1. Hydrogen gas is placed in a glass tube in a laboratory.

Fig. 19.1 shows the emission spectrum of hydrogen.

Each line in the emission spectrum has a different colour

Fig. 19.1

i. Complete the sentences to explain the cause of the lines in the emission spectrum.

Use words from the list.

atoms	**electrons**	**light**	**protons**	**sound**

..... move from a higher energy level to a lower energy level and emit .....

[2]

ii. There is a potential difference of 3000 V across the tube.

A charge of 0.08 C flows in the tube.

Calculate the energy transferred.

Use the equation: energy transferred = charge × potential difference

Energy transferred = ... J **[2]**

iii. A special power supply is needed to provide the high potential difference of 3000 V.

Describe **one** risk of using this power supply

[1]

2(a). Since 2009, filament lamps in the home have often been replaced by other lamps, called LED lamps.

The table compares a filament lamp and an LED lamp which produce the **same** intensity of light.

	Filament lamp	**LED lamp**
Power	60 W	0.01 kW
Lifetime	2000 hours	26 000 hours
Cost to buy	£1.00	£5.00
Cost to run over 1 year	£22.00	£3.65
Dimmable	Yes	No
Structure	Glass	Plastic

State the power of the filament lamp in kW.

kW **[1]**

(b). Calculate the energy transferred by the LED lamp during its lifetime.

Use the equation: energy transferred = power × time

Give your answer in kW h.

Energy transferred = ... kW h **[2]**

(c). Since 2009, filament lamps in the home have often been replaced by other lamps, called LED lamps. In 1 year, the filament lamp transfers 110 kW h of energy.

This costs £22.00.

What is the cost of 1 kW h of electricity?

Cost = £..... **[1]**

3. A book is lifted a vertical distance, x, from the floor to a table.

The gravitational potential energy store of the book increases by 10 J.

The book is then lifted a further vertical distance, x, from the table onto a shelf.

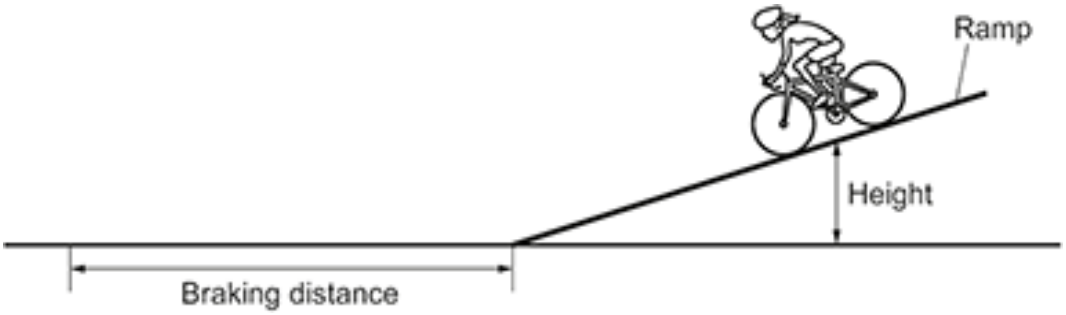
What is the **total** increase in the gravitational potential energy store of the book when it is lifted from the floor to the shelf?

A 5 J
B 10 J
C 20 J
D 40 J

Your answer ☐ **[1]**

4. Student **A** is investigating braking distance using a bicycle. This is their method:

- Freewheel down a ramp **without** pedalling.
- At the bottom of the ramp, press the brakes until the bicycle comes to a stop.
- Measure the braking distance of the bicycle from the bottom of the ramp.



The mass of student **A** and the bicycle is 80 kg.

The height of student **A** and the bicycle at the top of the ramp is 2.0 m.

Gravitational field strength = 10 N / kg.

Calculate the gravitational potential energy of student **A** and the bicycle at the top of the ramp.
Use the Data sheet_J249 01/02/03/04, June 2022.

Gravitational potential energy = ... J **[3]**

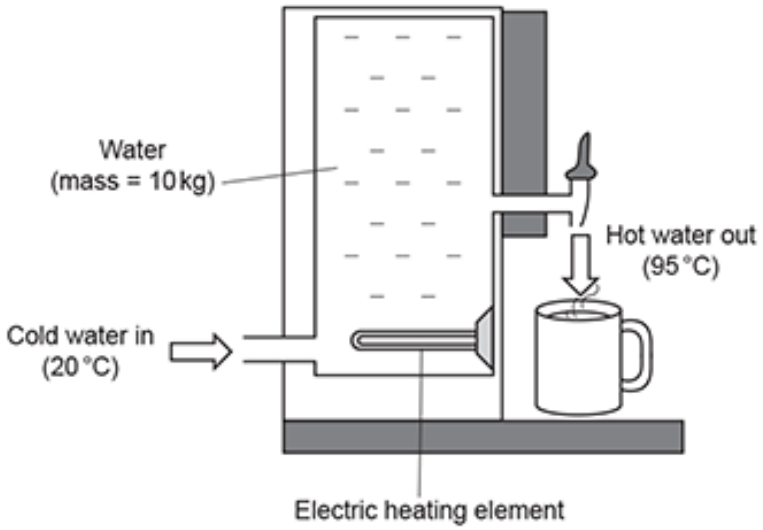
5. A power station has an output power of 2×10^6 kW.

Calculate the energy produced by the power station in 3 hours.
Give your answer in kW h.

Use the equation: energy transferred = power × time

Energy = ... kW h **[2]**

6(a). An electric water heater is used to make hot water for drinks.



The water heater is plugged into the mains supply and turned on.

Explain why the temperature of the water increases.
Write about energy stores in your answer.

[2]

(b). The heater increases the temperature of the water from 20 °C to 95 °C.
The mass of water is 10 kg.
The specific heat capacity of water is 4200 J / kg °C.

Calculate the energy required to increase the temperature of the water.

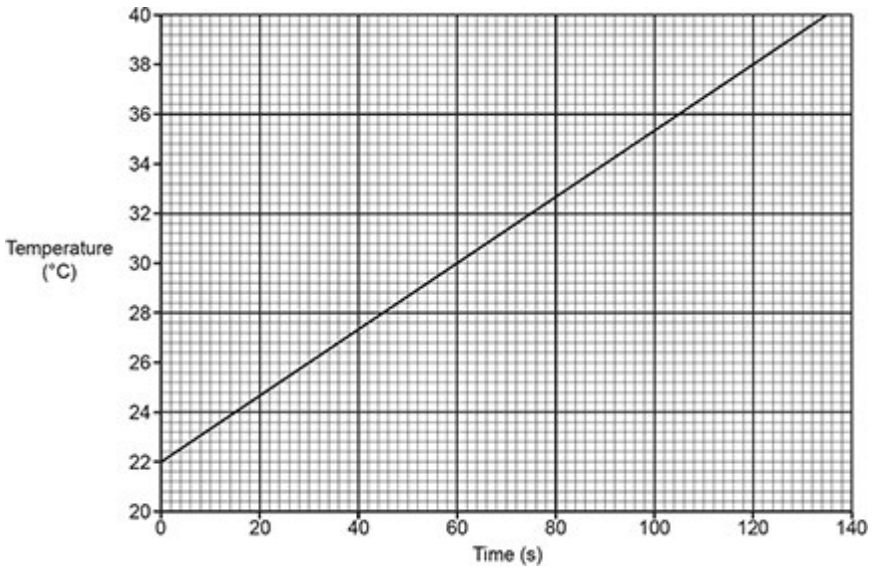
Use the equation:
change in thermal energy = mass × specific heat capacity × change in temperature

Energy = ... J **[3]**

7. A student increases the temperature of a metal block.

They measure how the temperature of the metal block increases with time.

The graph shows their results.



What is the increase in temperature between 60 s and 120 s?

A 8 °C
B 16 °C
C 30 °C
D 38 °C

Your answer ☐ **[1]**

8. A motor transfers 4.3 kJ of energy.

What is 4.3 kJ converted into joules?

A 0.0043 J
B 0.43 J
C 430 J
D 4300 J

Your answer ☐ **[1]**

END OF QUESTION PAPER