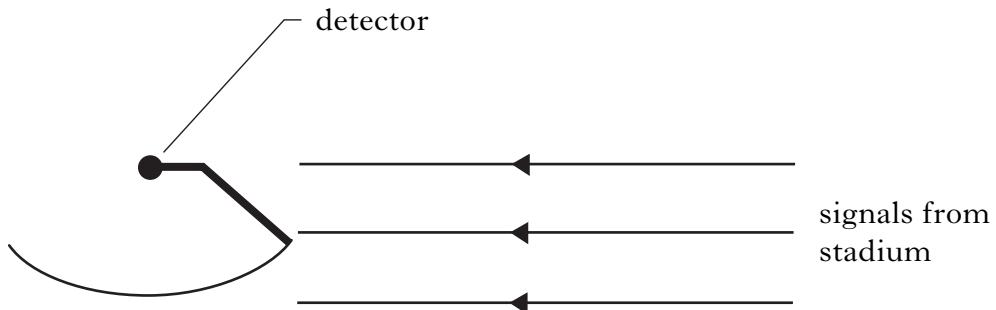


2

Marks

7. (continued)

- (b) During the match, strong winds cause the reflector to move to a new position as shown.



State the effect this has on the signal received at the detector.

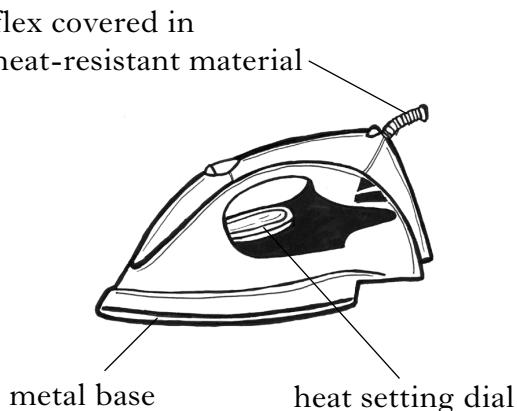
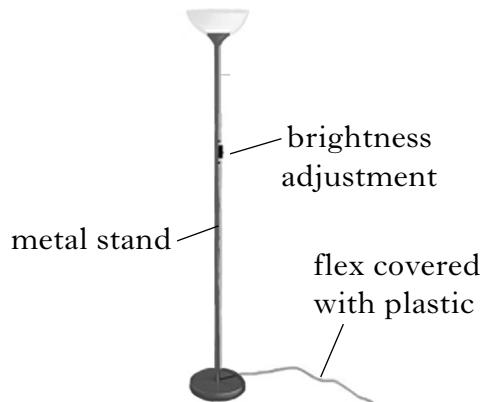
.....

1

[Turn over

Marks

8. Two household electrical appliances, a 1500 watt electric iron and a 300 watt uplighter lamp, are shown below.

**electric iron****uplighter lamp**

- (a) The brightness of the uplighter lamp can be changed.

State an electrical component that could be used to change the brightness of the uplighter lamp.

.....

1

- (b) Explain why the flex for the iron is covered with a heat-resistant material.

.....

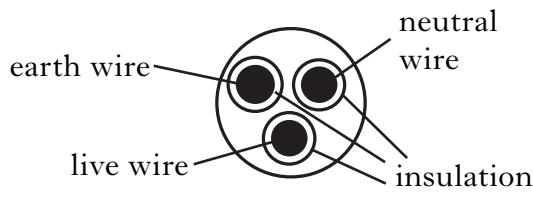
1

K&U	PS
-----	----

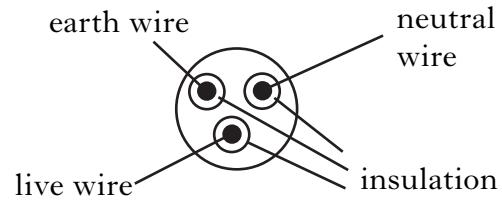
Marks

8. (continued)

- (c) A cross-section of the flex for each appliance is shown.



electric iron



uplighter lamp

- (i) State the colour of the insulation on the live wire.

.....

1

- (ii) State the purpose of the earth wire.

.....

1

- (iii) Explain why the wires in the flex for the electric iron are thicker than those for the uplighter lamp.

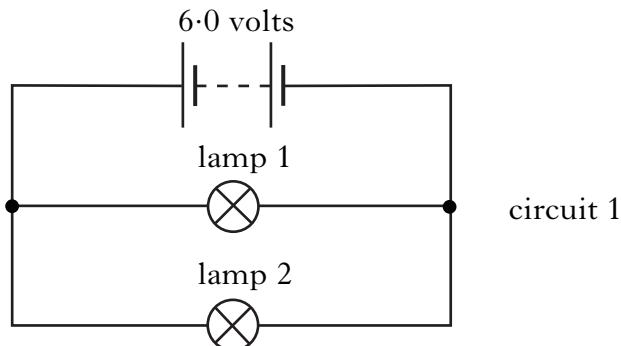
.....

1

[Turn over

Marks

9. Two identical lamps are connected to a 6·0 volt battery as shown in circuit 1.



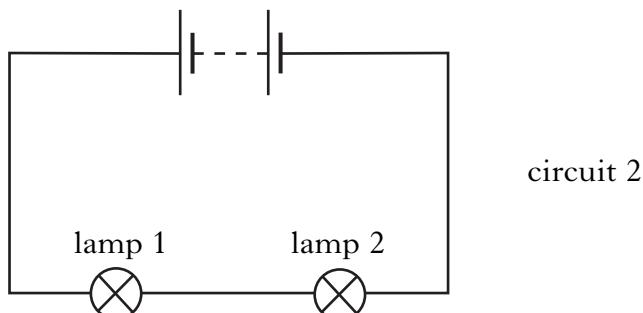
- (a) The battery supplies a current of 0·40 ampere to the circuit.

Complete the following table to show the current in each lamp and the voltage across each lamp.

	Lamp 1	Lamp 2
Current (amperes)		
Voltage (volts)		

2

- (b) The two lamps are now connected as shown in circuit 2.



State the voltage of the battery required to light the lamps with the same brightness as in circuit 1.

.....

1

- (c) In which of the two circuits, circuit 1 or circuit 2, would lamp 2 still be on when lamp 1 is removed?

.....

1

Marks

10. (a) A drummer in a rock band is exposed to sound levels of up to 110 decibels.



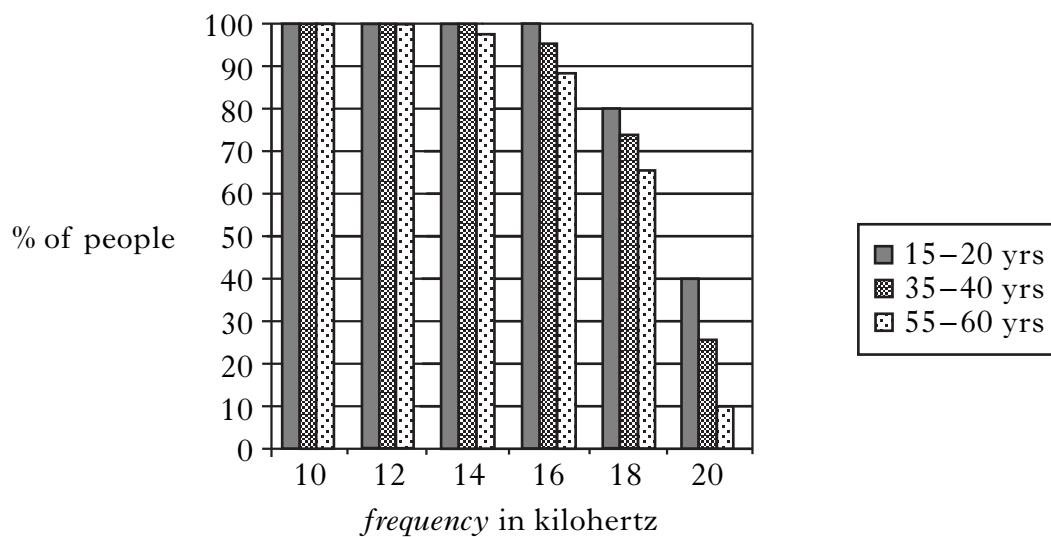
Explain why ear protectors are used to reduce the sound level experienced by the drummer.

.....

1

- (b) A medical researcher is measuring the upper range of hearing of people in different age groups.

The bar graph shows the frequencies of sound detected by these people.



- (i) State **two** conclusions which can be made from this bar graph about the hearing of different age groups.

.....

2

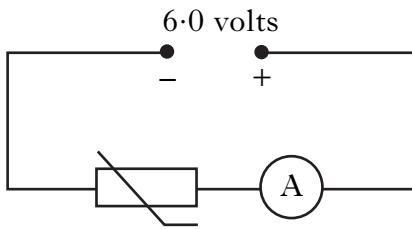
- (ii) What name is given to sound frequencies greater than 20 kilohertz?

.....

1

Marks

11. (a) A thermistor is connected to a 6.0 volt supply in circuit 1. The table gives some information about the thermistor.



temperature (degrees Celsius)	resistance (ohms)
20	1000
30	600
40	400

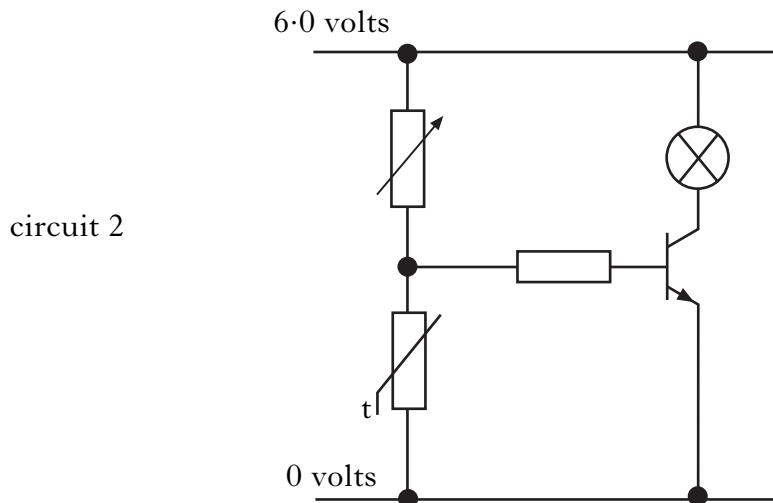
circuit 1

Calculate the reading on the ammeter when the thermistor is placed in a beaker of water at 40 degrees celsius.

*Space for working and answer*

3

- (b) The thermistor is now connected as shown in circuit 2 and placed in a tropical fish tank. The circuit provides a warning when the temperature of the water in the tank becomes too low.



- (i) What is the purpose of the transistor in circuit 2?

.....

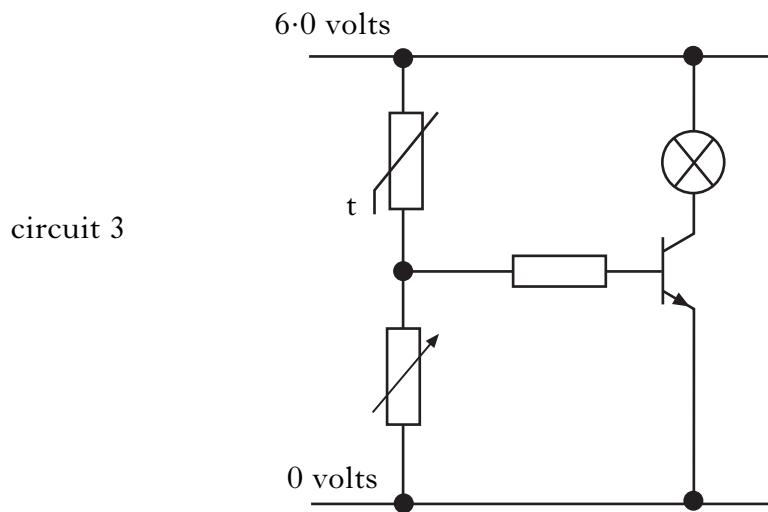
1

K&U	PS
-----	----

Marks

## 11. (b) (continued)

- (ii) The same components are used to construct circuit 3.



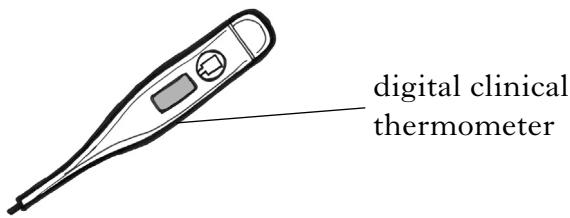
State how the operation of circuit 3 differs from the operation of circuit 2.

..... 1

[Turn over

Marks

12. (a) A nurse uses a clinical thermometer to measure the body temperature of a patient. The temperature of the patient is 39 degrees celsius.



- (i) Give **two** reasons why a clinical thermometer is used instead of an ordinary thermometer when measuring the body temperature of the patient.

.....  
.....

2

- (ii) Why does the nurse conclude that the patient is unwell?

.....

1

- (b) Radioactive sources are used in the treatment of many illnesses. The table below gives some properties of three radioactive sources used in medicine.

Name of Source	Type of Source	Half-life of Source
Radium – 226	Alpha	1600 years
Iodine – 131	Beta	8 days
Technetium – 99	Gamma	6 hours

- (i) One type of treatment requires a source that produces high ionisation.

Which source should be used?

.....

1

- (ii) Which source would be most suitable for use in diagnostic tests where a tracer is injected into the body?

.....

1

- (iii) Which source should not be stored in an aluminium box for safety reasons?

.....

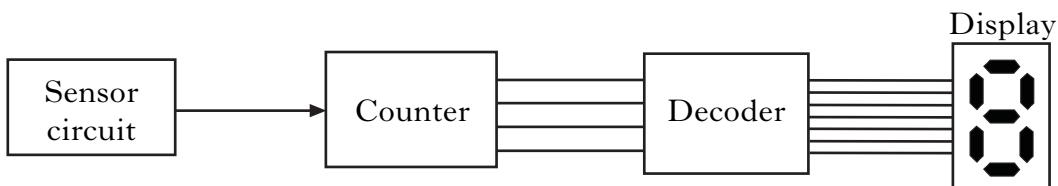
1

Marks

13. An electronic system is designed to count the number of vehicles that enter a car park.

When a vehicle enters the car park it cuts through a beam of light and a sensor circuit produces a digital pulse. The number of pulses produced by the sensor circuit is then counted and decoded before being displayed. The display consists of a number of illuminated sections.

A diagram for part of this system is shown.



- (a) (i) Select a suitable device **from the list below** to be used as an input for the sensor circuit.

LDR

thermistor

microphone

capacitor

.....

1

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

The output of the counter is { analogue  
binary  
decimal }.

1

- (iii) Name the device used to display the number of vehicles that enter the car park.

.....

1

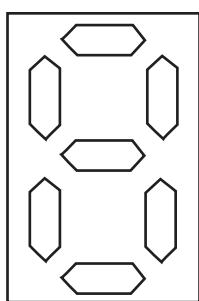
- (b) The counter is reset to zero. Over a period of time, the sensor circuit then produces the following signal.

logic level 1



logic level 0

On the diagram of the display below, shade in the sections that should be illuminated to show the number of vehicles that have entered the car park during this time.



1

K&U	PS
-----	----

Marks

14. A walker wears a pedometer. A pedometer is an instrument that measures the distance walked by counting the number of steps taken. The walker measures the distance of one step as 0·8 metres, and enters it into the pedometer.



- (a) The walker completes 9000 steps during a walk.  
Calculate the distance travelled.

*Space for working and answer*

1

- (b) The walker completes this walk in 80 minutes.  
What is the average speed of the walker in **metres per second**?

*Space for working and answer*

2

- (c) Give a reason why the distance measured by the pedometer may not be accurate.

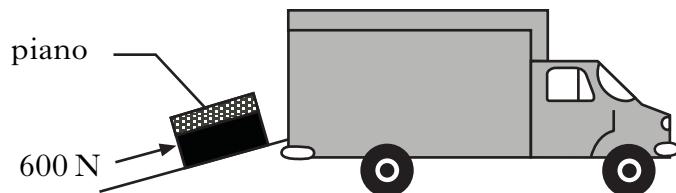
.....

1

Marks

15. A piano of mass 250 kilograms is pushed up a ramp into a van by applying a constant force of 600 newtons as shown.

The ramp is 3 metres long and the van floor is 0.75 metres above the ground.



- (a) (i) Calculate the weight of the piano.

*Space for working and answer*

2

- (ii) What is the minimum force required to lift the piano vertically into the van?

.....

1

- (b) Calculate the work done pushing the piano up the ramp.

*Space for working and answer*

2

- (c) How can the force required to push the piano up the ramp be reduced?

.....

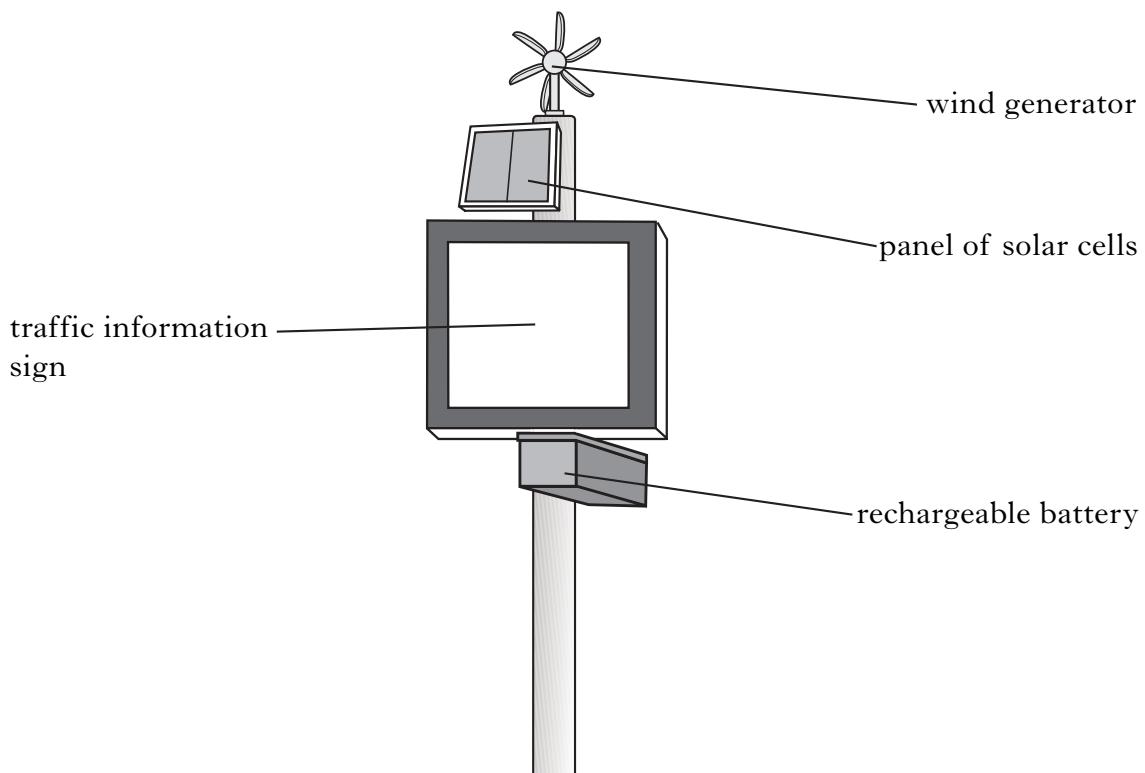
1

[Turn over

Marks

16. A traffic information sign is located in a remote area.

The sign is supplied with energy by both a panel of solar cells and a wind generator. The panel of solar cells and the wind generator are connected to a rechargeable battery.



- (a) One square metre of solar cells can generate up to 80 watts.

The panel of solar cells has an area of 0·4 square metres.

- (i) State the energy change that takes place in the solar cells.

.....

1

- (ii) Calculate the maximum power produced by the panel of solar cells.

*Space for working and answer*

1

K&U	PS
-----	----

Marks

## 16. (continued)

- (b) The following table shows the power produced by the wind generator at different wind speeds.

<i>wind speed</i> (metres per second)	<i>power output of</i> <i>wind generator</i> (watts)
2	8
4	16
6	
8	32
10	40

- (i) Suggest the power produced when the wind speed is 6 metres per second.

.....

1

- (ii) At a wind speed of 10 metres per second the voltage produced by the wind generator is 16 volts.

Calculate the current produced by the wind generator.

*Space for working and answer*

2

- (c) Explain why a rechargeable battery is also required to supply energy to the traffic information sign.

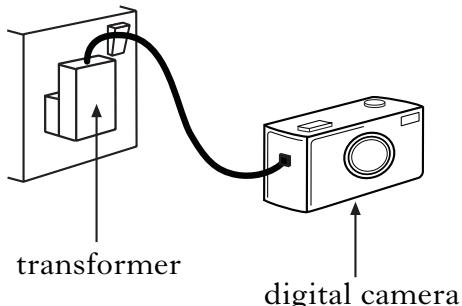
.....

1

[Turn over]

Marks

17. (a) A digital camera contains a rechargeable battery. The battery requires a voltage of 5.75 volts to be recharged. The battery is recharged using a transformer connected to the mains supply. The transformer is used to step down the 230 volt a.c. mains supply to 5.75 volts.



The transformer has 2000 turns on the primary coil.

- (i) Calculate the number of turns on the secondary coil.

*Space for working and answer*

2

- (ii) Give **one** reason why a transformer cannot be used to charge the camera battery from a 12 volt d.c. car battery.

.....

1

- (b) Complete the following passage.

In the National Grid, ..... transformers are used to increase the 25 000 volts from a power station to 132 000 volts for transmission.

This reduces ..... in the transmission lines.

The voltage is then decreased to 11 000 volts for industry and 230 volts

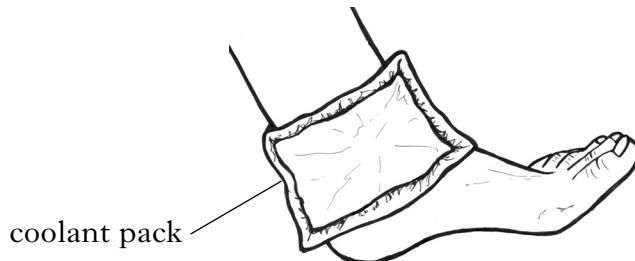
for domestic use using ..... transformers.

3

K&U	PS
-----	----

Marks

18. A coolant pack is used to treat an injured player at a hockey match.



Before use the coolant pack is stored in a refrigerator at 2 degrees celsius.

The coolant inside the pack changes state from liquid to solid.

The coolant has a melting point of 7 degrees celsius and a mass of 0.5 kilograms.

The coolant pack is removed from the refrigerator and placed on the injured ankle of a player.

- (a) (i) Calculate the energy required to raise the temperature of the coolant pack from 2 degrees celsius to its melting point.  
(specific heat capacity of coolant = 2100 joules per kilogram per degree celsius)

*Space for working and answer*

3

- (ii) Where does most of the energy required to raise the temperature of the coolant pack come from?

.....

1

- (b) Having reached its melting point the coolant pack then remains at the same temperature for 15 minutes.

What is happening to the coolant during this time?

.....

1

- (c) One of the other players suggests insulating the coolant pack and ankle with a towel.

Why should this be done?

.....

1

K&U	PS
-----	----

Marks

19. Read the following passage about a space mission to the moons of Jupiter.

The spacecraft will use a new kind of engine called an ion drive. The ion drive will propel the spacecraft away from Earth on its journey to the moons of Jupiter, although for much of the journey the engine will be switched off.

The spacecraft will first visit the moon Callisto.

Callisto is only slightly smaller than the planet Mercury. Next, the spacecraft will visit Ganymede, the largest moon in the Solar System, before travelling on to Europa.

The radiation around Europa is so intense that the spacecraft will not be able to operate for long before becoming damaged beyond repair.

The spacecraft will eventually burn up in the atmosphere of Jupiter.

- (a) (i) Name one object, **mentioned in the passage**, which orbits a planet.

.....

1

- (ii) State what is meant by the term Solar System.

.....

1

- (b) (i) The ion drive engine exerts a backward force on small particles called ions.

Explain how the ion drive engine is propelled forwards.

.....

1

- (ii) The mass of the spacecraft is 1200 kilograms and the thrust produced by the engine is 3 newtons.

Calculate the maximum acceleration produced by the ion drive engine.

*Space for working and answer*

2

- (c) State why the ion drive engine need not be kept on for most of the journey from Earth to Jupiter.

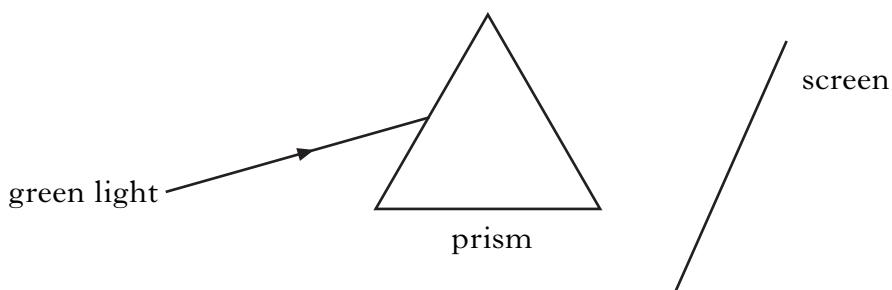
.....

1

K&U	PS
-----	----

Marks

20. (a) A ray of green light strikes a triangular prism as shown.



- (i) Complete the diagram to show the path of the ray of green light as it passes through the prism and on to the screen.

1

- (ii) The green light is now replaced by white light.

Describe what is now observed on the screen.

.....

1

- (iii) State **one** colour which has a longer wavelength than green light.

.....

1

- (b) Light from a star produces a line spectrum.

What information is obtained about the star from this spectrum?

.....

1

[END OF QUESTION PAPER]

**YOU MAY USE THE SPACE ON THIS PAGE TO REWRITE ANY ANSWER YOU HAVE DECIDED TO CHANGE IN THE MAIN PART OF THE ANSWER BOOKLET. TAKE CARE TO WRITE IN CAREFULLY THE APPROPRIATE QUESTION NUMBER.**

**YOU MAY USE THE SPACE ON THIS PAGE TO REWRITE ANY ANSWER YOU HAVE DECIDED TO CHANGE IN THE MAIN PART OF THE ANSWER BOOKLET. TAKE CARE TO WRITE IN CAREFULLY THE APPROPRIATE QUESTION NUMBER.**

K&U	PS

**YOU MAY USE THE SPACE ON THIS PAGE TO REWRITE ANY ANSWER YOU HAVE DECIDED TO CHANGE IN THE MAIN PART OF THE ANSWER BOOKLET. TAKE CARE TO WRITE IN CAREFULLY THE APPROPRIATE QUESTION NUMBER.**

K&U	PS

**YOU MAY USE THE SPACE ON THIS PAGE TO REWRITE ANY ANSWER YOU HAVE DECIDED TO CHANGE IN THE MAIN PART OF THE ANSWER BOOKLET. TAKE CARE TO WRITE IN CAREFULLY THE APPROPRIATE QUESTION NUMBER.**

**[BLANK PAGE]**