Exampro GCSE Physics

P2 Motor Effect and Transformers Self Study Questions Higher tier

Name:

Class:

Author:

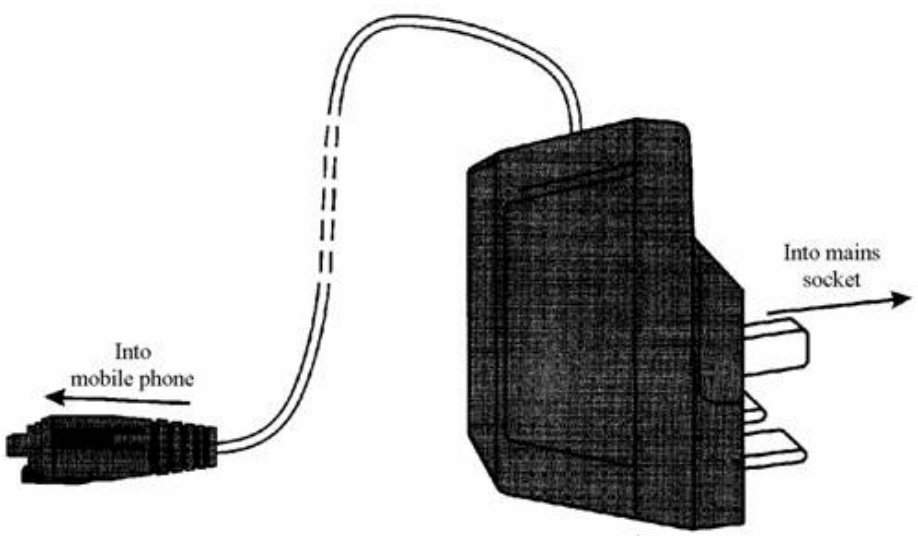
Date:

Time: 128

Marks: 126

Comments:

Q1. (a) The drawing shows a small transformer used to recharge the battery in a 4.2 V mobile phone from a 230 V mains supply.



Explain how you know that this is a *step-down* transformer.

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(1)

(b) A transformer consists of an insulated coil of wire, called the primary coil, on one side of a core. Another coil of insulated wire, called the secondary coil, is on the other side.

Give **two** features of the *core*.

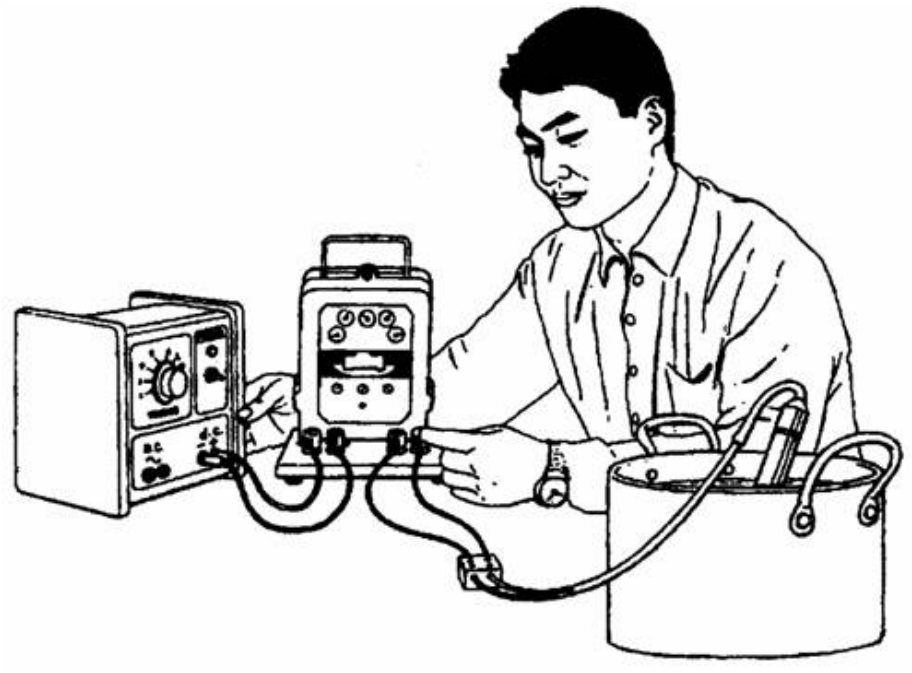
1 .....

2 .....

(2)

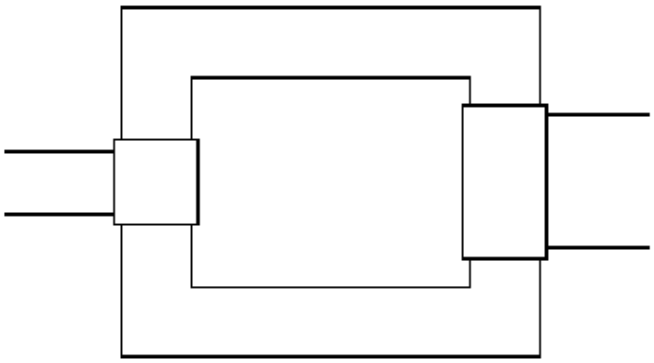
(Total 3 marks)

Q2. The drawing shows an experiment using a low voltage supply, a joulemeter, a small immersion heater and a container filled with water.



The immersion heater is designed for use in a tropical fish tank. It is connected to a step-down transformer supplied by 230 V a.c. mains.

The inside of a step-down transformer consists of three main parts. Name the **three** parts and briefly describe them. You may add to the diagram to help you to answer.



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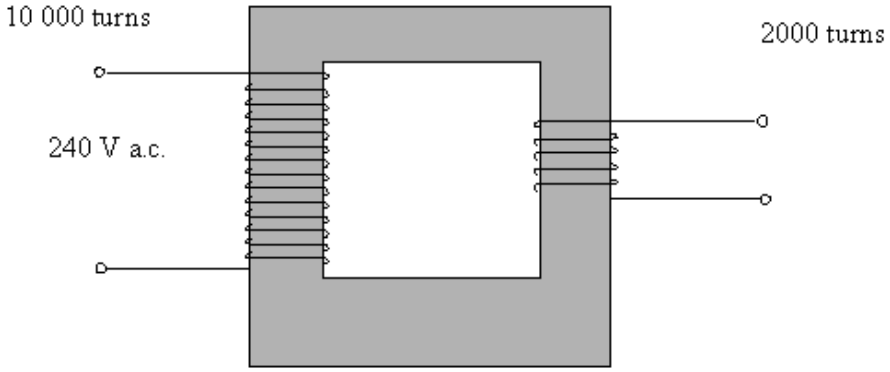
(Total 4 marks)

Q3. (a) An appliance in a house has a transformer. The transformer is used to reduce the voltage to the level needed by the appliance.

The diagram shows the transformer.



(i) Name the material used for the core of the transformer.

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(1)

(ii) The transformer has 10 000 turns on the input side and 2000 turns on the output side. If the mains voltage of 240 volts is applied to the input, calculate the output voltage. You may find the following information helpful:

$$\frac{\text{output voltage}}{\text{input voltage}} = \frac{\text{number of turns on output coil}}{\text{number of turns on input coil}}$$

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(3)

(b) Explain, in terms of magnetic fields, how a transformer works.

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(4)

(c) A 12 V car battery is connected to the input leads of the transformer. It is hoped to reduce the voltage to 2.4 V in order to run a small motor. When the output voltage is measured it is found to be zero.

Explain why the output voltage is zero.

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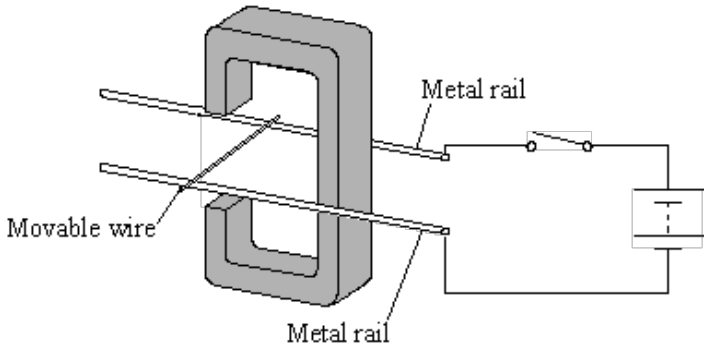
(2)
(Total 10 marks)

Q4. The diagram shows apparatus used to demonstrate the electric motor effect. When he switch is closed the wire moves.



(i) Draw an arrow on the diagram to show the direction the wire moves.

(1)

(ii) Explain why the wire moves.

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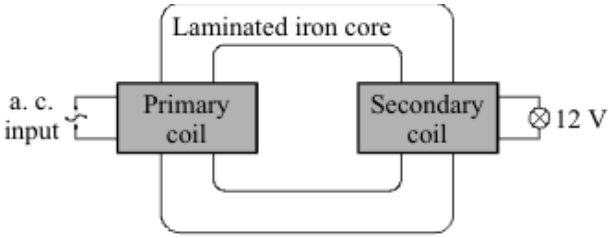
(2)
(Total 3 marks)

Q5. (a) The diagram represents a simple transformer used to light a 12 V lamp. When the power supply is switched on the lamp is very dim.



(i) Give **one** way to increase the voltage at the lamp without changing the power supply.

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(1)

(ii) What is meant by the iron core being *laminated*?

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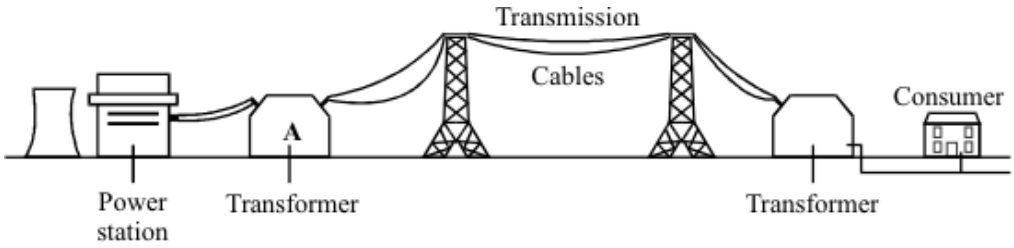
(1)

(b) Electrical energy is distributed around the country by a network of high voltage cables.



(i) For the system to work the power is generated and distributed using alternating current rather than direct current. Why?

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(1)

(ii) Transformers are an essential part of the distribution system. Explain why.

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(2)

(iii) The transmission cables are suspended high above the ground. Why?

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(1)

(c) The power station generates 100 MW of power at a voltage of 25 kV. Transformer **A**, which links the power station to the transmission cables, has 44 000 turns in its 275 kV secondary coil.

(i) Write down the equation which links the number of turns in each transformer coil to the voltage across each transformer coil.

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(1)

(ii) Calculate the number of turns in the primary coil of transformer **A**. Show clearly how you work out your answer.

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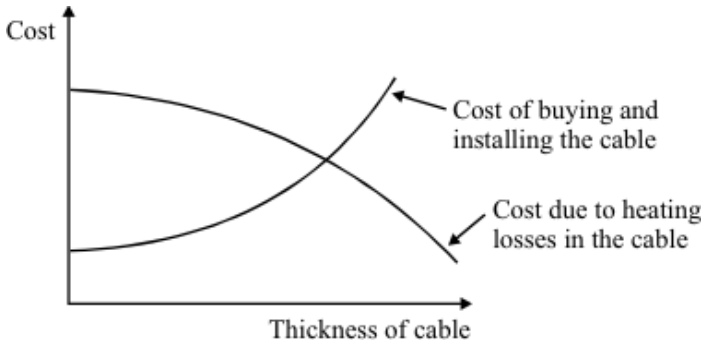
Number of turns = ...

(2)

(d) The diagram shows how the cost of transmitting the electricity along the cables depends upon the thickness of the cable.



(i) Why does the cost due to the heating losses go down as the cable is made thicker?

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(1)

(ii) By what process is most heat energy lost from the cables?

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(1)

(Total 11 marks)

Q6. A transformer is used to reduce the 230 V a.c. mains to the 12 V supply required for the lighting system. The transformer has 1150 turns on its primary coil.

(i) Write down the equation which links the number of turns of each transformer coil to the voltage across each transformer coil.

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(1)

(ii) Calculate the number of turns on the secondary coil of the transformer. Show clearly how you work out your answer.

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number of turns on the secondary coil = ...

(2)

(Total 3 marks)

Q7. (a) This notice is on the back of a television set.

The transformer used in the television set has 75 turns on its primary coil. The potential difference (p.d.) across the primary coil is 230 volts and the p.d. across the secondary coil is 32 200 volts.

Use the equation below 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.

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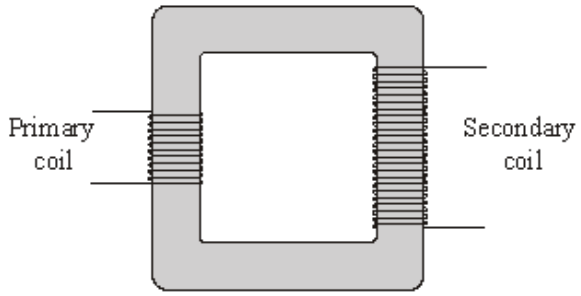
Number of turns on the secondary coil = ...

(2)

(b) The diagram shows the structure of a transformer.



Explain how the transformer works.

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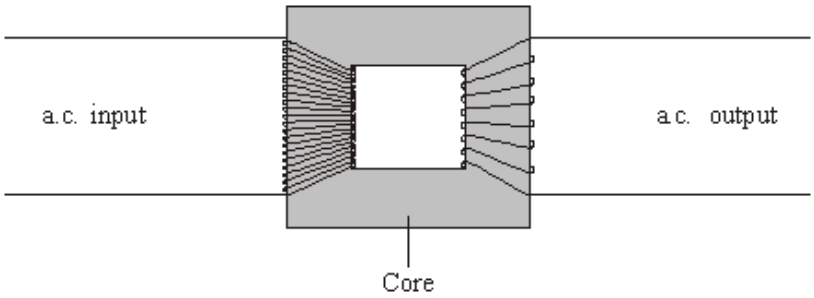
(3)

(Total 5 marks)

Q8. (a) The diagram shows a transformer.



(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 ☐

Explain your answer.

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(1)

(ii) Why is insulated wire, and not uninsulated wire, used to make the coils?

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(1)

(iii) Why is the core made of iron?

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(1)

(b) A transformer has 500 turns on its primary coil and 7500 turns on its secondary coil. The potential difference across the primary coil is 150 volts.

Use the equation in the box to calculate the potential difference across 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.

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Potential difference across the secondary coil = ... volts

(2)

(c) Step-down transformers are used between power lines and people's houses.

Explain why.

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(2)

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

Explain the advantage of having a National Grid system.

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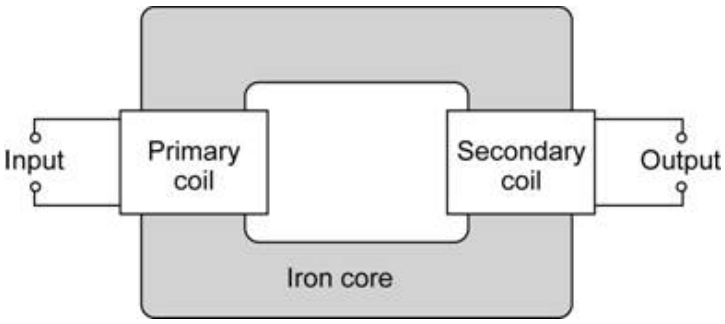
(2)
(Total 9 marks)

Q9. The diagram shows the basic structure of a transformer.



(a) Explain how a transformer works.

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(5)

(b) A transformer is used to change the 230 volt mains electricity supply to the 12 volts needed to operate a low voltage halogen lamp. The current through the halogen lamp is 4 amps.

Calculate the current drawn by the transformer from the mains electricity supply.

Assume that the transformer is 100 % efficient.

Write down the equation you use, and then show clearly how you work out your answer.

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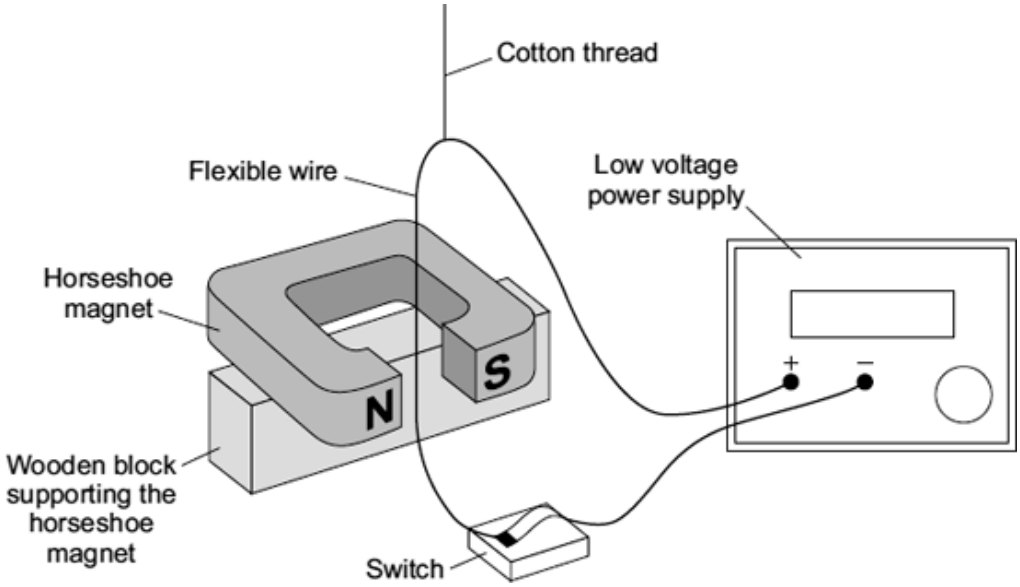
Current = ... amps

(2)

(Total 7 marks)

Q10. (a) A laboratory technician sets up a demonstration.



A flexible wire is suspended between the ends of a horseshoe magnet. The flexible wire hangs from a cotton thread. When the switch is closed, the wire kicks forward.

Identify the effect which is being demonstrated.

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(1)

(b) A teacher makes some changes to the set-up of the demonstration.

What effect, if any, will each of the following changes have?

(i) more powerful horseshoe magnet is used.

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(1)

(ii) The connections to the power supply are reversed.

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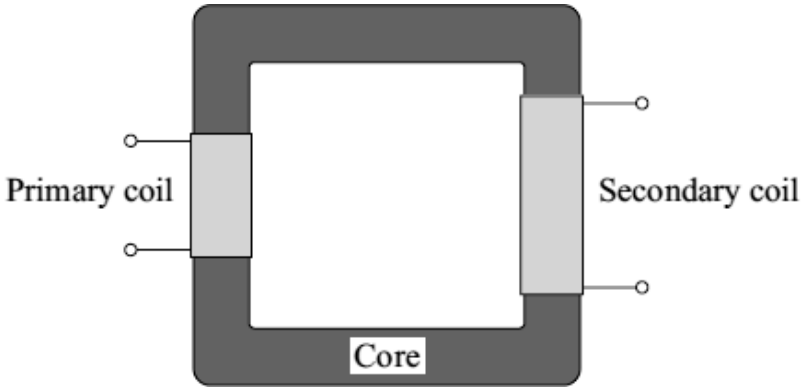
(1)
(Total 3 marks)

Q11. (a) The diagram shows the basic structure of a step-up transformer.



(i) What is the core made of?

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(1)

(ii) Explain how an alternating input produces an alternating output.

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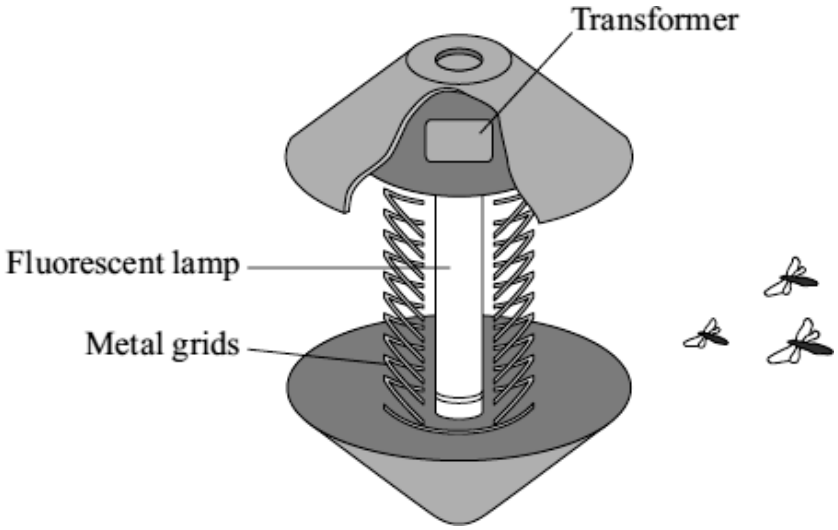
(3)

(b) Fly killers are used in kitchens and food stores because flying insects carry diseases which cause food poisoning.

The diagram shows the inside of one design. Insects are attracted to a fluorescent lamp. The metal grids have a high potential difference (p.d.) between them. The insects are killed as they fly between the grids.



A transformer is used in the fly killer. There is a p.d. of 230 V across the primary coil. There are 300 turns of wire on the primary coil and 4000 turns on the secondary coil.

Use the equation in the box to calculate the p.d. across 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.

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Potential difference = ...V

(3)

(Total 7 marks)

Q12. (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 **and** give the unit.

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p.d. across secondary coil = ...

(3)

(b) The primary and secondary coils of a transformer are made of insulated wire.

Why is this insulation necessary?

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(1)

(c) Describe what happens when an alternating potential difference is applied across the primary coil of a transformer.

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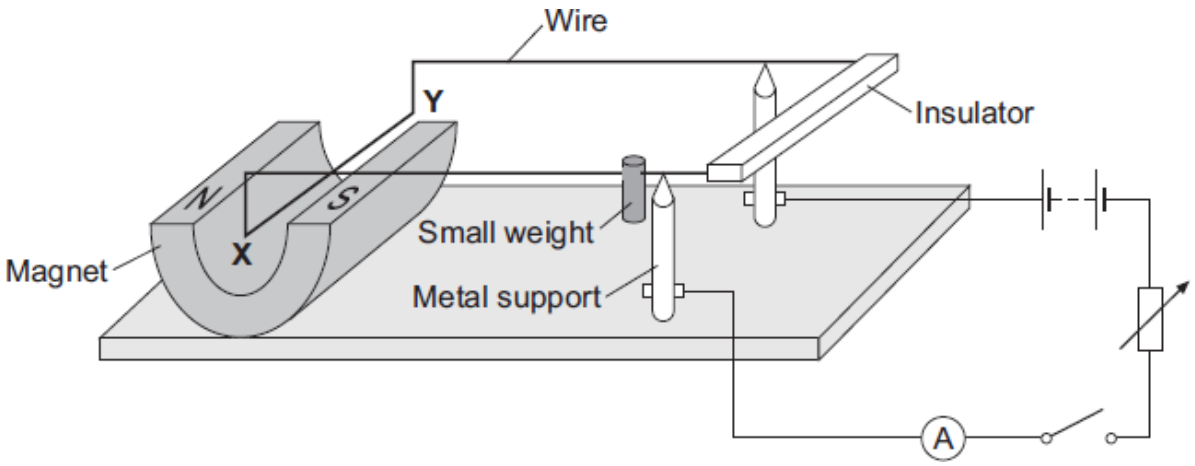
(3)
(Total 7 marks)

Q13. The diagram shows a device called a current balance.



(a) (i) When the switch is closed, the part of the wire labelled **XY** moves upwards.

Explain why.

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(2)

(ii) What is the name of the effect that causes the wire **XY** to move?

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(1)

(iii) An alternating current (a.c.) is a current which reverses direction. How many times the current reverses direction in one second depends on the frequency of the alternating supply.

Describe the effect on the wire **XY** if the battery is replaced by an a.c. supply having a frequency of 5 hertz.

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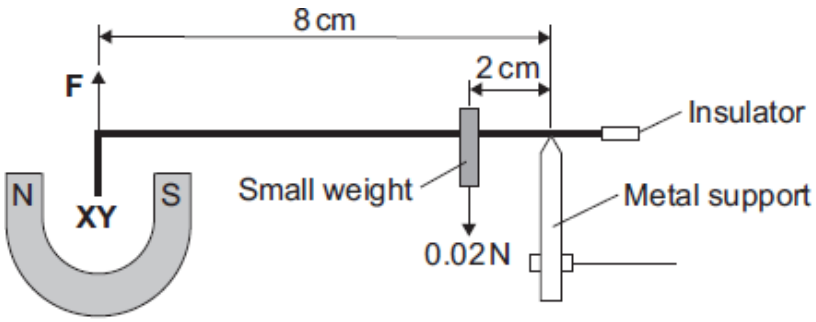
(2)

(b) The diagram shows how a small weight can be used to make the wire **XY** balance horizontally.



Side view

Use the data in the diagram and the equation in the box to calculate the force, **F**, acting on the wire **XY**.

moment	=	force	×	perpendicular distance from the line of action of the force to the axis of rotation

Show clearly how you work out your answer.

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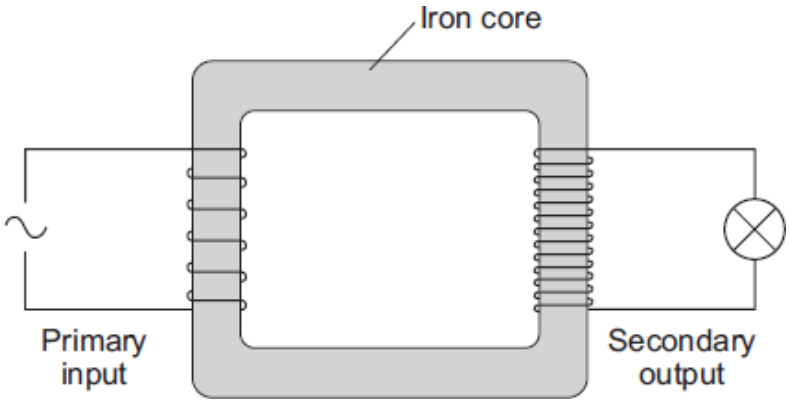
Force = ... N

(3)

(Total 8 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.

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(1)

(ii) Why is the core made of iron?

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(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.

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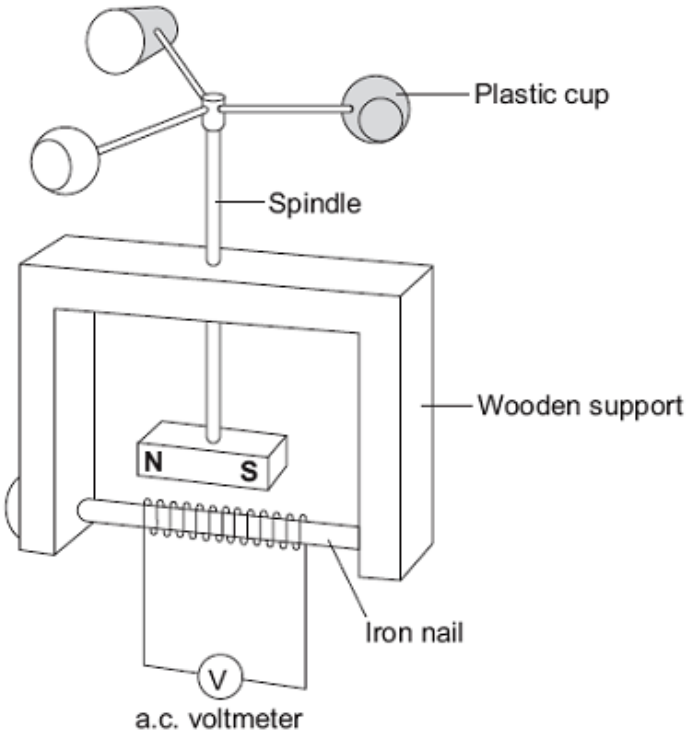
Number of turns on the secondary coil = ...

(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. .....

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(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.

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(1)
(Total 4 marks)

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.

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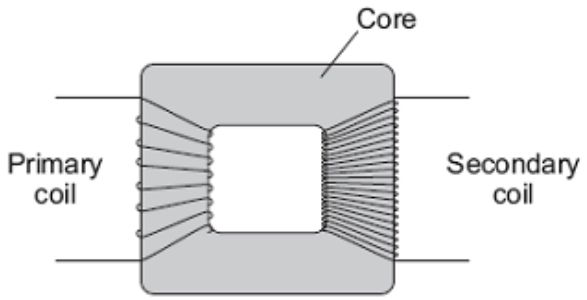
p.d. across secondary coil = ... volts

(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?

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(1)

(ii) Why is the core made of iron?

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(1)

(iii) Explain how the transformer works.

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(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 .....

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2 .....

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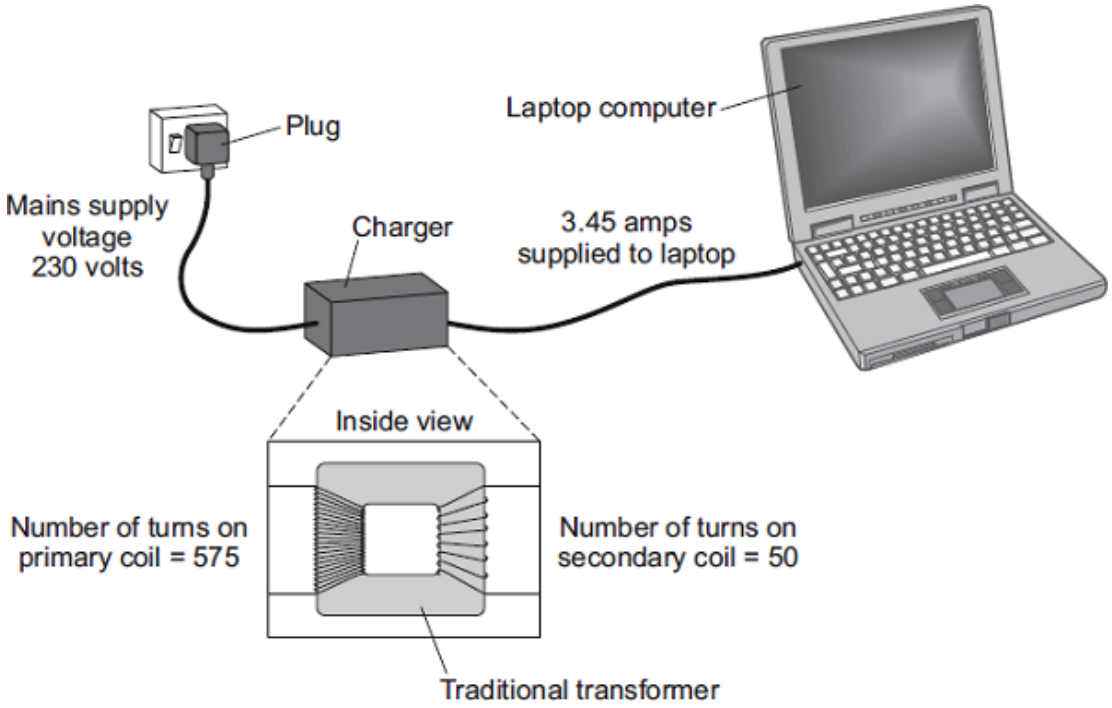
(2)
(Total 9 marks)

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.

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(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.

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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.

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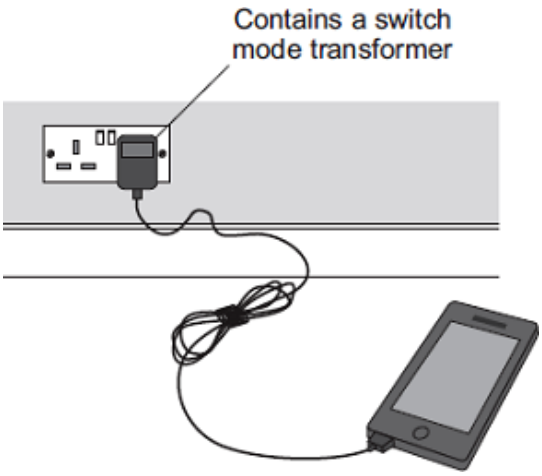
Current = ... A

(2)

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



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.

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(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.

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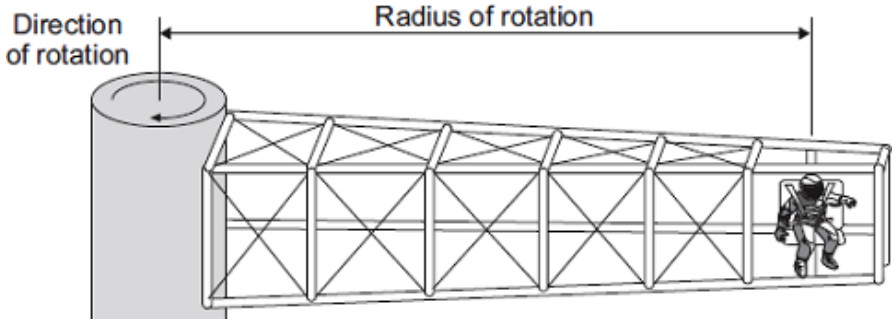
(1)
(Total 9 marks)

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 .....

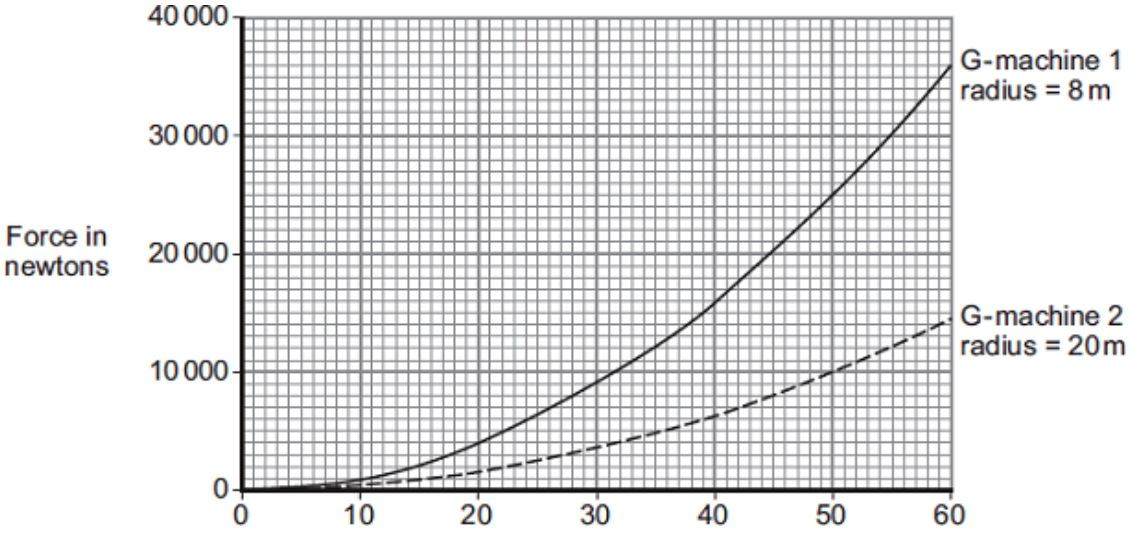
.....

(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.



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

1 .....

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2 .....

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3 .....

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(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.

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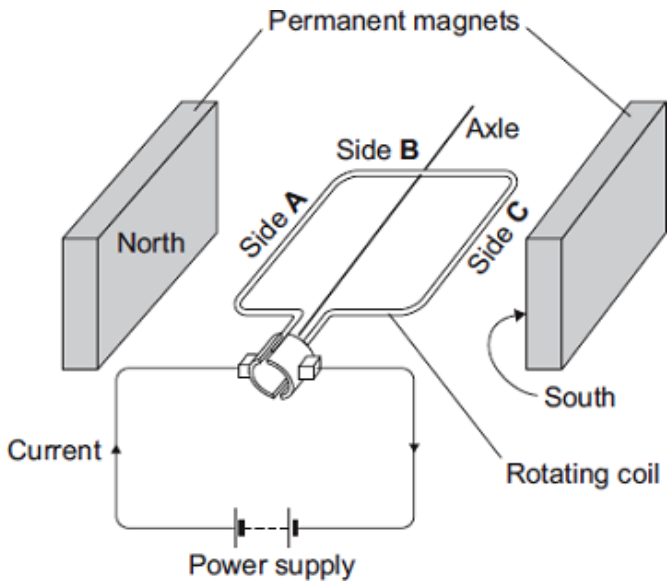
Change in force = ... N

(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.

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(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.

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(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?

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(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.

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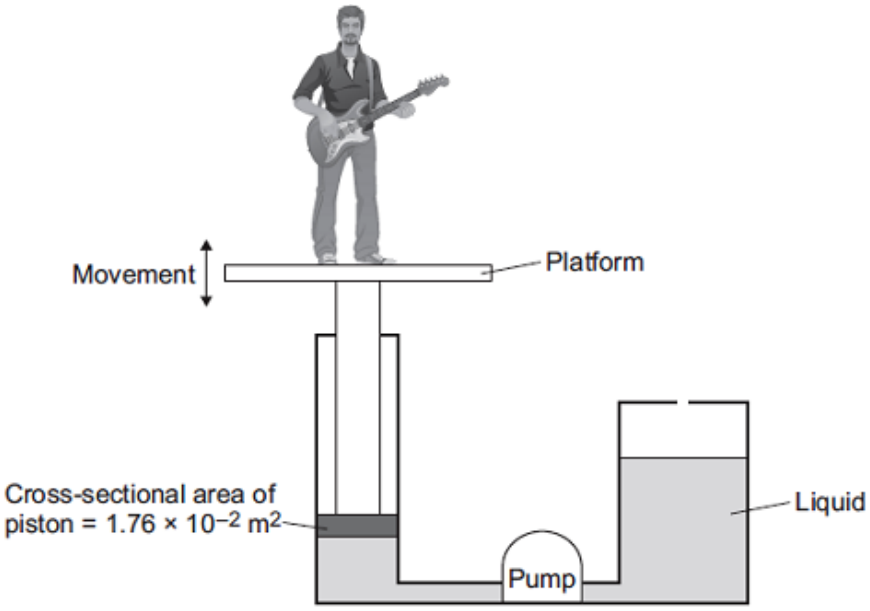
(1)

(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?

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(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.

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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.

.....

.....

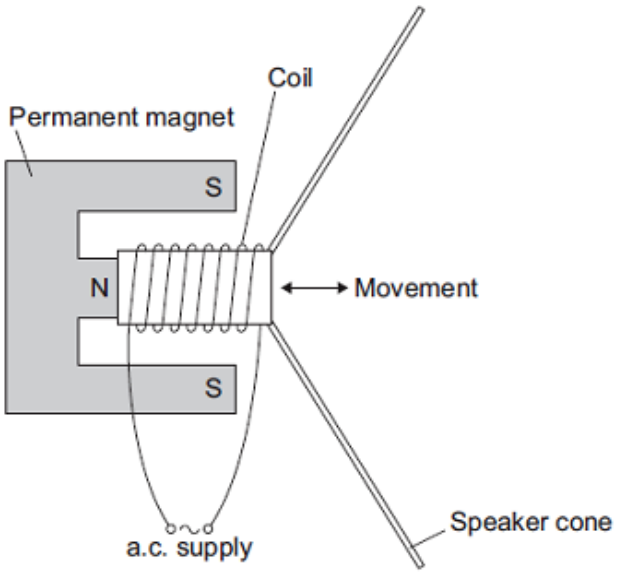
.....

(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)

M1. (a) output voltage less than (the) input voltage

*or p.d. across output less that p.d. across input **or** output is (only) 4.2 V*
(whereas) the input is 230V
or WTTE (words to that effect)

1

(b) any **two** from

(made of soft) iron

laminated

***or** designed to reduce eddy currents*
***or** made of thin slices with slices of insulating material between them*

core(s) joined to make a ring

2

[3]

M2.

*each mark may be gained from a written description **or** from a caption on the diagram **or** from both together but do not credit if there is any contradiction between them*

one coil on each side

1

of insulated wire

***or** insulated coil*

1

number of turns on primary coil/coil 1/input coil greater than number of turns on the secondary coil/coil 2/output coil

this must be clear for example do not credit more coils do not credit bigger coil

1

core of laminated iron

***or** core of (soft) iron*

1

[4]

M3. (a) (i) Iron

for 1 mark

1

(ii) V/240 = 2000/10 000
V = 48
V

for 1 mark each

3

(b) changing current in primary causes changing (magnetic) field in core links to secondary inducing voltage (emf) in secondary (**NOT** current) secondary voltage/current is alternating

for 1 mark each

4

(c) magnetic field not changing/no electromagnetic induction because direct current

for 1 mark each

2

[10]

M4. (i) away from magnet

arrow should be perpendicular to field lines and current as judged by eye

1

(ii) current in wire creates magnetic field around wire

1

two fields interact **or** combine giving a resultant force (on the wire)

1

[3]

M5. (a) (i) **one** of the following:

- increase number of turns on the secondary coil
- decrease number of turns on the primary coil

1

(ii) constructed in (thin) layers

1

(b) (i) transformers only work with a c

1

(ii) used to increase **or** decrease **or** change voltage **or** current

reducing the energy **or** heat **or** power loss (along the cables)

1

or reduce to safe domestic level

must be consistent with first answer

1

(iii) (several metres of) air gives good electrical insulation (between cables and earth)
or reduce chance of earthing **or** sparks **or** arcing
or to avoid people touching it

1

(c) (i) $$\frac{\text{voltage across primary}}{\text{voltage across secondary}} = \frac{\text{no of turns in primary}}{\text{no of turns in secondary}}$$

accept $\frac{VP}{VS} = \frac{NP}{NS}$

or $\frac{Vin}{Vout} = \frac{Nin}{Nout}$

1

(ii) Np = 4000

$\frac{25(000)}{275(000)} = \frac{NP}{44000}$ *for **1** mark*

2

(d) (i) resistance of cable decreases

1

(ii) convection (to the air)
or
conduction (to the air)
not radiation

1

[11]

M6. (i) $\frac{\text{voltage across primary}}{\text{voltage across secondary}} = \frac{\text{number of turns on primary}}{\text{number of turns on secondary}}$

accept input for primary
accept output for secondary

accept $\frac{V_p}{V_s} = \frac{N_p}{N_s}$ *accept* $\frac{V_1}{V_2} = \frac{N_1}{N_2}$ ***or*** *correct transposition*

1

(ii) 60

*allow **1** mark for correct transformation*

2

[3]

M7. (a) 10 500

*allow **1** mark for 75 × 32 200 ÷ 230*

2

(b) any **three** from:

- alternating current (a.c.) in the primary (coil)
- produces a **changing** magnetic field / flux (in the core)
- which is made of (laminated soft) iron
- this induces
  must be idea of inducing something in the secondary coil
- an alternating potential difference across the secondary coil
  accept voltage for potential difference

3

[5]

M8. (a) (i) step-down (transformer) because fewer turns on the output/secondary (coil)

no credit for just 'step-down transformer'
accept '…less turns…'
*do **not** credit '…fewer coils…'*
***or** 'the p.d. across the input / primary will be greater than the p.d. across the output / secondary'*

1

(ii) to prevent a short (circuit)(through the turns of wire or through the core

*do **not** credit references to safety **or** heat (insulation)*

1

(iii) (easily) magnetised (and demagnetised)

accept '(it's) magnetic'
*do **not** accept 'because it's a conductor'*

1

(b) 2250

correct substitution

eg $\frac{150}{p.d.across secondary} = \frac{500}{7500}$ *gains **1** mark*

***or** appropriate transformation*

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

*× p.d. across primary gains **1** mark*

2

(c) any **two** from:

- <u>to reduce the voltage</u> / p.d. (of the domestic supply)

  ***or** to reduce to 230 V*
  allow 'to reduce to 240 V'
  *do **not** credit 'reduce <u>current</u> to 230V'*

- higher voltage difficult to insulate

- higher voltage (would) result in (fatal) electric shock

  ***not** just 'less dangerous'*

- domestic appliances are not designed for (very) high voltage (input) / (are designed) for 230V

  *do **not** credit 'to increase efficiency' / 'to save energy' do **not** credit just 'it's safer'*

2

(d) any **two** (1) each

- if the (local) power station breaks down / fails / demand / load exceeds supply

1

or words to that effect

- electricity / power can be switched from elsewhere in the system / from other power station(s)

or *words to that effect*

- electricity can be generated in places remote from customers

or *words to that effect*

- (in total) fewer power stations are needed
- power available in rural / remote areas
- National Grid allows for (better) control of supply and demand

*do **not** credit just cheaper / more efficient / safer*

1

[9]

M9. (a) an alternating input / current to primary (coil)

1

which produces an alternating magnetic field

accept changing magnetic field for alternating magnetic field

if first mark point scores then 'alternating' not required here

1

in the (iron) core

this magnetic field links with the secondary coil

1

which induces an (alternating) voltage / p.d. across the secondary (coil)

1

(b) 0.21

accept 0.2 or any answer that rounds to 0.21

*allow **1** mark for correct equation*
ie power input = power output

or

*allow **1** mark for substitution into correct equation*
ie $230 \times I_p = 12 \times 4$

2

[7]

M10. (a) motor (effect)

1

(b) (i) wire kicks further (forward)

accept moves for kicks

accept moves more

accept 'force (on the wire) increased'

1

(ii) wire kicks back(wards) / into (the space in) the (horseshoe) magnet

accept moves for kicks

accept 'direction of force reversed'

1

[3]

M11. (a) (i) (laminated soft) iron

*do **not** accept steel*

1

(ii) produces a magnetic field

accept magnetic flux

which is alternating / changing / varying

and which induces / produces an alternating / changing potential difference across the secondary coil

accept current / voltage

3

(b) 3067 (V)

*allow all **3** marks for 3060 to 3070 (V)*

$V = \frac{230 \times 4000}{300}$ *gains **2** marks*

$\frac{230}{V} = \frac{300}{4000}$ *gains **1** mark*

3

[7]

M12. (a) 400 000

*allow **1** mark for correct substitution ie*

$\frac{25000}{?} = \frac{800}{12800}$

or

$\frac{25}{?} = \frac{800}{12800}$

2

volt(s) / V

*an answer 400 gains **2** marks*

*an answer 400 kilovolts / kV gains **3** marks*

*although the unit mark is independent to gain **3** marks it must be consistent with the numerical value*

1

(b) any **one** from:

*do **not** accept any response in terms of heat insulation, safety or electric shock*

- (so that there is) no short circuit
- (so that the) current goes round the coil

  *do **not** accept electricity for current*
- (so that the) current does not enter the core

1

(c) (the alternating p.d. in the primary causes) an (alternating) current in the primary

reference to the current in the core negates this mark

1

(causes an) <u>alternating / changing</u> (magnetic) field in the (iron) core

1

<u>induces</u> (alternating) p.d. across the <u>secondary</u> (coil)

accept in / through or similar for across

accept current for p.d.

accept output (coil) for secondary (coil)

*to gain **3** marks the sequence must be correct*

1

[7]

M13. (a) (i) current produces a magnetic field (around XY)

accept current (in XY) is perpendicular to the (permanent) magnetic field

1

(creating) a force (acting) on XY / wire / upwards

reference to Fleming's left hand rule is insufficient

1

(ii) motor (effect)

1

(iii) vibrate / move up and down

1

5 times a second

only scores if first mark point scores

*allow for **1** mark only an answer 'changes direction 5 times a second'*

1

(b) 0.005

*allow **1** mark for calculating moment of the weight as 0.04 (Ncm)*
and
*allow **1** mark for correctly stating principle of moments*
or
*allow **2** marks for correct substitution*
*ie $F \times 8 = 2 \times 0.02$ **or** $F \times 8 = 0.04$*

3

[8]

M14. (a) (i) step-up

both parts required

more turns on the secondary / output (coil)

*do **not** accept coils for turns*
'secondary output is greater than primary input' is insufficient

1

(ii) (easily) magnetised (and demagnetised)

accept (it's) magnetic
it's a conductor negates answer

1

(b) 60

*allow **1** mark for correct substitution, ie* $\frac{230}{15} = \frac{720}{N_s}$

2

[4]

M15. (a) which causes the magnet to turn / spin / rotate

1

(magnetic) field / lines of force / flux rotate(s) / move(s) / through / in / cut(s) the coil

*do **not** credit the idea that movement 'creates' the magnetic field*

1

potential difference / p.d. / voltage <u>induced</u> across the coil

*do **not** credit just 'current induced'*

1

(b) any **one** from:

- more powerful / stronger / lighter magnet
  *do **not** credit 'a bigger magnet'*
- larger / more / bigger / lighter cups / with a bigger surface area
- longer arms
- lubricate the spindle
- add more turns to the coil

1

[4]

M16. (a) 400 000

*allow **1** mark for correct substitution ie*

$$\frac{25000}{?} = \frac{800}{12800}$$

or

$$\frac{25}{?} = \frac{800}{12800}$$

2

(b) (i) any **one** from:

*do **not** accept any response in terms of heat insulation, safety or electric shock*

- (so that there is) no short circuit
- (so that the) current goes around the coil
  *do **not** accept electricity for current*
- (so that the) current does not enter the core

1

(ii) (easily) magnetised (and demagnetised)

accept '(it's) magnetic'
*do **not** accept 'because it's a conductor'*

1

(iii) alternating current in the primary (coil)

1

produces a changing magnetic field (in the core)

1

this induces an (alternating) potential difference across the secondary (coil)

1

(c) any **two** from:

- if the (local) power station breaks down / fails / demand / load exceeds supply
- electricity / power can be switched from elsewhere in the system / from other power station(s)
- electricity can be generated in places remote from customers
- (in total) fewer power stations are needed
- power available in rural / remote areas
- National Grid allows for (better) control of supply and demand

2

[9]

M17. (a) (the alternating current creates) a changing / alternating magnetic field

1

(magnetic field) in the (iron) core

accept that links with the secondary coil
current in the core negates this mark

1

(causing a) potential difference (to be) induced in / across secondary coil

accept voltage for p.d.

1

(b) (i) 20

*allow **1** mark for correct substitution, ie* $\frac{230}{V_s} = \frac{575}{50}$

or $\frac{V_s}{230} = \frac{50}{575}$

2

(ii) 0.3

or

correct calculation using $230 \times I_p$ = their (b)(i) × 3.45

*allow **1** mark for correct substitution, ie*
$230 \times I_p = 20 \times 3.45$
allow ecf from (b)(i) for 20
OR
substitution into this equation $\frac{I_p}{I_s} = \frac{N_s}{N_p}$

2

(c) (switch mode transformers) use (very) little power / current / energy when switched on but no load is applied

accept no for little

ignore it is more portable

*do **not** accept electricity for power / current / energy*

or

it is more efficient

*accept does not get as hot **or** less heat produced*

1

(d) any **one** from:

- fewer (waste) batteries have to be sent to / buried in land-fill
- the soil is polluted less by batteries in land-fill
- fewer (waste) batteries have to be recycled
- fewer batteries have to be made
- less raw materials are used in making batteries
- customers have to replace their batteries less often

  longer lifetime is insufficient
- customers have to buy fewer (replacement) batteries

  it costs less is insufficient

1

[9]

M18. (a) centripetal (force)

allow tension (between astronaut and seatbelt)

1

towards the centre (of the G-machine / circle)

*do **not** accept towards the centre of the Earth*

allow inwards

1

(b) (i) the greater the speed (of a centrifuge), the greater the force

answers must be comparative

accept velocity for speed

accept positive correlation between speed and force

speed and force are not proportional – treat as neutral

1

the smaller the radius, the greater the force (at a given speed)

*allow **(G machine) 1** has / produces a greater force (than **G machine 2**) at the same speed*

must be comparative, eg a small radius produces a large force = 0 marks on own

1

as the speed increases the rate of change in force increases

accept force is proportional to the square of the speed

or

doubling speed, quadruples the force

accept any clearly correct conclusion

1

(ii) 12000 (N)

or

12 k(N)

1

(c) (i) the current (in the coil) creates a magnetic field (around the coil)

accept the coil is an electromagnet

1

so the magnetic field of the coil interacts with the (permanent) magnetic field of the magnets (producing a force)

accept the two magnetic fields interact (producing a force)

*if no marks scored an answer in terms of current is perpendicular to the (permanent) magnetic field is worth max **1** mark*

1

(ii) vertically downwards arrow on side A

one arrow insufficient

and

vertically upwards arrow on side C

1

(iii) the current is parallel to the magnetic field

allow the current and magnetic field are in the same direction

allow it / the wire is parallel to the magnetic field

1

(d) increase the current / p.d. (of the coil)

accept decrease resistance

accept voltage for p.d.

accept increase strength of magnetic field / electromagnet

1

(e) yes with suitable reason
or
no with suitable reason

eg

yes *– it has increased our knowledge*

yes *– It has led to more (rapid) developments / discoveries (in technology / materials / transport) accept specific examples*

no *– the money would have been better spent elsewhere on such things as hospitals (must quote where, other things not enough)*

no *mark for just* ***yes*** */* ***no***

reason must match ***yes*** */* ***no***

1

[12]

M19. (a) hydraulic (system)

1

(b) 15.40×10^2
or
1540

allow ***1*** *mark for correct substitution, ie*

$8.75 \times 10^4 = \frac{F}{1.76 \times 10^{-2}}$

or

$87\ 500 = \frac{F}{0.0176}$

or

$F = 8.75 \times 10^4 \times 1.76 \times 10^{-2}$

or

$F = 87\ 500 \times 0.0176$

2

(c) any **one** environmental **advantage**:

stating a converse statement is insufficient, or a disadvantage of the usual oil, ie the usual oil is non-renewable

plant oil is renewable

using plant oil will conserve (limited) supplies **or** extend lifetime of the usual / crude oil.

plant oil releases less carbon dioxide (when it is being produced / processed)

plant oil will add less carbon dioxide to the atmosphere (when it is being produced / processed, than the usual oil)

plant oil removes carbon dioxide from **or** adds oxygen to the air when it is growing

stating that plant oil is carbon neutral is insufficient

1

(d) (the current flowing through the coil) creates a magnetic field (around the coil)

1

(this magnetic field) interacts with the permanent magnetic field
or
current carrying conductor is in a (permanent) magnetic field

it must be clear which magnetic field is which

1

this produces a (resultant) force (and coil / cone moves)

1

when the direction of the current changes, the direction of the force changes to the opposite direction

*accept for **2** marks the magnetic field of the coil interacts with the permanent magnetic field*

1

[8]