UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER | | | | | |

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**PHYSICS** **0625/21**

Paper 2 Core **October/November 2012**

**1 hour 15 minutes**

Candidates answer on the Question Paper.

No Additional Materials are required.

**READ THESE INSTRUCTIONS FIRST**

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
You may lose marks if you do not show your working or if you do not use appropriate units.
Take the weight of 1 kg to be 10 N (i.e. acceleration of free fall = 10 m / $s^2$).

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

| For Examiner's Use | |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| 8 | |
| 9 | |
| 10 | |
| 11 | |
| 12 | |
| Total | |

This document consists of **16** printed pages.

**1** **(a)** State the name that is given to the turning effect of a force.

.....[1]

**(b)** A gate has rusty hinges that are very stiff. A man opens the gate by pulling on it, as shown in Fig. 1.1.

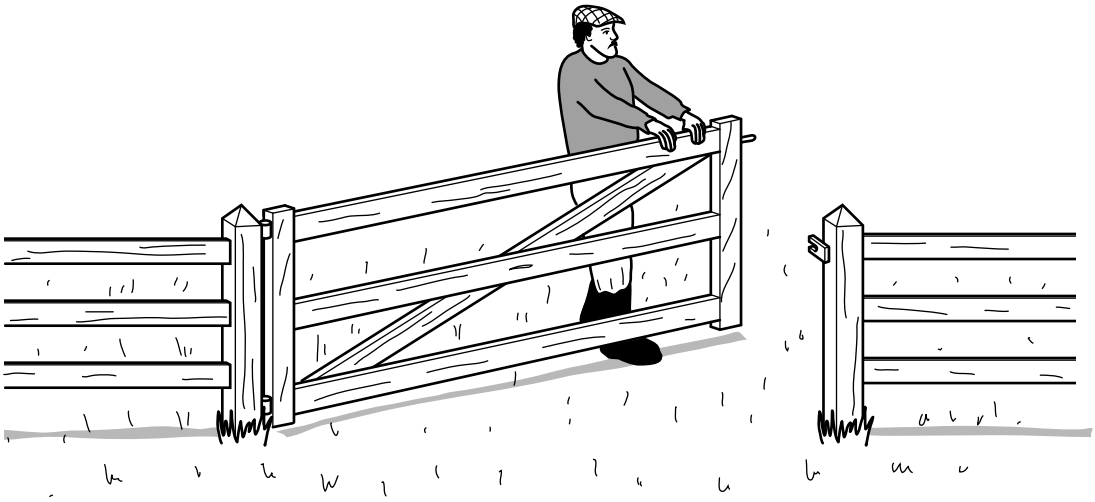

**Fig. 1.1**

After he has passed through the opening, he closes the gate behind him.

When closing the gate, the man pulls it at a point halfway along its length.

State two differences between his force when closing the gate and his force when he opened the gate.

1. .....

2. .....
[2]

**(c)** Suggest one way of reducing the force needed to open the gate.

.....[1]

[Total: 4]

**2** **(a)** State the equation linking the density of a substance with its mass and volume.

.....

.....[1]

**(b)** When oil leaks out of a damaged oil-tanker, it forms a very thin layer of oil, known as an oil slick, on the water.

One such oil slick covers an approximately rectangular area measuring $2.5 \times 10^4$ m by $6.0 \times 10^3$ m.

The oil slick is $3.0 \times 10^{-6}$ m (0.0000030 m) thick.

**(i)** Calculate the volume of the oil slick.

volume = ..... $m^3$ [3]

**(ii)** The density of the oil is 900 kg / $m^3$.

Calculate the mass of oil in the slick.

mass = ..... kg [2]

[Total: 6]

**3** Fig. 3.1 shows four runners at the start of an 80 m race on a school sports day.

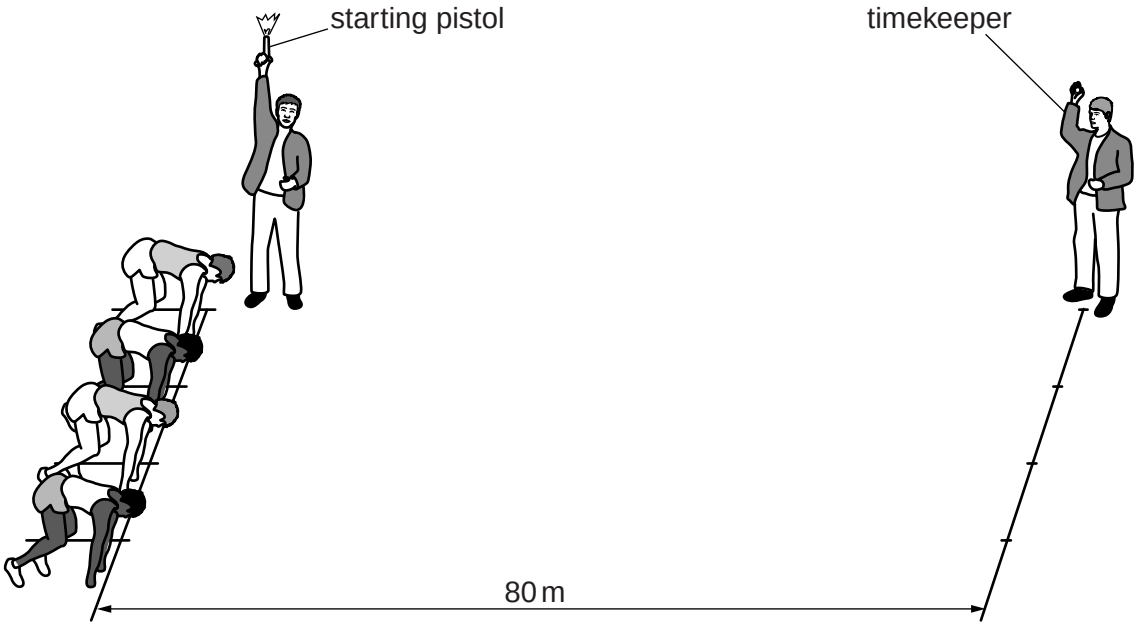


**Fig. 3.1** (not to scale)

**(a)** Sound travels at 320 m / s.

Calculate the time taken for the sound from the starting pistol to reach the timekeeper.

time = ..... s [3]

**(b)** The timekeeper takes 0.20 s to react after hearing the sound and then starts the stopwatch.

He makes no other experimental inaccuracies.

**(i)** By how much will his time for the race be in error?

time error = ..... s [2]

**(ii)** Suggest how he can reduce this error, whilst still using the same stopwatch.

.....

.....

..... [1]

**(c)** When he stops the stopwatch as the winner crosses the finishing line, the appe of the stopwatch is as shown in Fig. 3.2.

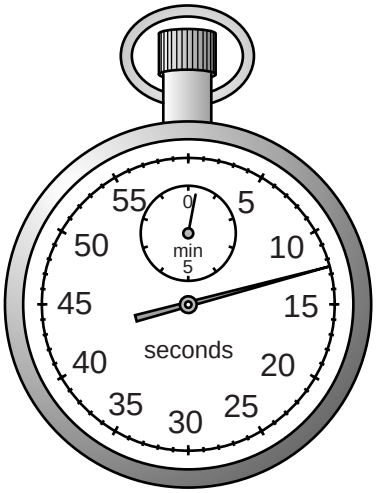


**Fig. 3.2**

How long did the winner actually take to run the race?

time = ..... s [2]

[Total: 8]

**4** An archer pulls the string of his bow, and moves the arrow to the position shown in F
He then releases the string so that the arrow is fired towards a target.

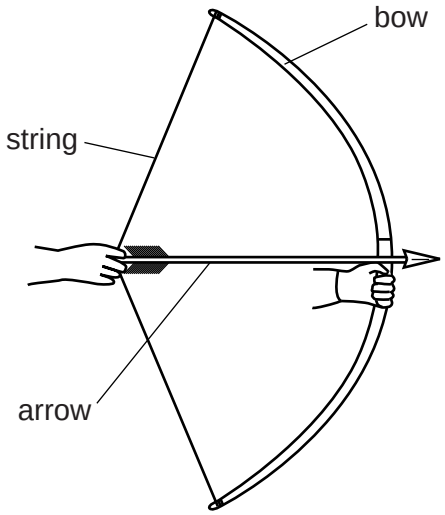


**Fig. 4.1**

**(a)** The archer does work on the bow.

When is this work done? Tick one box.

as the string is pulled back to the position shown in Fig. 4.1 ☐

whilst holding the string in the position shown in Fig. 4.1 ☐

after releasing the string to fire the arrow ☐ [1]

**(b)** What type of energy is stored in the bow because it is bent?

.....[1]

**(c)** What type of energy does the arrow have because it is moving?

.....[1]

**(d)** On another occasion, the archer fires the arrow so that it rises up to a maximum height before falling back down to the ground.

Use words from the following list to complete the sentences below.

**gravitational potential, kinetic, thermal, maximum, minimum, zero**

As the arrow rises, its ..... energy increases. At the top of the flight, this energy is at a ..... . As the arrow falls, this energy is converted into ..... energy. When it hits the ground, the energy of the arrow is converted into ..... energy.

[4]

**5** **(a)** A metal ruler with a rectangular cross-section is heated in an oven.

**(i)** State two things that happen to the atoms of the metal.

1. .....

2. .....

[2]

**(ii)** State what happens to

**1.** the length of the ruler, .....

**2.** the width of the ruler, .....

**3.** the thickness of the ruler. .....

[2]

**(b)** The nut in Fig. 5.1 has become jammed on the bolt, so that it will not rotate.

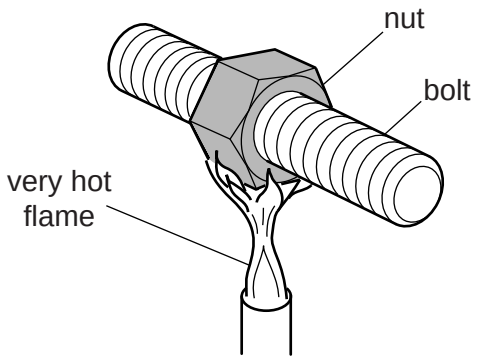


**Fig. 5.1**

Explain why heating the nut with a very hot flame is likely to free the jammed nut.

.....

.....

.....[2]

[Total: 6]

**6** **(a)** In Fig. 6.1, a ray of red light is shown passing through a triangular glass prism and [illegible] another prism that is identical but upside down.

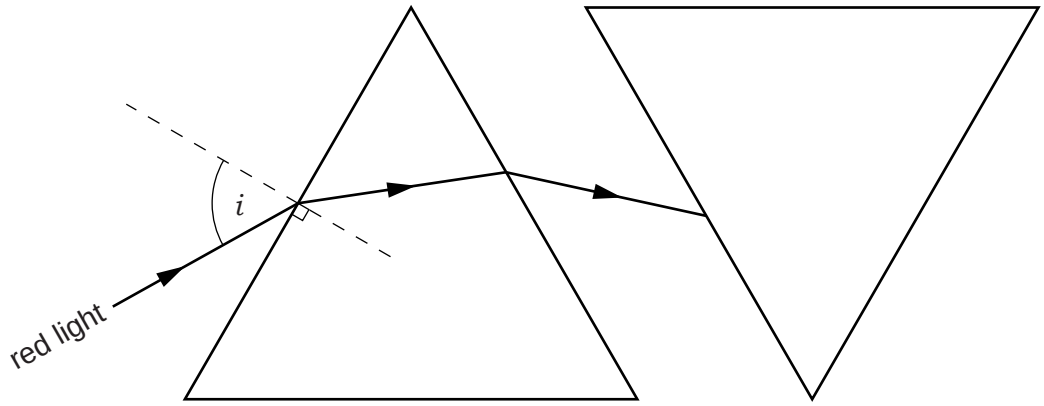


**Fig. 6.1**

**(i)** The angle of incidence of the red light at the first surface is shown on Fig. 6.1 as $i$.

On Fig. 6.1, use the letter $r$ to mark clearly the angle of refraction at the first surface. [1]

**(ii)** On Fig. 6.1, complete the path of the ray through the right-hand prism and out into the air again. Label the emergent ray "line R". [3]

**(iii)** The beam of red light is moved so that it shines into the right-hand prism along line R.

Using the letter P, mark clearly the point where this ray will emerge from the left-hand prism. [1]

**(b)** On another occasion, a beam containing a mixture of red and blue light is shone into a prism, as shown in Fig. 6.2.

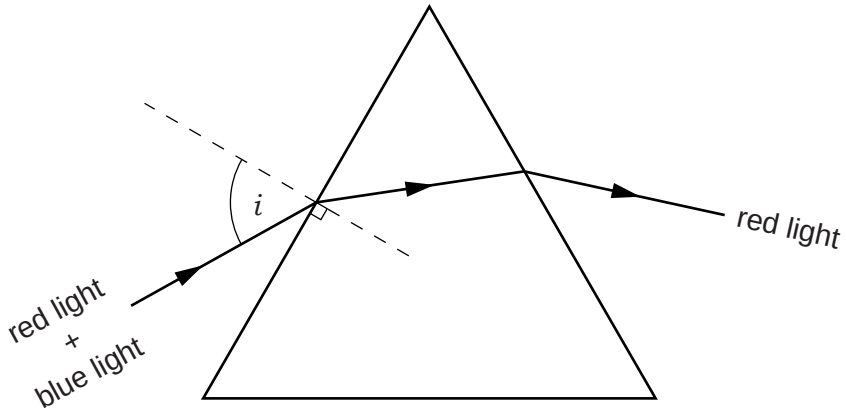


**Fig. 6.2**

**(i)** On Fig. 6.2, draw the path of the blue light through the prism and out into the air again. [3]

**(ii)** Refraction is occurring at the first surface.

Which of the following is also occurring? Tick one box.

| | |
|---|---|
| diffraction | ☐ |
| dispersion | ☐ |
| focusing | ☐ |
| total internal reflection | ☐ |

[1]

[Total: 9]

**7** Fig. 7.1 shows a compass needle that has come to rest in the Earth's magnetic field.

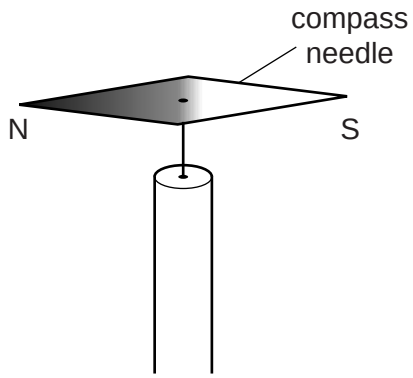


**Fig. 7.1**

**(a)** On Fig. 7.1, draw an arrow pointing towards the north pole of the Earth. [1]

**(b)** The S pole of a bar magnet is brought towards the S pole of the compass needle, as shown in Fig. 7.2.

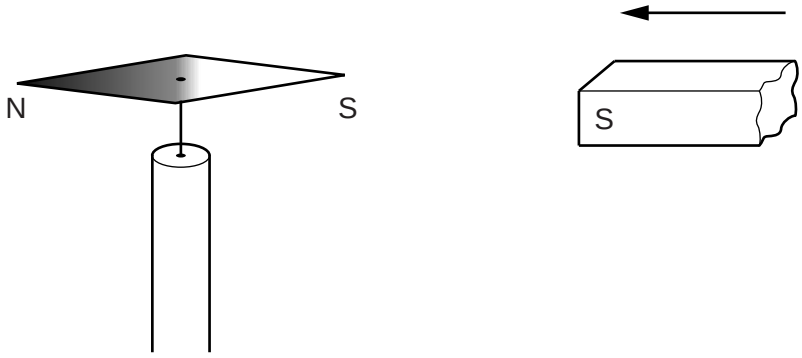


**Fig. 7.2**

Describe what is seen happening to the compass needle as this is done.

.....

.....

.....[2]

**(c)** The magnet in **(b)** is removed and a horizontal wire is positioned above the co… needle, as shown in Fig. 7.3.

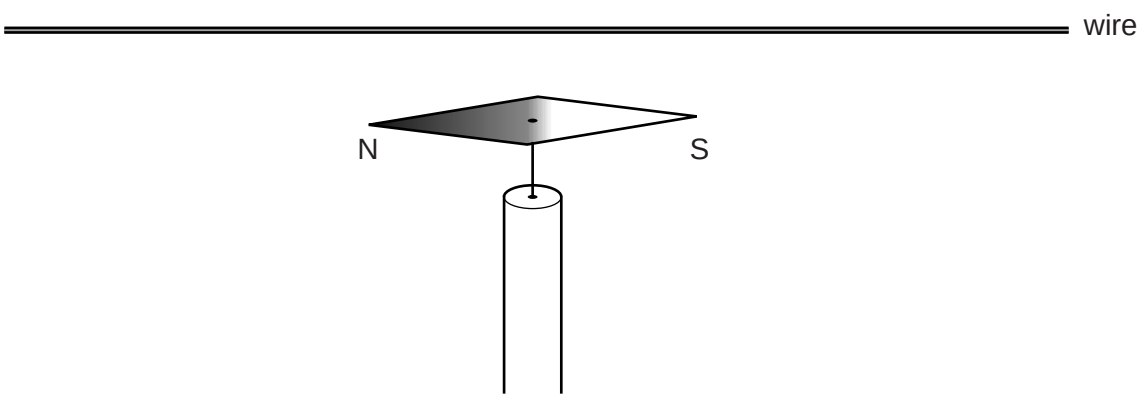


**Fig. 7.3**

When there is a current in the wire, the compass needle rotates through a small angle.

Suggest why this rotation occurs.

.....

.....

.....[2]

[Total: 5]

**8** Fig. 8.1 shows a cell.

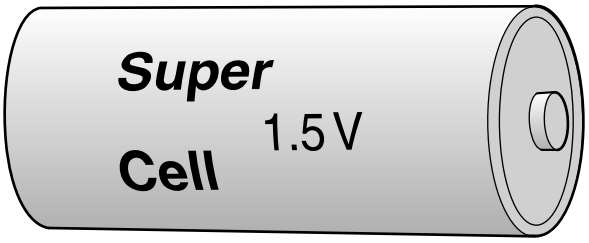


**Fig. 8.1**

**(a)** What does the 1.5 V indicate about the cell?

.....[2]

**(b)** Three cells identical to the cell in Fig. 8.1 make up a 4.5 V battery. The battery is connected in series with a 180 Ω resistor.

Calculate the current in the circuit.

current = .....[4]

**(c)** A second 180 Ω resistor is connected in parallel with the 180 Ω resistor from **(b)**.

**(i)** In the space below, draw the circuit diagram of the two resistors in parallel, connected to the battery. Use standard symbols.

[3]

**(ii)** State the value of

**1.** the potential difference across the second 180 Ω resistor, .....

**2.** the current in the second 180 Ω resistor. .....

[2]

**9** Fig. 9.1 shows a time-delay circuit that includes a capacitor C and a resistor of ve… resistance.

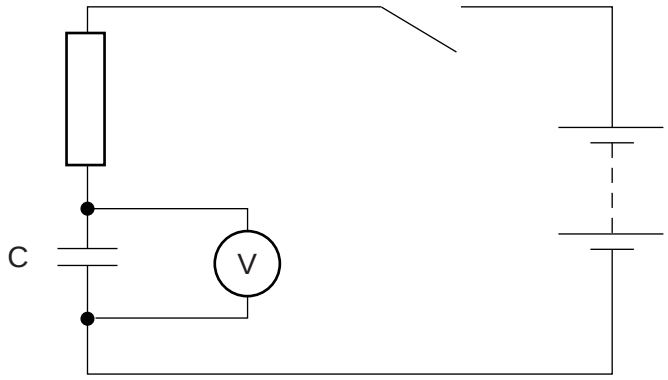


**Fig. 9.1**

**(a)** On Fig. 9.1, use the letter S to label the switch. [1]

**(b)** When the switch is open, the voltmeter in the circuit registers zero.

After the switch has been closed, what happens, if anything, to

**(i)** the charge in the circuit,

.....

..... [1]

**(ii)** the reading on the voltmeter?

.....

..... [2]

**(c)** The switch is now opened again.

State what happens, if anything, to the reading on the voltmeter.

.....

..... [1]

[Total: 5]

**10** A 240V a.c. mains supply is connected to the primary coil of the transformer sh... Fig. 10.1. A lamp that gives full brightness with a 6V supply is connected to the secon... coil.

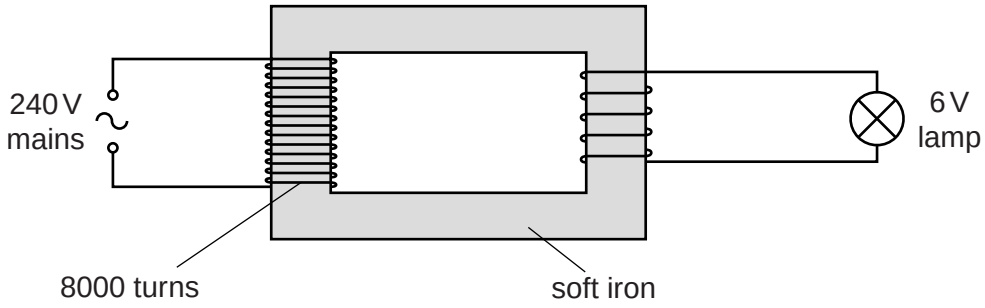


**Fig. 10.1**

**(a)** Name a suitable material from which the coils may be made.

.....[1]

**(b)** State the name given to the part of the transformer that is made of soft iron (see Fig. 10.1).

.....[1]

**(c)** Calculate the number of turns of wire in the secondary coil that will enable the lamp to light at full brightness.

number of turns = .....[3]

**(d)** State what would happen to the lamp if the number of turns in the secondary coil was

**(i)** much less than that calculated in **(c)**,

.....[1]

**(ii)** much more than that calculated in **(c)**.

.....[1]

[Total: 7]

**11** The apparatus for investigating the absorption of the emissions from a radioactive so... shown in Fig. 11.1.

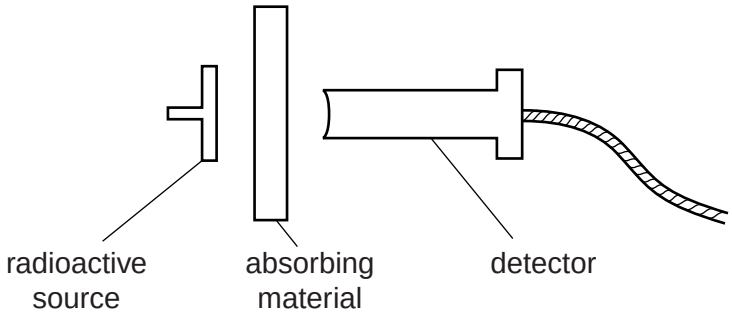


**Fig. 11.1**

The source and detector are about 2 cm apart. The detector is connected to a scaler, which measures the count rate.

Different absorbing materials are placed between the source and the detector.

The table below shows the count rate obtained with each of five absorbers.

| absorbing material | count rate / counts / s |
|---|---|
| air | 523 |
| sheet of paper | 523 |
| 0.5 mm of aluminium | 391 |
| 10 mm of aluminium | 214 |
| 10 mm of lead | 122 |

**(a)** How can you tell that the source is not emitting any $\alpha$-particles?

.....

.....

.....[2]

**(b)** What is the evidence that $\beta$-particles are being emitted?

.....

.....

.....[2]

**(c)** What is the evidence that $\gamma$-rays are being emitted?

.....

.....

.....[2]

[Total: 6]

**12** **(a)** The symbol for an $\alpha$-particle is either $^{4}_{2}\alpha$ or $^{4}_{2}\text{He}$.

**(i)** What does the 4 indicate about an $\alpha$-particle?

.....[1]

**(ii)** What does the 2 indicate about an $\alpha$-particle?

.....[1]

**(b)** The symbol for a $\beta$-particle is either $^{0}_{-1}\beta$ or $^{0}_{-1}\text{e}$.

**(i)** What does the 0 indicate about a $\beta$-particle?

.....[1]

**(ii)** What does the –1 indicate about a $\beta$-particle?

.....[1]

**(c)** The list below gives, in nuclide notation, the symbols of five radioactive nuclides.

$^{240}_{94}\text{Pu}$ $^{244}_{96}\text{Cm}$ $^{248}_{98}\text{Cf}$ $^{250}_{97}\text{Bk}$ $^{250}_{98}\text{Cf}$

**(i)** $^{244}_{96}\text{Cm}$ decays by emitting an $\alpha$-particle.

Into which of the other nuclides in the list does it decay? .....[1]

**(ii)** $^{250}_{97}\text{Bk}$ decays by emitting a $\beta$-particle.

Into which of the other nuclides in the list does it decay? .....[1]

[Total: 6]