Student number

Name _____

Date _____

Attempt/Time taken _____

GCSE
PHYSICS

Topic Paper: 7.2 & 7.3 The motor effect, induced potential, transformers, national grid (Higher tier physics)
Part 3

Time allowed: 50 minutes

Materials
For this paper you must have:
- the Periodic Table/Data Sheet, provided as an insert (enclosed)
- a ruler with millimetre measurements
- a calculator, which you are expected to use where appropriate.

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- All working must be shown.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The Periodic Table/Data Sheet is provided as in insert.
- You are reminded of the need for good English and clear presentation in your answers.
- When answering questions you need to make sure that your answer:
  - is clear, logical, sensibly structured
  - fully meets the requirements of the question
  - shows that each separate point or step supports the overall answer.

46 Marks

Q14. The diagram shows a transformer.
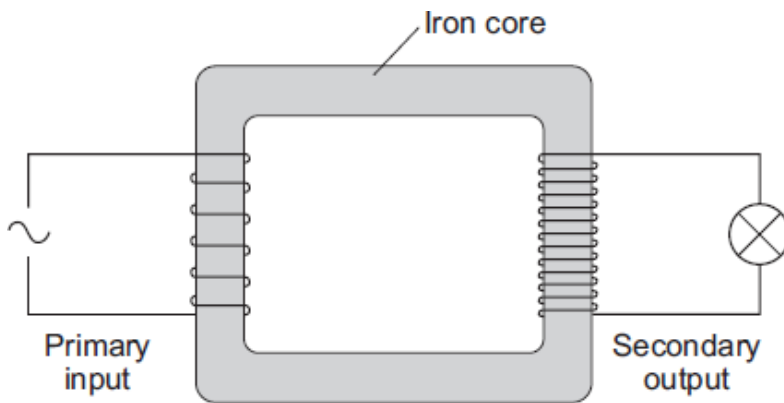
(a) (i) Is the transformer in the diagram being used as a step-up transformer or as a step-down transformer?

Put a tick (✓) in the box next to your answer.

a step-up transformer ☐

a step-down transformer ☐

Give a reason for your answer.

....

....

(1)

(ii) Why is the core made of iron?

....

....

(1)

(b)   The power supply to a laptop computer contains a transformer designed to change the 230 V mains input to a 15 V output. The transformer has 920 turns on its primary coil.

Use the equation in the box to calculate the number of turns on the secondary coil.

$$\frac{\text{p.d. across primary}}{\text{p.d. across secondary}} = \frac{\text{number of turns on primary}}{\text{number of turns on secondary}}$$

Show clearly how you work out your answer.

....

....

....

Number of turns on the secondary coil = ...

(2)
(Total 4 marks)

Q15. The diagram shows a student's design for a simple wind speed gauge.
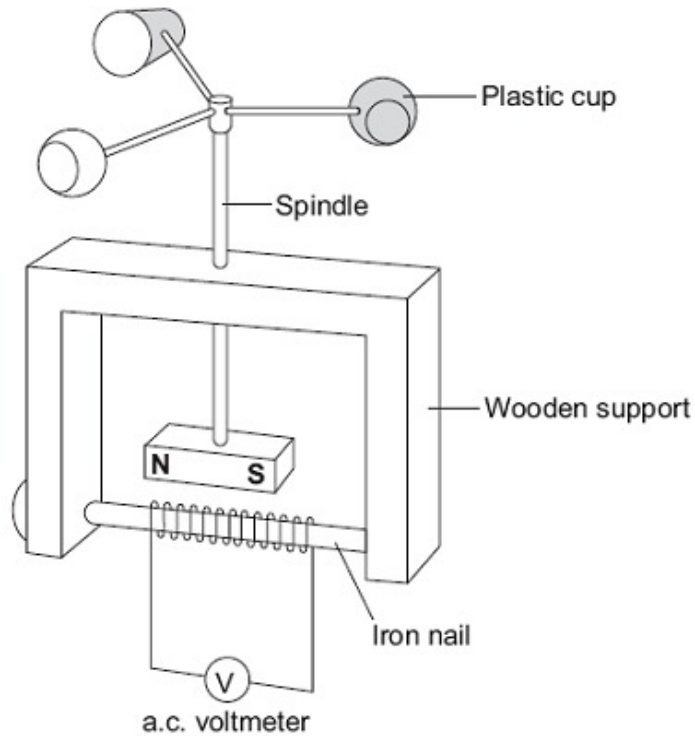
(a) Explain why the wind causes the a.c. voltmeter to give a reading. The explanation has been started for you.

The wind causes the plastic cups to turn. ....

....

....

....

....

....

....

(3)

(b) The gauge is not sensitive enough to measure light winds.

Suggest **one** way that the design can be modified to make the gauge more sensitive.

....

....

(1)
(Total 4 marks)

4

Q16. (a) In the National Grid, very large step-up transformers link power stations to the transmission cables.

A transformer used for this purpose has 800 turns on its primary coil and 12 800 turns on its secondary coil. The p.d. (potential difference) across its primary coil is 25 kV.

Use the equation in the box to calculate the p.d. across its secondary coil.

$$\frac{\text{p.d. across primary}}{\text{p.d. across secondary}} = \frac{\text{number of turns on primary}}{\text{number of turns on secondary}}$$

Show clearly how you work out your answer.

....

....

p.d. across secondary coil = ... volts

(2)

(b) The diagram shows the structure of a transformer.
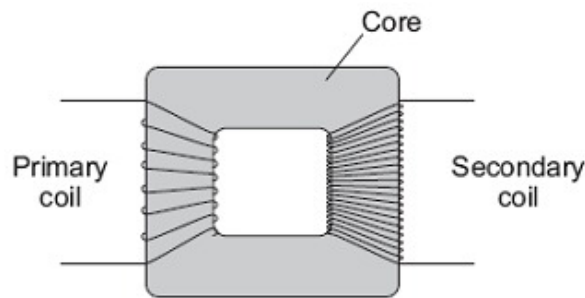
(i) The primary and secondary coils of a transformer are made of insulated wire.

Why is this insulation necessary?

....

....

(1)

(ii) Why is the core made of iron?

....

....

(1)

(iii)   Explain how the transformer works.

....

....

....

....

....

....

(3)

(c)   Before 1926, large towns had their own local power stations. After 1926, these power stations were connected to form the National Grid.

Give **two** advantages of having a National Grid system.

1 ....

....

2 ....

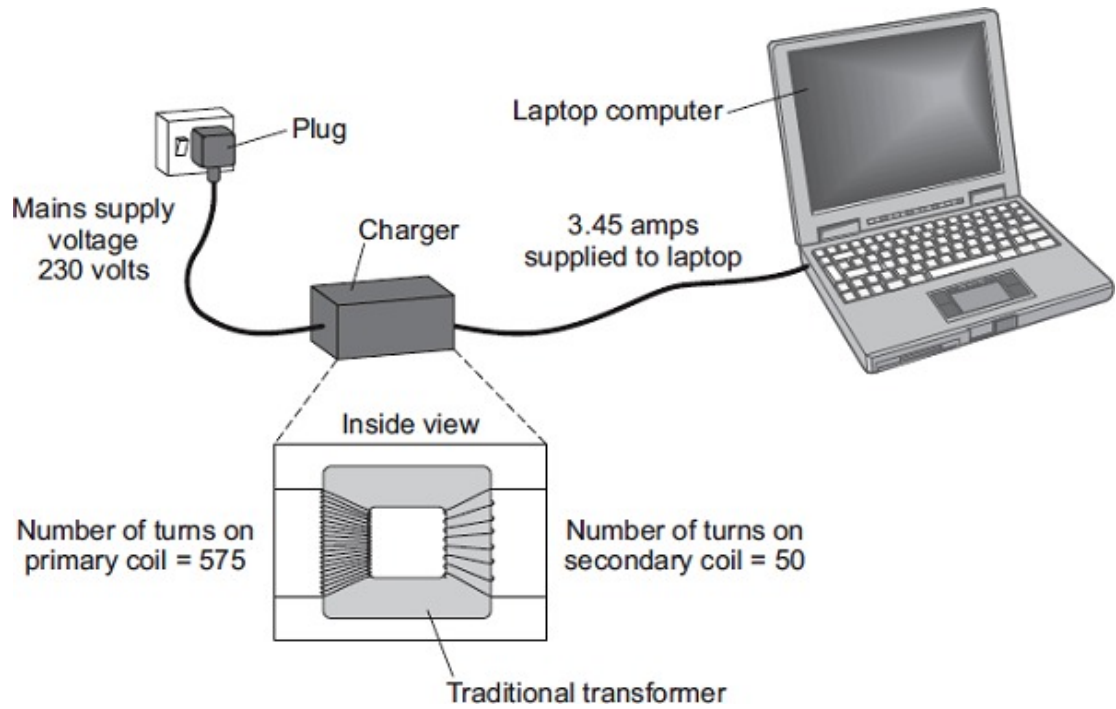..

(2)
(Total 9 marks)

Q17. Batteries inside laptop computers are charged using laptop chargers. The laptop charger contains a traditional transformer.

(a) The alternating current flowing through the primary coil of the transformer creates an alternating current in the secondary coil.

Explain how.

....

....

....

....

....

....

....

....

(3)

(b)　(i)　Use information from the diagram to calculate the potential difference the charger
supplies to the laptop.

Use the correct equation from the Physics Equations Sheet.

....

....

....

....

Potential difference = ... V

(2)

(ii)　Calculate the current in the primary coil of the transformer when the laptop is being
charged.

Assume the transformer is 100% efficient.

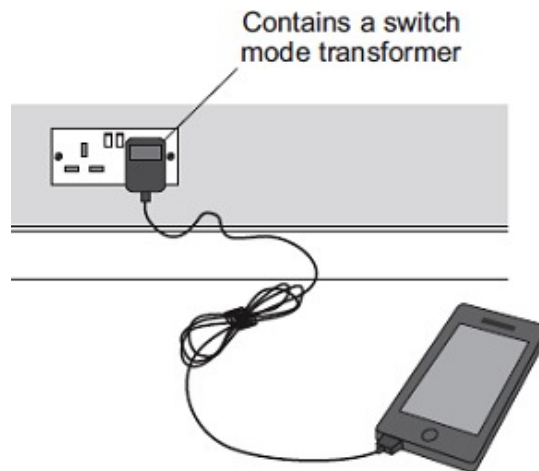Use the correct equation from the Physics Equations Sheet.

....

....

....

....

Current = ... A

(2)

(c)   Switch mode transformers can be used in mobile phone chargers.

Contains a switch
mode transformer

Switch mode transformers and traditional transformers can both use the UK mains supply.

The switch mode transformer is smaller and lighter than the traditional transformer used in the laptop charger.

Give **one** other advantage of the switch mode transformer.

....

....

(1)

(d)   Laptop batteries and mobile phone batteries can only be recharged a limited number of times. After this, the batteries cannot store enough charge to be useful. Scientists are developing new batteries that can be recharged many more times than existing batteries.

Suggest **one** other advantage of developing these new batteries.

....

....

....
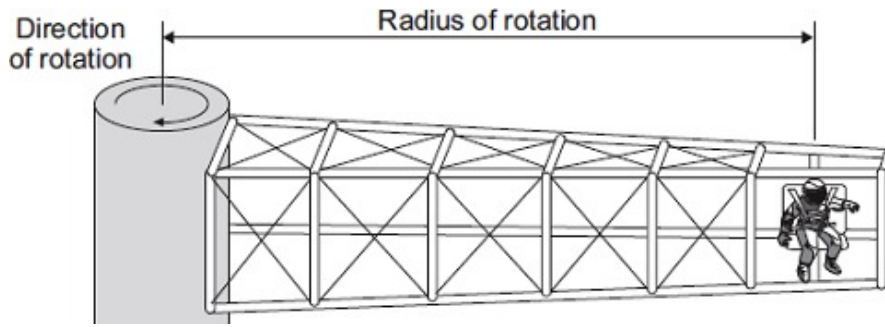
(1)
(Total 9 marks)

Q18. The diagram shows a 'G-machine'. The G-machine is used in astronaut training.

The G-machine moves the astronaut in a horizontal circle.

(a) When the G-machine is rotating at constant speed, the astronaut is accelerating.

State the name and direction of the force causing the astronaut to accelerate.

Name of force ....

Direction of force ....

....
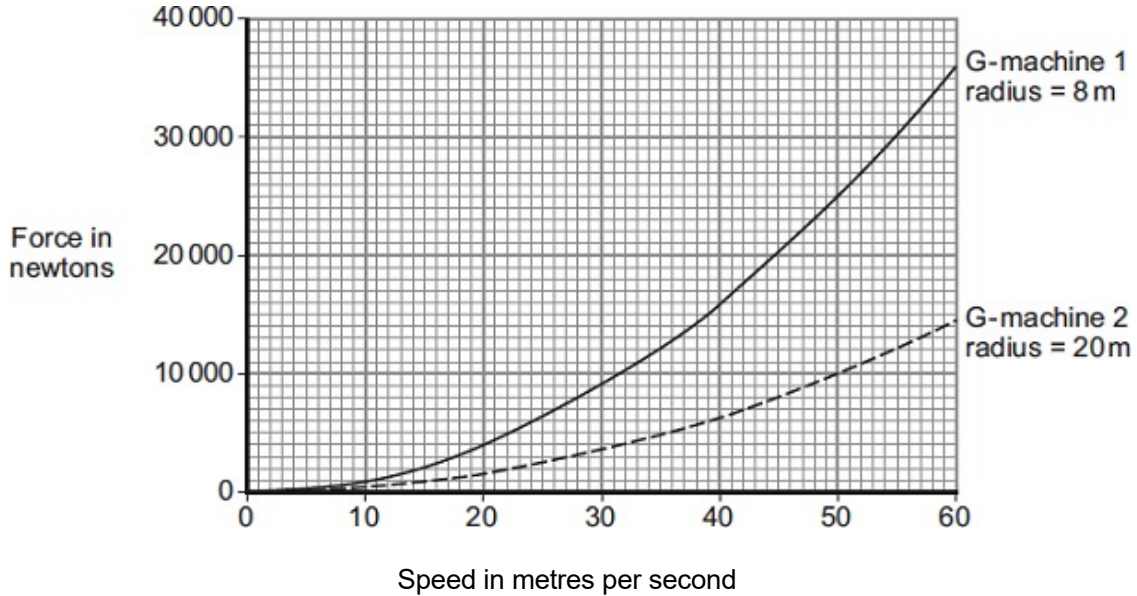
(2)

(b)   The force causing the astronaut to move in a circle is measured.

The graph shows how the speed of the astronaut affects the force causing the astronaut to move in a circle for two different G-machines.

The radius of rotation of the astronaut is different for each G-machine.

Speed in metres per second

(i)   State **three** conclusions that can be made from the graph.

1 ....

....

2 ....

....

3 ....

....

(3)

(ii)   The speed of rotation of G-machine 1 is increased from 20 m/s to 40 m/s.

Determine the change in force on the astronaut.

....

Change in force = ... N

(1)

(c)   Each G-machine is rotated by an electric motor. The diagram shows a simple electric motor.
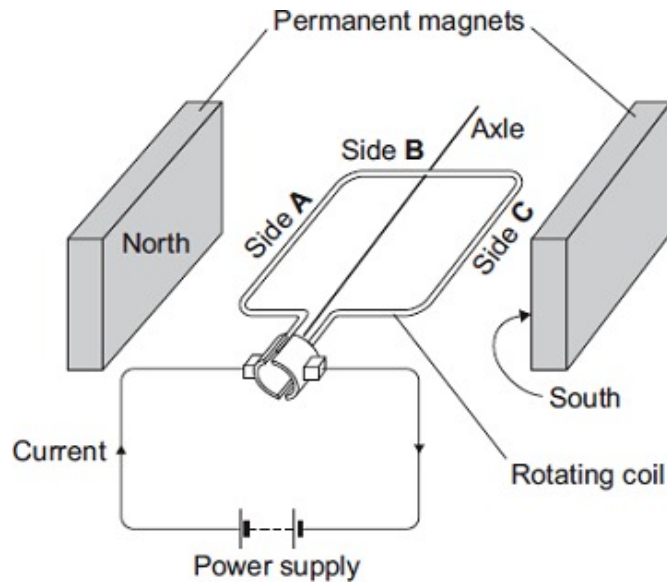
(i)   A current flows through the coil of the motor.

Explain why side **A** of the coil experiences a force.

....

....

....

....

(2)

(ii) Draw arrows on the diagram to show the direction of the forces acting on side **A** of the coil and side **C** of the coil.

(1)

(iii) When horizontal, side **B** experiences no force.

Give the reason why.

....

....

(1)

(d)   While a G-machine is rotating, the operators want to increase its speed.

What can the operators do to make the G-machine rotate faster?

....

....

(1)

(e)   The exploration of space has cost a lot of money.

Do you think spending lots of money on space exploration has been a good thing?

Draw a ring around your answer.

Yes   **No**

Give a reason for your answer.

....

....

(1)
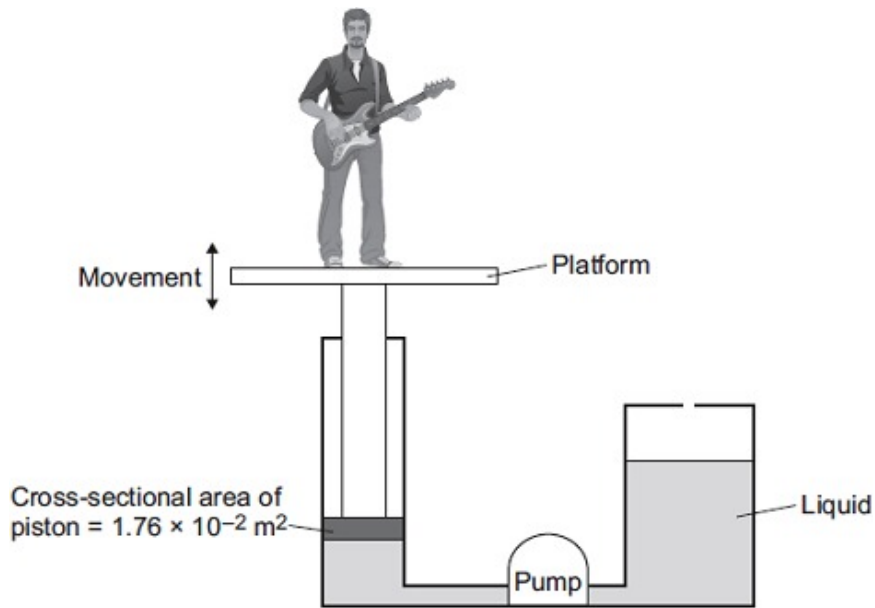**(Total 12 marks)**

Q19.   Musicians sometimes perform on a moving platform.

Figure 1 shows the parts of the lifting machine used to move the platform up and down.

Figure 1

(a)   What type of system uses a liquid to transmit a force?

....

(1)

(b)   The pump creates a pressure in the liquid of 8.75×10^4 Pa to move the platform upwards.

Calculate the force that the liquid applies to the piston.

Use the correct equation from the Physics Equations Sheet.

....

....

....

Force = ... N

(2)

(c)   The liquid usually used in the machine is made by processing oil from underground wells.
A new development is to use plant oil as the liquid.

Extracting plant oil requires less energy than extracting oil from underground wells.

Suggest an environmental advantage of using plant oil.

....

....

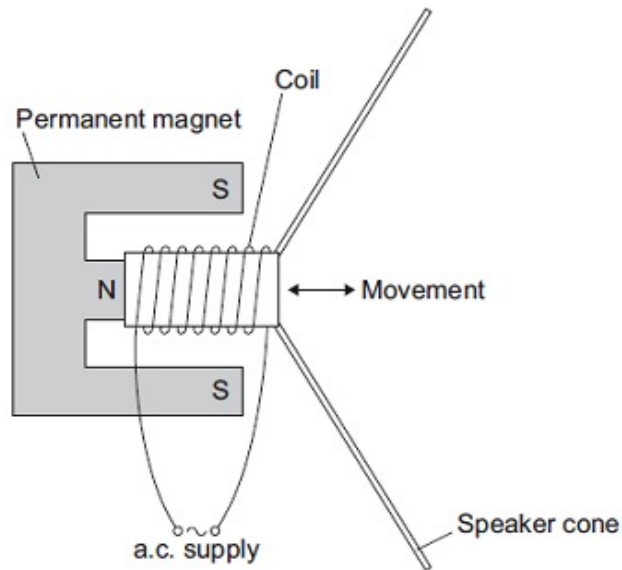...

(1)

(d) Musicians often use loudspeakers.

Figure 2 shows how a loudspeaker is constructed.

Figure 2

The loudspeaker cone vibrates when an alternating current flows through the coil.

Explain why.

....

....

....

....

....

....

....

....

....

....

(4)
(Total 8 marks)