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 1–7, 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 8–19, 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.
1. Which part of a television receiver picks up all signals?
   A Tuner
   B Modulator
   C Decoder
   D Amplifier
   E Aerial

2. The nucleus of a uranium atom contains
   A electrons only
   B neutrons only
   C electrons and protons only
   D protons and neutrons only
   E electrons, protons and neutrons.

3. What is the unit of equivalent dose?
   A becquerel
   B joule
   C kilogram
   D sievert
   E watt

Answer [ ] 1

Answer [ ] 1

Answer [ ] 1
4. An uncharged capacitor C is connected to a resistor R, a 9 volt battery and a switch S as shown.

When switch S is closed the voltage across the capacitor
A remains at 0 volt
B gradually rises from 0 volt to 9 volts
C immediately drops from 9 volts to 0 volt
D gradually drops from 9 volts to 0 volt
E remains at 9 volts.

5. Which of the following is a unit of heat?
A degree celsius
B joule
C joule per kilogram
D joule per kilogram per degree celsius
E watt

6. Which of the following is the shortest distance?
The distance from the Earth to the
A nearest star in our galaxy
B edge of our galaxy
C Moon
D Sun
E nearest planet.
7. Radio waves from space can be detected by a
   A  Geiger-Müller tube
   B  photographic plate
   C  scintillation counter
   D  telescope
   E  tuner.

   Answer  

   Marks  1
8. A factory chimney is demolished using explosives.

A crowd of people watches from a safe distance. A person in the crowd hears the sound 2.5 seconds after seeing the explosion.

(a) Explain why there is a delay between seeing the explosion and hearing the sound.

...........................................................................................................................................

........................................................................................................................................... 1

(b) Calculate the distance between the chimney and the person in the crowd. (The speed of sound in air is 340 metres per second.)

Space for working and answer

........................................................................................................................................... 2

(c) Why should the demolition worker who sets off the explosives wear ear protectors to reduce the noise level to below 80 decibels?

...........................................................................................................................................

........................................................................................................................................... 2
9. The flex of a mains appliance has a 3-pin plug fitted as shown.

The flex contains three wires—live, neutral and earth.

(a) Circle the correct answer for each of the questions about the wires.

(i) The colour of the insulation around the live wire is
    { blue  brown  green/yellow }.

(ii) The colour of the insulation around the neutral wire is
     { blue  brown  green/yellow }.

(iii) The { earth  live  neutral } wire is a safety device.

(b) **Explain** why the flex must be held in place by the cord grip.

(c) Another appliance has only two wires in its flex. This appliance carries the following symbol.

   ![Symbol](image)

(i) Name this symbol.

(ii) Which wire is not needed in this flex?
10. Read the following passage.

The temperature of the human body is maintained at about 37 degrees celsius. An increase or a decrease in body temperature of as little as 5 degrees celsius can be very serious.

Doctors often use ear thermometers to measure body temperature. Ear thermometers measure the infrared radiation emitted from the eardrum and surrounding tissue.

One type of ear thermometer has a scale that ranges from 32 degrees celsius to 42 degrees celsius. The temperature sensor used in this thermometer is a device that has a resistance which changes as the temperature changes.

Use information **given in the passage** to answer the following questions.

(a) Name the type of radiation given out by the human body.

................................................................. 1

(b) Give a reason why the scale of the ear thermometer ranges from 32 degrees celsius to 42 degrees celsius only.

.................................................................

................................................................. 1

(c) Suggest a temperature sensor that could be used in the ear thermometer.

................................................................. 1

[Turn over]
11. A student has a sight defect and is unable to see near objects clearly.

(a) The following diagram shows what happens to light rays when the student is reading a book.

(i) By referring to the diagram, explain why the student sees a blurred image.

..............................................................................................................................................

.............................................................................................................................................. 1

(ii) Name this sight defect.

.............................................................................................................................................. 1

(iii) In the space below, draw the shape of the lens that would correct this sight defect.

Space for diagram

.............................................................................................................................................. 1

(iv) When this sight defect has been corrected, the student looks at a picture printed in the book.

Which statement describes the image on the retina of the student’s eye compared to the actual picture?

A  The image is the same way up and larger.
B  The image is upside down and larger.
C  The image is the same way up and smaller.
D  The image is upside down and smaller.

Answer  1
11. (continued)

(b) Another student has a different eye defect. This student is prescribed spectacles that have red tinted glass. The graph below shows the percentage of light of different colours that passes through this glass.

![Graph showing percentage of light passed through glass]

(i) Which colour of light is blocked most by the tinted glass?

.................................................................................................................. 1

(ii) List the three colours given on the graph in order of decreasing wavelength.

.................................................................................................................. 1

[Turn over]
12. A karaoke machine contains various input and output devices.

![Diagram of a karaoke machine with labels for CD motor, loudspeaker, on/off switch, LED, 7-segment display, and microphone.]

(a) State **two** output devices labelled on the diagram.

   Device 1 ................................................................. 

   Device 2 ................................................................. 2

(b) State **two** input devices labelled on the diagram.

   Device 1 ................................................................. 

   Device 2 ................................................................. 2

(c) The karaoke machine has an LED.

   (i) State the useful energy transfer that takes place in the LED.

   ................................................................. to ................................................................. 1

   (ii) In the space below draw the symbol for an LED.

   ![Space for symbol](image)s
13. A technician uses a signal generator and two oscilloscopes as shown to test an amplifier.

(a) The screens of both oscilloscopes are shown below.

![Oscilloscope Screens]

oscilloscope P

oscilloscope Q

The settings on both oscilloscopes are identical.

(i) Complete the diagram to show the amplified output signal seen on oscilloscope Q.

(ii) Circle the correct answer in the statement below.

The signal shown on oscilloscope P is \(\{\text{analogue}\}, \{\text{decimal}\}, \{\text{digital}\}\).

(b) Which of the following devices contains an amplifier?

lamp radio relay transformer

................................................................. 1

[Turn over]

The time for their boat at each stage of the race is shown.

<table>
<thead>
<tr>
<th>Time from start</th>
<th>minutes</th>
<th>seconds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start: 0 metres</td>
<td>00</td>
<td>00</td>
</tr>
<tr>
<td>500 metres</td>
<td>01</td>
<td>40</td>
</tr>
<tr>
<td>1000 metres</td>
<td>03</td>
<td>50</td>
</tr>
<tr>
<td>1500 metres</td>
<td>05</td>
<td>50</td>
</tr>
<tr>
<td>Finish: 2000 metres</td>
<td>07</td>
<td>45</td>
</tr>
</tbody>
</table>

(a) **Describe** how to find the average speed of the boat from the start of the race to the finish.

(b) Calculate the average speed of the boat during the first 500 metres of the race.

*Space for working and answer*
14. (continued)

(c) The crew supplies a force to move the boat forward. When the boat is moving, a force opposes the motion of the boat.

(i) Name the force that opposes the motion of the boat.

................................................................. 1

(ii) During the first 500 metres, there is a constant unbalanced force acting on the boat.
Describe the motion of the boat during this section of the race.

................................................................. 1

(iii) During one stage of the race, the speed of the boat is constant.
What can be said about the forces acting on the boat during this stage?

................................................................. 1

[Turn over]
15. A car is being repaired in a garage. The car is on a ramp and is raised to a height of 1.5 metres.

The car has a mass of 1200 kilograms.

(a) Calculate the weight of the car.

Space for working and answer

(b) Calculate how much gravitational potential energy the car has gained when it is 1.5 metres above the garage floor.

Space for working and answer

(c) The car is raised in 12 seconds.
   (i) Calculate the minimum power needed to lift the car 1.5 metres in 12 seconds.

Space for working and answer

(ii) In practice, the power needed to raise the car in this time is greater than the minimum power.

Explain why.

..................................................................................................................................................
16. A fan operates using a solar cell and a light bulb.

(a) What energy transformation takes place in the solar cell?

.................................................................................................................. 1

(b) When the lamp is on, the fan turns slowly.

(i) Suggest two changes that could be made which would make the fan turn faster.

Change 1 ........................................................................................................ 2

Change 2 ........................................................................................................

(ii) The 60 watt lamp operates for 2 minutes.

Calculate how much energy is transformed by the lamp in this time.

Space for working and answer

..................................................................................................................

(c) Solar energy is a renewable source of energy.

(i) Name one other renewable source of energy.

.................................................................................................................. 1

(ii) Name a non-renewable source of energy.

.................................................................................................................. 1

[Turn over]
17. The diagram shows all the ways in which heat is lost from a house.

(a) Using information from the diagram, calculate the percentage of heat lost through windows.

Space for working and answer

(b) Various windows of area one square metre are tested for rate of heat loss. The results are shown in the table.

<table>
<thead>
<tr>
<th>Window</th>
<th>Rate of heat loss (joules per second)</th>
</tr>
</thead>
<tbody>
<tr>
<td>single glazed</td>
<td>80</td>
</tr>
<tr>
<td>double glazed</td>
<td>60</td>
</tr>
<tr>
<td>triple glazed</td>
<td>50</td>
</tr>
</tbody>
</table>

(i) How many joules of heat are lost per square metre from a single glazed window every second?

..................................................................................................................
17. (b) (continued)

(ii) All the windows in a particular house are single glazed. Every second a total of 500 joules of heat is lost through the windows in this house.

(A) Calculate the total area of the windows.

Space for working and answer

(B) Describe one way of reducing heat loss through the windows in this house.

.................................................................................................................................

................................................................................................................................. 1

(c) A householder keeps the temperature in a house at 20 degrees celsius all year.

18 degrees celsius

20 degrees celsius

summer

4 degrees celsius

20 degrees celsius

winter

At which time of the year is the rate of heat loss from this house greater? Explain your answer.

.................................................................................................................................

.................................................................................................................................

................................................................................................................................. 2
18. A 5 volt battery in a mobile phone is recharged from the mains using a charger containing a step down transformer.

(a) The transformer consists of three parts.

```
core   primary coil   secondary coil
```

Label each of these parts on the diagram below.

(b) There are 11 500 turns on the primary coil of the transformer.

Calculate the number of turns on the secondary coil.

```
Space for working and answer
```

(c) **Explain** why a transformer cannot be used to step down the voltage from a battery.

........................................................................................................................................
........................................................................................................................................
........................................................................................................................................

........................................................................................................................................
........................................................................................................................................
........................................................................................................................................

........................................................................................................................................
........................................................................................................................................
........................................................................................................................................

........................................................................................................................................
........................................................................................................................................
........................................................................................................................................

........................................................................................................................................
........................................................................................................................................
........................................................................................................................................

........................................................................................................................................
........................................................................................................................................
........................................................................................................................................

........................................................................................................................................
19. A spacecraft is far out in space. An astronaut wearing a backpack leaves the spacecraft. The astronaut uses the backpack to move around. The backpack contains a pressurised gas cylinder connected to a valve. When the valve is opened, a jet of gas is released.

(a) Complete the passage below by circling the correct answer.

When the astronaut opens the valve, the cylinder pushes gas backwards.

The gas pushes the \{cylinder \textit{jet} \textit{spacecraft}\} forwards. \(1\)

(b) The astronaut and backpack have a combined mass of 120 kilograms. The jet of gas exerts a constant thrust of 24 newtons.

(i) Calculate the acceleration of the astronaut when the jet is switched on.

\textit{Space for working and answer} \(2\)

(ii) The jet is now switched off.

Describe the motion of the astronaut. 

Explain your answer.

\[ \text{...............................................................................................................} \]

\[ \text{...............................................................................................................} \]

\[ \text{...............................................................................................................} \] \(2\)
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.