Candidate Name	Centre Number	Candidate Number

GCSE COMBINED SCIENCE

COMPONENT 3

Concepts in Physics

FOUNDATION TIER

SAMPLE PAPER

(1 hour 45 minutes)

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**5**	
2.	**5**	
3.	**6**	
4.	**7**	
5.	**10**	
6.	**8**	
7.	**15**	
8.	**11**	
9.	**6**	
10.	**8**	
11.	**9**	
Total	**90**	

ADDITIONAL MATERIALS

In addition to this examination paper you will need a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.
Write your name, centre number and candidate number in the spaces at the top of this page.
Answer **all** questions.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.
The assessment of the quality of extended response (QER) will take place in question **8(a).**

EQUATION LIST

final velocity = initial velocity + acceleration × time	$v = u + at$
distance = ½ (initial velocity + final velocity) × time	$x = \frac{1}{2}(u + v)t$
(final velocity)^2 = (initial velocity)^2 + 2 × acceleration × distance	$v^2 = u^2 + 2ax$
change in thermal energy = mass × specific heat capacity × change in temperature	$\Delta Q = mc\Delta\theta$
thermal energy for a change of state = mass × specific latent heat	$Q = mL$
energy transferred in stretching = 0.5 × spring constant × (extension)^2	$E = \frac{1}{2}kx^2$
potential difference across primary coil × current in primary coil = potential difference across secondary coil × current in secondary coil	$V_1 I_1 = V_2 I_2$

*Answer **all** questions.*

1. Study the table below which gives information about 4 domestic appliances.

Appliance	Voltage (V)	Power (kW)	Current (A)	Time used each day (hours)	Units used each day kWh
kettle	230	2.30	10.0	1.6	3.68
toaster	230	0.46	2.0	0.5	0.23
lamp	230	0.005	0.02	3	0.015
microwave oven	230	1.15	5.0	0.8	0.92

(a) Write down the power of the toaster in watts. [1]

………………………W

(b) Which appliance uses the least energy each day? [1]

……………………………………………………………………………………………..

(c) Appliances are protected with fuses rated in amps.
Circle the best fuse rating to use with the kettle. [1]

3 5 10 13

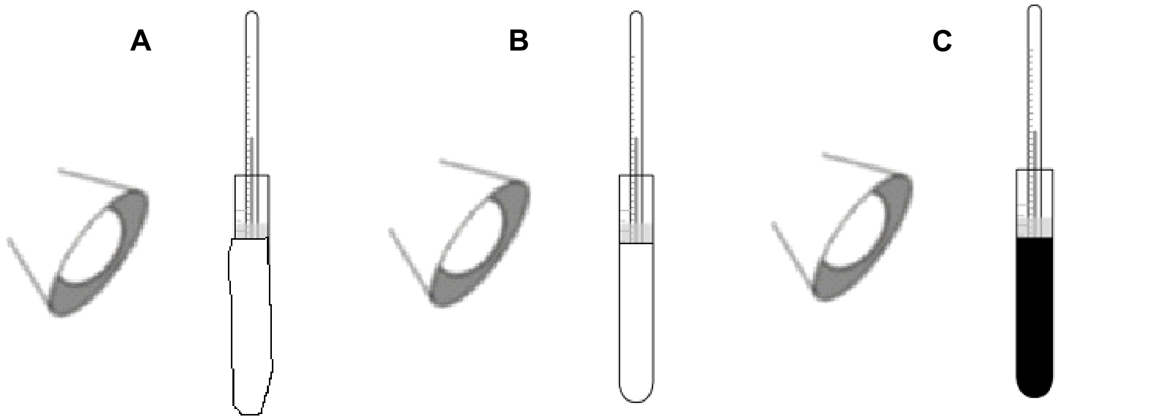
(d) Which appliance costs the most to use each day? ……………………… [1]

(e) Which appliance uses half the energy used by the kettle every second? [1]

………………………

5

2. A group of pupils set up the following experiment to study how the colour and surface can have an effect on the transfer of energy.

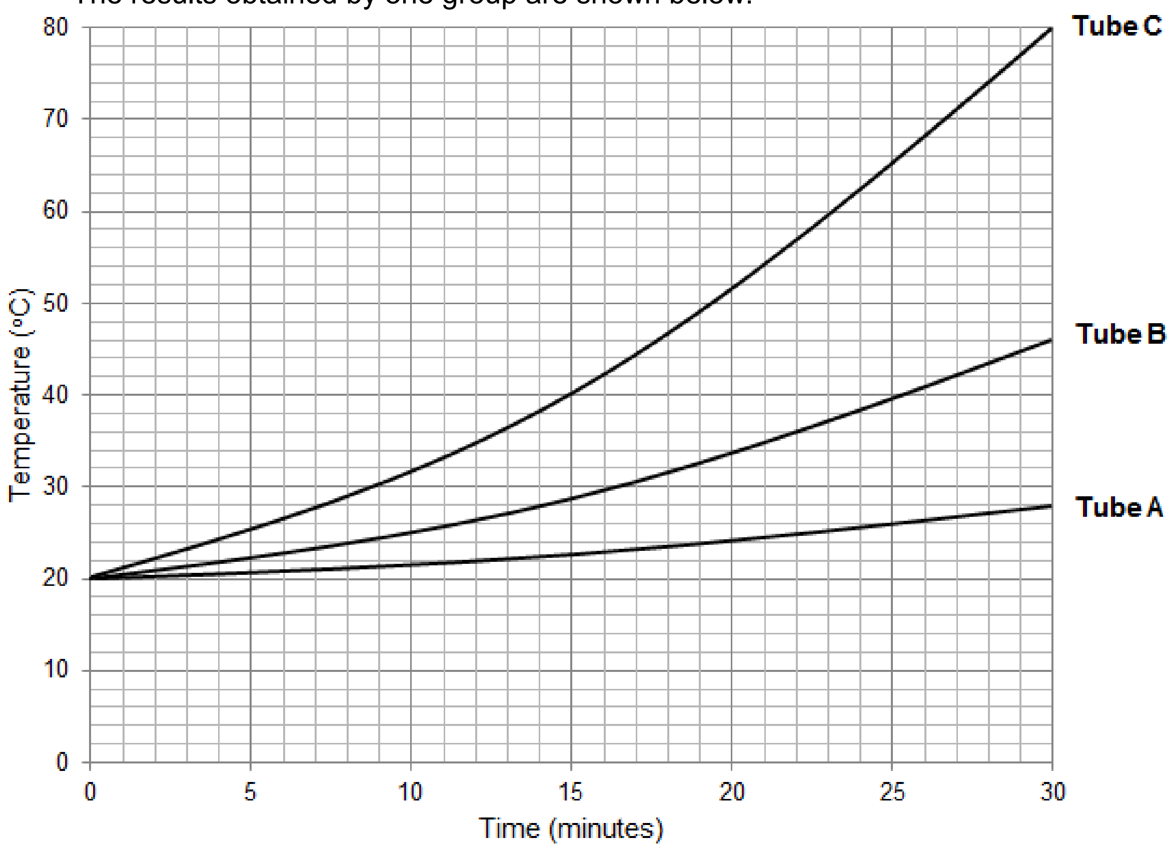


Boiling tube covered in shiny foil

Boiling tube painted white

Boiling tube painted black

The results obtained by one group are shown below.



(a) (i) Write down the starting temperature of the water. [1]

.... °C

(ii) Write down the time taken for the temperature of the water in tube **B** to rise to 36 °C. [1]

.... minutes

(iii) Determine the temperature difference between tubes **C** and **A** at the end of the experiment. [1]

.... °C

(b) Before the pupils did the experiment, they identified the variables that needed to be controlled.

This is the outline procedure they were given:

1. Fill each boiling tube with some water.
2. Place a thermometer in each tube.
3. Place each boiling tube near to a lamp. (The lamp used should be identical in each case.)
4. Record the temperature every 2 minutes to 30 minutes.

What variable did they need to control in: [2]

line 1 of the procedure;

....

line 3 of the procedure?

....

5

3. Newton's laws of motion are important in the way rockets move.

(a) **Tick (✓)** the box next to the statement that correctly completes each sentence.

(i) Newton's **3rd** Law states: [1]

The forces of two objects on each other (action and reaction) are always:

equal and act in opposite directions ☐

equal and act in the same direction ☐

different but act in opposite directions ☐

different but act in the same direction ☐

(ii) A rocket exerts a force of 15 000 000 N on hot gases. The hot gases exert a force of: [1]

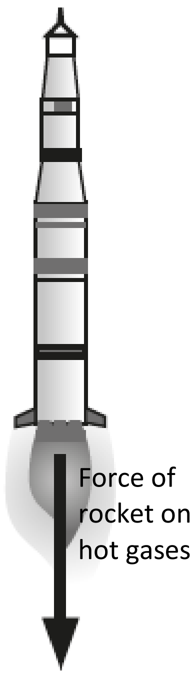
0 N ☐

less than 15 000 000 N on the rocket ☐

15 000 000 N on the rocket ☐

more than 15 000 000 N on the rocket ☐

(b) The diagram shows the direction of the force produced by a rocket on the hot gases.



Add an arrow to the diagram to show the direction of the force of the hot gases on the rocket. [1]

(c) (i) A model rocket has a weight of 5 N. The upward thrust on the rocket is 20 N. Calculate the resultant force on the rocket. [1]

resultant force = ... N

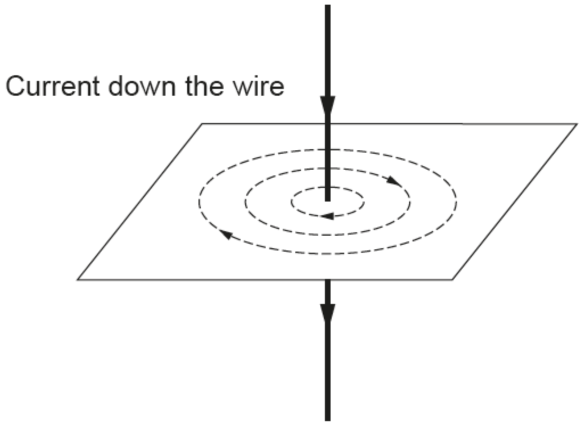
(ii) The mass of this rocket is 0·5 kg.
Calculate the acceleration of the model rocket using your answer to (c)(i) and the equation: [2]

force = mass × acceleration

acceleration = ... m/s^2

6

4. The diagram shows the shape of the magnetic field (as dashed lines) around a long straight wire. A current flows down the wire.



(a) Describe how you would show the shape and direction of the magnetic field around the current in a long straight wire, including the apparatus you would use. [2]

....

....

....

..

(b) Describe the shape of the magnetic field lines around the wire. [1]

....

(c) The current is now reversed. State how this affects the magnetic field. [1]

....

(d) State what happens to the magnetic field when the current is turned off. [1]

....

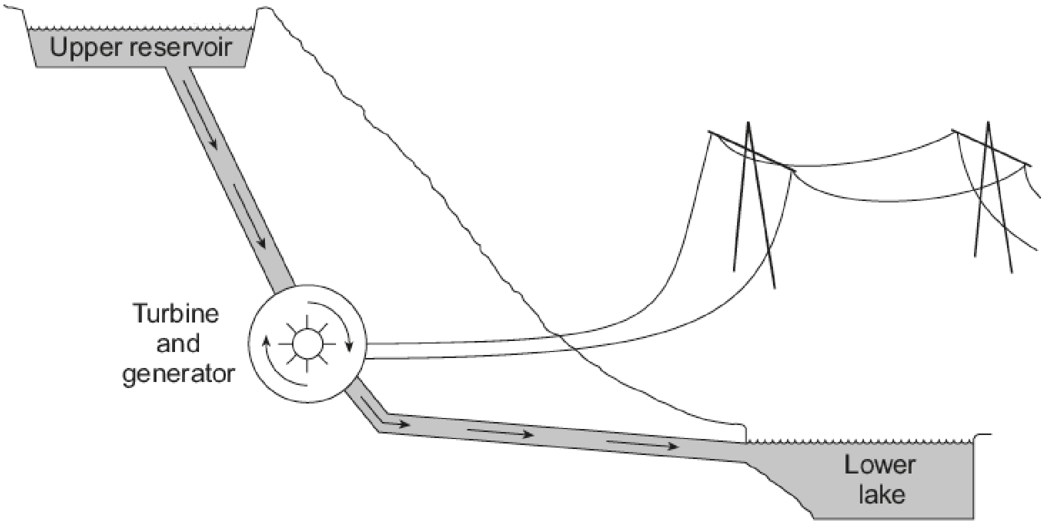
(e) State the **two** factors that affect the strength of the magnetic field near the wire. [2]

1. ....

2. ....

7

5. The diagram shows how electricity is generated in a hydroelectric power station that is in a National Park – an area of outstanding natural beauty.



The upper reservoir holds water that flows through the pipes to the lower lake. The electricity that is generated is transmitted along wires that are underground inside the National Park and along wires supported by pylons after that.

The upper reservoir is re-filled by pumping water back up from the lower reservoir.

The power station is only used when we need more electricity than all the other power stations in the National Grid can supply.

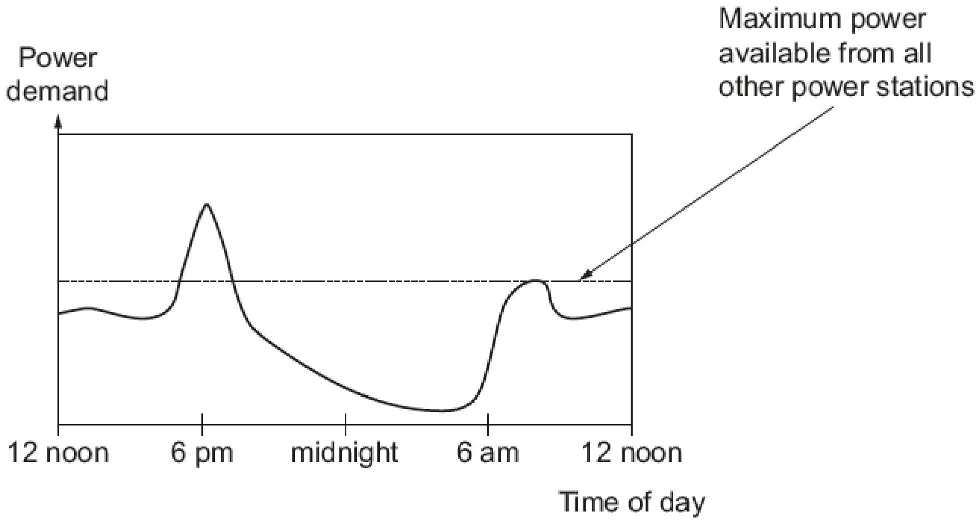
(a) Give a reason why the electrical wires are taken underground for the first few kilometres. [1]

....

(b) Give a reason why this power station is used when there is a sudden increase in demand. [1]

....

(c) The need for electricity changes through the day in the way shown below.



Explain what is happening in this hydroelectric power station between the times of:

(i) 4 pm. to 7 pm [2]

....

....

(ii) midnight to 3 am [2]

....

....

(d) (i) Each generator in this power station supplies 600 A at 440 000 V to the National Grid. There are **6** of these generators in the power station. Calculate the total power output of this power station. [3]

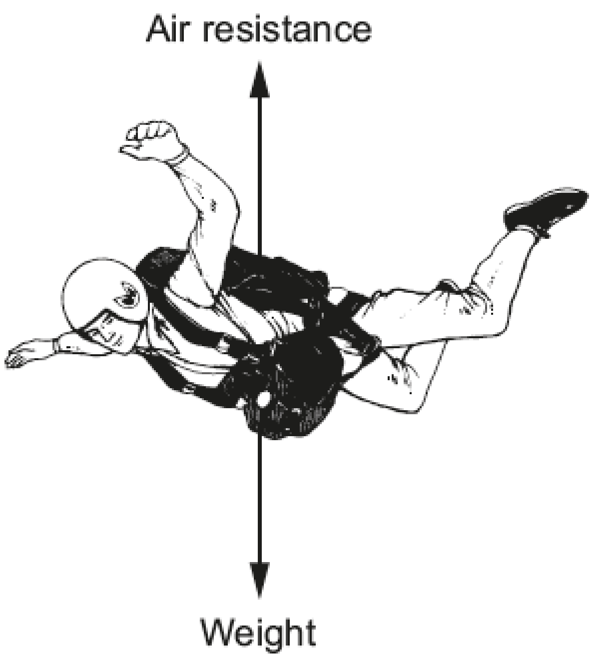
total power output = ...W

(ii) The mean power used by a home is 2 kW. Calculate the number of homes that could be supplied by this power station. [1]

number of homes = ...

10

6. A skydiver falls vertically.
She is acted upon by two forces as shown in the diagram.

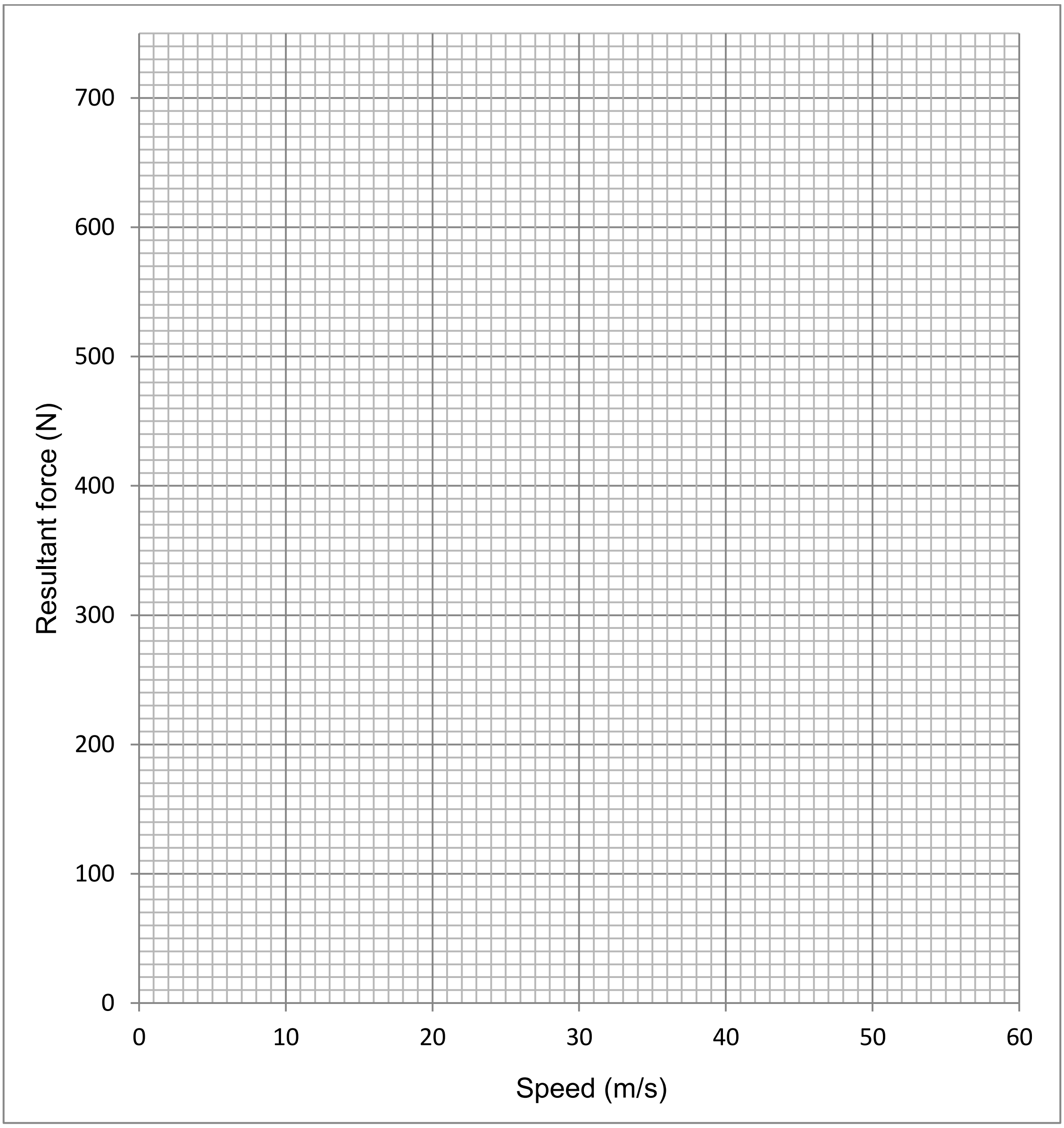


(a) The table gives some information about the forces on the skydiver during her fall.

Speed (m/s)	Weight (N)	Air resistance (N)	Resultant force (N)
0	700	0	700
10	……	280	420
20	700	490	210
30	……	630	70
50	700	……..	0

(i) **Complete** the table. [2]

(ii) Use the information in the table to plot a graph of resultant force against speed and draw a suitable line. [3]



(b) (i) State the value of the skydiver's speed when she is no longer accelerating. [1]

speed = ... m/s

(ii) The skydiver estimated that the air resistance is over 550 N at 25 m/s. Use the graph to calculate the air resistance and explain if she is correct. [2]

air resistance = ………………. N

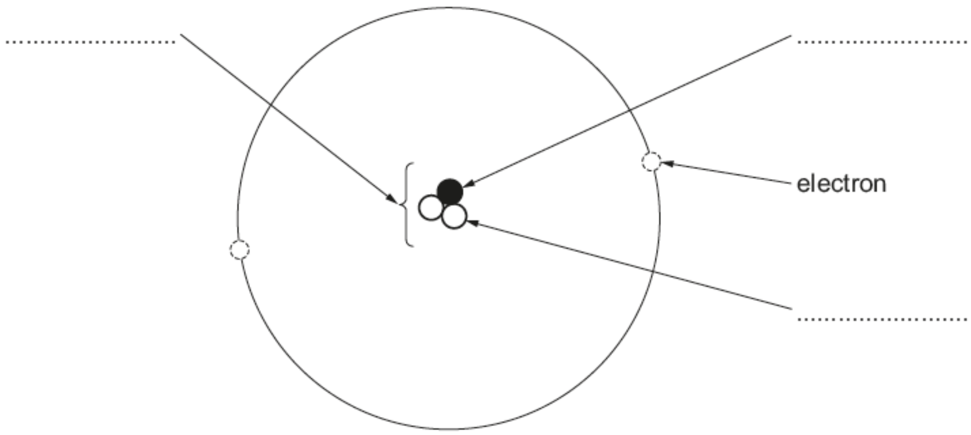
……………………………………………………………………………………………

8

7. The diagram shows the structure of a **neutral** atom of helium-3 ($^{3}_{2}\mathrm{He}$).

(a) Use the words in the box to label the parts of the atoms shown. [3]

electron	proton	isotope	neutron	nucleus



(b) Explain why there are **two** electrons in the atom. [2]

....

....

(c) Compare the structure of a helium-3 atom ($^{3}_{2}\mathrm{He}$) with a helium-4 atom ($^{4}_{2}\mathrm{He}$) in terms of the particles in the atoms. [3]

....

....

....

....

(d) Name the **force** acting in each case below. [2]

(i) Earth orbiting the Sun.

....

(ii) The particle orbiting the centre of an atom.

....

(e) Helium-7 ($^{7}_{2}\mathrm{He}$) is unstable and emits beta particles. It also emits electromagnetic radiation with a frequency of 7×10^{25} Hz.

(i) Explain what is meant by "electromagnetic radiation with frequency of 7×10^{25} Hz". [2]

……………………………………………………………………………………………..

……………………………………………………………………………………………

……………………………………………………………………………………………..

(ii) Three different regions of the electromagnetic spectrum are **A**, **B** and **C.** The wavelength of the three regions is shown in metres (m) in the table below.

Region of electromagnetic spectrum	**Wavelength (m)**
A	$<1 \times 10^{-12}$
B	1×10^{-11} to 1×10^{-8}
C	1×10^{-7} to 4×10^{-7}

The speed of light is 300 000 000 m/s.

speed of light = frequency $\times$ wavelength

Use the information above to explain which part of the electromagnetic spectrum, **A**, **B** or **C,** the radiation emitted by helium-7 belongs to.
You should show any calculations that you make. [3]

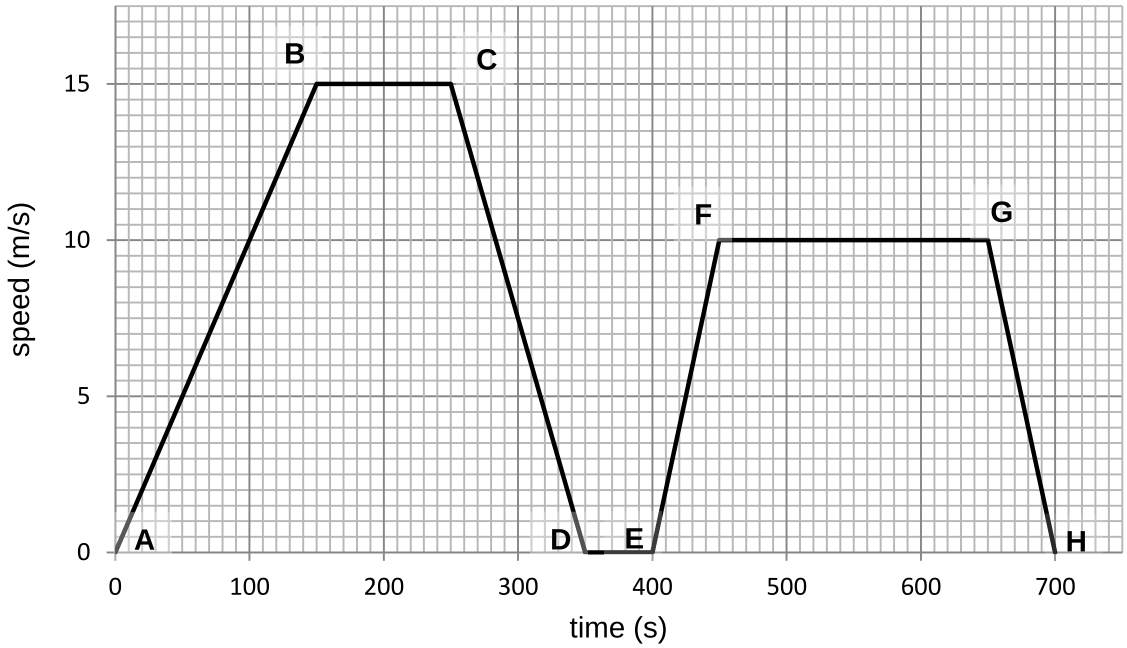
....

....

15

8. A student cycled from home to school and stopped briefly at a pedestrian crossing after travelling for 350 s.

The graph below shows how her speed changed along the journey.



(a) Describe fully the motion during the first 350 s. You should include some calculations relating to the motion.
*Do **not** include calculations of distance travelled*. [6 QER]

....

....

....

....

....

....

....

....

(b) (i) For how many seconds did the cyclist stop at the crossing? [1]

.... s

(ii) Between which **two** letters on the graph did the cyclist travel fastest? [1]

....

(iii) Compare the distances travelled during the times when she travelled at constant speed. [3]

....

....

....

11

9. (a) The time it takes to accelerate from 0 to 60 mph (i.e. 0 to 27 m/s) is a commonly used performance measure for cars. A car is advertised to accelerate from stationary (0 m/s) to a velocity of 27 m/s in 6.5 seconds.

Select a suitable equation from page 2 and use it to calculate its acceleration in that time. [4]

acceleration …………………… m/s^2

(b) Explain in terms of kinetic energy why reducing the speed limit on roads makes the risk of accidents less. [2]

....

....

....

....

6

10. Four competitors in a weightlifting competition have to lift a weight above their heads.

Their best lifts are displayed in the table below.

Weightlifter	Mass lifted (kg)	Force needed (N)	Distance lifted (m)	Work done (J)
A	68	680	2.4	1 632
B	72	……	2.3	1 656
C	74	740	2.4	……….
D	80	800	2.0	1 600

(a) **Complete** the table. [2]

(b) (i) Weightlifter **D** is the winner of the competition as he lifted the largest mass.
Using information from the table explain why he does the least amount of work. [2]

....

....

(ii) Weightlifter **D** lifts the weight in a time of 5 seconds.
Calculate the mean power for his lift. [2]

mean power = ... W

(iii) All four weightlifters lift their maximum weight in 5 seconds.
State and explain which weightlifter uses the least amount of energy per second. [2]

....

....

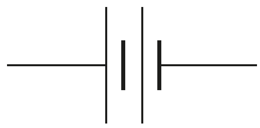
....

8

11. Students are given this information to set up a circuit in their physics lesson.
A 2 Ω resistor, a 4 Ω resistor and an ammeter are connected in series with a 12 V battery.

(a) Using the correct symbols complete the circuit diagram. [3]

12V battery



(b) (i) Calculate the **total resistance** in the circuit. [1]

total resistance = ... Ω

(ii) Calculate the reading on the ammeter. [3]

ammeter reading .... A

(iii) Both of the resistors get hot. Power depends both on the current and resistance. Explain which of the two resistors in this circuit will get hotter. [2]

....

....

....

9