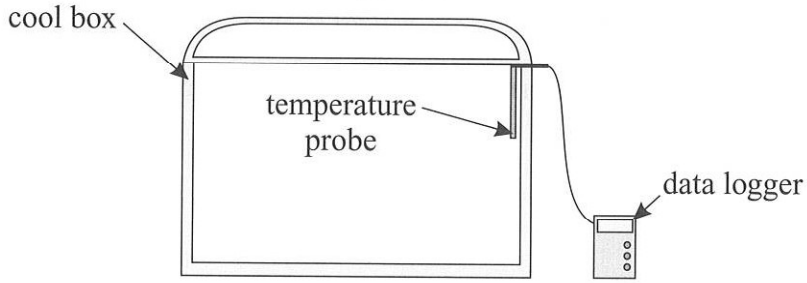
Mixed Questions for Paper 2

1 A cool box is a highly insulated container used for keeping food and drinks at a low temperature.

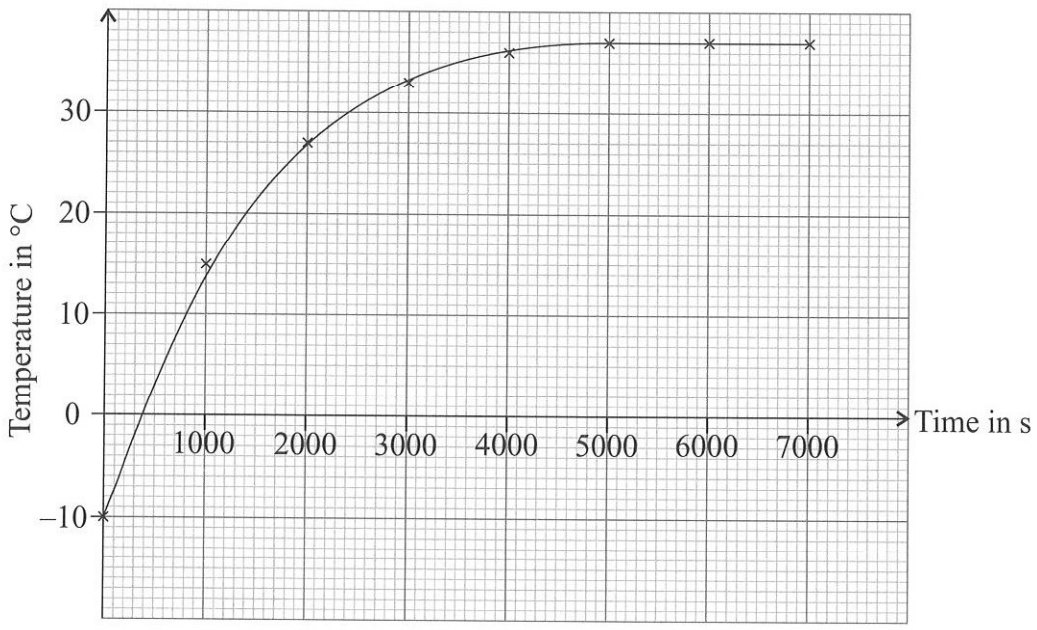
A student does an experiment to test the quality of insulation of a cool box, using the equipment shown in **Figure 1**. The student uses ice packs to bring the temperature inside the cool box down to –10 °C. He then leaves the cool box in a hot room.
The student measures the temperature inside the cool box every 1000 s, using a temperature probe and data logger.

Figure 1



The student plots the results of his experiment on the graph shown in **Figure 2**.

Figure 2



a) i) Using **Figure 2**, determine the instantaneous rate of temperature change inside the cool box 2000 s after the start of the experiment.

Rate of temperature change = ... °C/s
[3]

ii) The walls of the cool box have a specific heat capacity of 1800 J/kg°C.
The cool box has a mass of 2.0 kg.
Calculate the instantaneous rate of energy transfer from the surroundings to the cool box 2000 s after the start of the experiment.

Rate of energy transfer = ... J/s
[2]

b) The freezer used to freeze the ice packs for the experiment has an efficiency of 95%.
The freezer has an input power of 250 W.
Calculate the useful energy transferred by the freezer in 20.0 minutes.

Energy transferred = ... J
[5]

[Total 10 marks]

2 When some stars explode, they leave behind a very dense object called a neutron star.

a) A neutron star has a mass of 2.1×10^{30} kg and a volume of 1.4×10^{13} m^3. A sugar cube has a volume of 1.0×10^{-6} m^3. Calculate how much mass a sugar cube with the same density as this neutron star would have.

Mass = ... kg
[5]

b) The Sun releases approximately 4×10^{26} J of energy per second. The kind of explosions that produce neutron stars can release as much as 1×10^{44} J of energy. Calculate how many years it would take for the Sun to release this amount of energy if it continued releasing energy at the same rate. Give your answer to one significant figure. Assume there are no leap years.

Time taken = ... years
[3]

c) Every star starts its life as a gas cloud. Explain how the pressure in the gas cloud changes if the cloud is heated by a nearby star, assuming the gas cloud has a constant volume.

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[3]

[Total 11 marks]

3 A mobile phone charger contains a transformer to decrease the mains potential difference to the potential difference needed to charge a phone battery. While being charged, the phone is attached to the secondary coil of the transformer as part of a charging circuit.

a) The primary coil of the transformer has 920 turns. The potential difference across the primary coil is 230 V and the current through it is 40 mA. A current of 1840 mA is required in the charging circuit. Calculate the number of turns on the secondary coil, assuming the transformer is 100% efficient.

Number of turns = ...

[5]

b) The transformer generates an alternating current (a.c.) in the charging circuit, but a direct current (d.c.) is required to charge a phone battery. Which of the following components could be included in the charging circuit to convert from a.c. to d.c.? Tick **one** box.

- ☐ **A** LDR
- ☐ **B** Variable resistor
- ☐ **C** Diode
- ☐ **D** Cell

[1]

c) The fuse in the charging circuit blows and must be replaced.
Explain why a 5 A fuse would not be a suitable replacement in this circuit.

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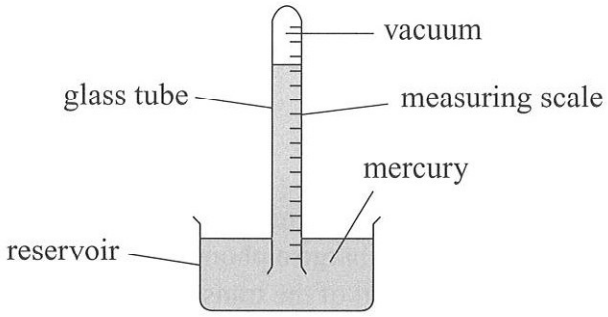
[3]

[Total 9 marks]

4 A mercury barometer is shown in **Figure 3**.

The barometer can be used to measure changes in atmospheric pressure. Atmospheric pressure pushes down on the mercury in the reservoir, forcing mercury up the glass tube.

Figure 3



a) A student takes the barometer to the top of a skyscraper. He observes that the level of the mercury in the glass tube is lower at the top of the skyscraper than at the bottom.

Explain the student's observation.

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[5]

b) The student uses a lift to return to the bottom of the skyscraper.
The lift is fitted with a 75 W light bulb. The potential difference across the light bulb is 120 V.
Calculate the resistance of the light bulb.

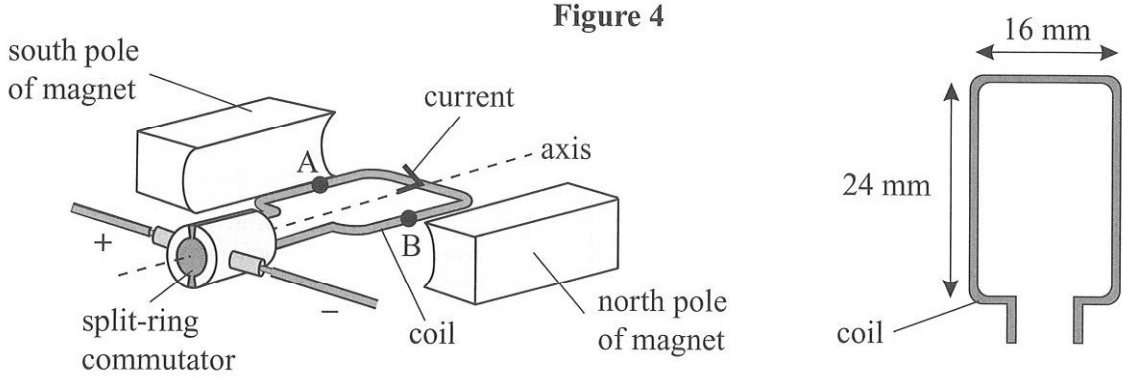
Resistance = ... Ω

[5]

[Total 10 marks]

5 **Figure 4** shows a d.c. electric motor and the dimensions of the motor's coil.

Figure 4



a) i) A 3.7 A current flows through the coil in the direction indicated in **Figure 4**, causing each part of the coil that is perpendicular to the magnetic field to experience a force. Add arrows to **Figure 4** to show the direction of the forces acting on the coil at the points marked **A** and **B**.

[2]

ii) The forces on the coil cause it to turn. The field between the magnetic poles has a strength of 0.45 T. The coil is symmetrical about the axis marked on **Figure 4**. Calculate the net moment about this axis, when the coil is in the position shown. State the direction of the moment.

Net moment = ... Nm

Direction = ...

[5]

iii) State **one** way in which the net moment of the coil about its axis could be increased.

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[1]

b) The split-ring commutator swaps the contacts on the motor every half turn, so that the current through the coil reverses. Explain why it is necessary to reverse the current every half turn.

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[1]

[Total 9 marks]

Exam Practice Tip

Well, that's it — you've made it to the end. I hope you've enjoyed stretching your physics muscles and now feel ready to take on the real exams. Make sure you rest up and get an early night before each exam so you're bright-eyed and bushy-tailed, ready to show that physics exam who's boss.

Score: ☐ / **49**