G

K & U   PS

Total Marks

3220/401

NATIONAL
QUALIFICATIONS
2003

MONDAY, 19 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

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 1–6, 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 7–19, 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.

SCOTTISH
QUALIFICATIONS
AUTHORITY
©

1. Which of the following is a use for ultrasound in medicine?

   A   Correcting eye defects such as a detached retina

   B   Killing cancerous cells

   C   Producing an image of an unborn baby

   D   Removing "port wine" birth marks

   E   Sterilising medical instruments

   Answer [   ]   1

2. Three parallel rays of light are passed through a glass shape that is placed under a card. The effect of the glass shape on the rays is shown.
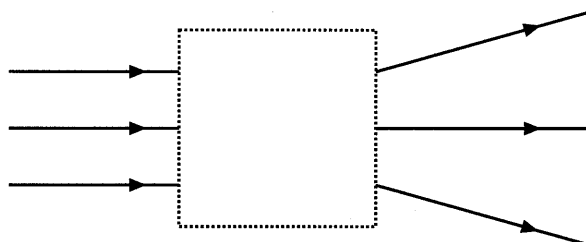
   The glass shape is a

   A   concave lens

   B   convex lens

   C   prism

   D   rectangular block

   E   semi-circular block.

   Answer [   ]   1

3. Identify the circuit symbol shown.
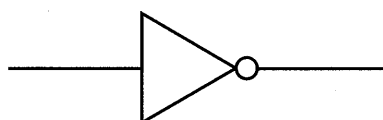
   A   AND gate

   B   OR gate

   C   NOT gate

   D   diode

   E   LED

   Answer [   ]   1

Marks

4. Which of the following electronic devices contains a counter circuit?

A Automatic parking light

B Digital stopwatch

C Electronic thermometer

D Intercom

E Radio receiver

Answer ☐ 1

5. What is the purpose of the objective lens in a telescope?

A To bring stars closer to the observer

B To detect radio waves from distant stars

C To magnify the image produced by the eyepiece

D To produce an image that is magnified by the eyepiece

E To split light from stars into different colours

Answer ☐ 1

6. When a spacecraft enters the Earth's atmosphere, one effect of friction is to transform

A potential energy into kinetic energy

B kinetic energy into potential energy

C heat into potential energy

D potential energy into heat

E kinetic energy into heat.

Answer ☐ 1

[Turn over

Marks

7. The block diagram below shows some of the main parts of a radio receiver.
    The label in one of the blocks is missing.

| Aerial | → | Tuner | → | Decoder | → | | → | Loudspeaker |
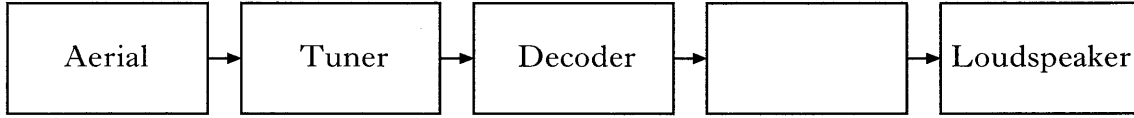
(*a*) Complete the block diagram by filling in the missing label.   **1**

(*b*) What is the purpose of the block that is unlabelled?

....

....   **1**

(*c*) The electricity supply is not shown on the block diagram.

What is the purpose of the electricity supply in a radio receiver?

....

....   **1**

Marks

8. A television reporter uses a videophone to send news reports, via a communications satellite, to a television station. The videophone has a dish aerial, which transmits microwave signals. The signals are received at a curved dish on the satellite.

(*a*) What is the speed of the microwave signals?

.... **1**

(*b*) Why is the signal that is received stronger when a curved dish is used on the satellite than when there is no reflector?
You may use a diagram in your answer.

....

....

....

....

....

....

Space for diagram

2

(*c*) Fill in the gaps in the following passage.

The communications satellite stays in the same place above the Earth in

its orbit. It is therefore described as a .... satellite.

The satellite has a period of ....

The signal is retransmitted from the satellite back to Earth, and is

received at a ....

The signal is then sent on using .... links. **4**

Marks

9. The following information is taken from a leaflet comparing conventional lamps with energy saving lamps.

> A 20 watt energy saving lamp produces the same amount of light as a conventional 100 watt lamp.

> Energy saving lamps can last 10 times as long as conventional lamps.

> A conventional 100 watt lamp, used for an average of 4 hours per day, costs £1·00 per month to run.
> An energy saving lamp producing the same amount of light, and used for the same time, costs 20 pence per month to run.

(a) From the information given in the leaflet, state **one** advantage of using an energy saving lamp.

....

1

(b) A householder replaces one conventional 100 watt lamp with a 20 watt energy saving lamp. It is used for an average of 4 hours per day.
Calculate how much money is saved in running costs in one year.

> *Space for working and answer*

2

(c) The leaflet claims that the energy saving lamp is more energy efficient. Use information given to explain what this means.

....

....

....

2

DO NOT
WRITE IN
THIS
MARGIN

K&U | PS

Marks

9. (continued)

(*d*) The conventional lamp is a filament lamp.
The energy saving lamp is a discharge tube.

(i) Where does the energy transformation take place in the conventional lamp?

.... **1**

(ii) Where does the energy transformation take place in the energy saving lamp?

.... **1**

[Turn over

Marks

10. A student sets up circuit 1 to calculate the resistance of resistor R.

power supply

8·800
AMPERES
VOLTS   OHMS
OFF   KILOHMS

resistor
R

0·020
AMPERES
VOLTS   OHMS
OFF   KILOHMS

Circuit 1

(*a*) Calculate the resistance of resistor R using the meter readings.

Space for working and answer

2

(*b*) The student then sets up circuit 2 to measure the resistance of R directly.

000·4
AMPERES
VOLTS   OHMS
OFF   KILOHMS

resistor
R

Circuit 2

Write down the resistance of R, **in ohms**, obtained from circuit 2.

.... **1**

Marks

10. (continued)

(*c*) The value obtained for the resistance of R using circuit 1 is more accurate than the value obtained using circuit 2.

    (i) Explain why circuit 1 gives a more accurate value for the resistance of R.

    ....

    ....

    .... **1**

    (ii) What change could be made in circuit 2 to give a more accurate value for the resistance of R?

    ....

    ....

    .... **1**

[Turn over

DO NOT
WRITE IN
THIS
MARGIN

K&U | PS

Marks

11. A continuity tester is used to test if a fuse has "blown". The continuity tester contains a lamp and a 1·5 volt battery.

lamp

P

fuse being tested

Q

battery
inside

(*a*) Complete the circuit diagram for the continuity tester.

On your diagram, include the fuse being tested between points P and Q.

You must use correct circuit symbols for all components.

Space for circuit diagram

P   Q

4

(*b*) Describe how the continuity tester is used to show that the fuse being tested has "blown".

....

....

....

....

....

3

12. Several types of thermometers are shown below.

Liquid-in-glass
thermometer

Electronic
thermometer with
digital display and
remote probe

Liquid crystal
thermometer

Clinical digital
thermometer

Marks

(*a*) What is the purpose of a thermometer?

....

.... **1**

(*b*) Clinical thermometers are designed for medical use. Other thermometers
(sometimes called "ordinary" thermometers) are made for general
laboratory use.

Describe **two** important differences between a clinical thermometer and
an "ordinary" thermometer.

Difference 1 ....

....

Difference 2 ....

.... **2**

[Turn over

Marks

13. Lasers have several uses in medicine.

One type of laser is used in surgery to replace a scalpel. This laser allows a doctor to cut through tissue and seal blood vessels immediately.

Another type of laser is used to treat tumours. In this case the laser light is directed at the tumour using an endoscope. The laser supplies energy that vaporises the tumour.

Some lasers give out red light, while others produce blue or green light. A coloured laser beam is used as a pointer to line up X-rays in an X-ray machine.

(*a*) Describe how a laser can be used to provide "bloodless surgery".

....

.... **1**

(*b*) A section of an optical fibre used in an endoscope is shown below.

laser
light

Complete the diagram to show how the laser light is transmitted along the optical fibre. **2**

(*c*) What energy transformation takes place when a laser is used to vaporise a tumour?

.... to **2**

(*d*) Arrange the laser colours red, blue and green in order of increasing wavelength.

.... **2**

(*e*) Describe **one** use of X-rays in medicine.

....

.... **1**

Marks

14. The list below contains input and output devices.

capacitor	LDR (light dependent resistor)	switch
lamp	LED (light emitting diode)	loudspeaker
microphone	7 segment display	relay
solenoid	electric motor	thermistor

(*a*) **From the list**, select an input device for **each** of the applications below.

(i) A camera light level indicator.

.... **1**

(ii) An ice sensor for a car.

.... **1**

(iii) A public announcement system at a railway station.

.... **1**

(*b*) (i) Select **two** output devices from the list that transform electrical energy to light.

Device 1 ....

Device 2 .... **2**

(ii) When a current passes through a conductor, there is a magnetic field created round the conductor.

Select **two** output devices from the list that make use of this effect.

Device 1 ....

Device 2 .... **2**

[Turn over

Marks

15. During a football match, one player heads the ball towards the goal.

(*a*) When the ball is headed, the player applies a force to the ball. This force has three effects on the ball.

Complete the sentence below to describe the **three** effects.

The force changes the ....,

the ....,

and the .... of the ball.   **3**

(*b*) Later in the match, another player takes a penalty kick. The player kicks the stationary ball with a force of 27 newtons. The mass of the ball is 0·6 kilogram.

Calculate the acceleration of the ball.

Space for working and answer

2

16. A battery-powered model car has a mass of 0·8 kilogram. The car has an electric motor that provides a constant force of 1·2 newtons.

(a) The car travels 25 metres at constant speed along a horizontal track.

(i) State the value of the force of friction acting against the car.

.... **1**

(ii) Calculate the work done by the car's electric motor.

Space for working and answer

2

(b) The car then climbs up a sloping part of the track. The car travels a further 25 metres gaining 2 metres in height.

(i) Calculate the gravitational potential energy gained by the car when it is at the top of the climb.

Space for working and answer

2

(ii) The force of friction remains the same as in part (a).
Calculate the total work done during the climb.

Space for working and answer

1

(iii) The car takes 5 seconds to complete the climb.
Calculate the output power of the motor during the climb.

Space for working and answer

2

Marks

17. Heat can be lost from a home in three ways – conduction, convection and radiation.

For each of these ways, state a method by which heat loss can be reduced.

You must give three **different** methods of reducing heat loss.

Conduction ....

....

Convection ....

....

Radiation...

.... **3**

Marks

18. The table gives some information about a metal.

melting point	327 degrees celsius
specific heat capacity	126 joules per kilogram per degree celsius
density	11 300 kilograms per cubic metre

(a) Calculate the energy needed to increase the temperature of a 2·5 kilogram block of this metal from 27 degrees celsius to its melting point.

> *Space for working and answer*

3

(b) (i) Explain why extra heat is needed to **melt** the metal block once it has reached a temperature of 327 degrees celsius.

....

.... 1

(ii) What happens to the temperature of the metal **while it is melting**?

....

.... 1

[Turn over for Question 19 on *Page eighteen*

Marks

19. A space probe is travelling between Earth and Mars. The mass of the probe is 75 kilograms. A rocket motor on the probe supplies a thrust of 900 newtons when it is fired.

(*a*) Earth and Mars are planets.

What is a planet?

....

.... **1**

(*b*) The rocket motor is fired at a point, between Earth and Mars, where the effects of gravity can be ignored.

Calculate the acceleration of the probe when the rocket motor is fired.

Space for working and answer

2

(*c*) For most of the journey from Earth to Mars, the rocket motor on the probe is switched off.

Explain, with reference to a law of motion, why this is possible.

....

....

.... **2**

(*d*) The probe lands on the surface of Mars.

Circle **one** phrase in the passage below to make the statement correct.

The weight of the probe on Mars is $\begin{cases} \text{the same as its weight on Earth} \\ \text{zero} \\ \text{different from its weight on Earth} \end{cases}$. **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.

[BLANK PAGE]