Mark schemes

(a) iron
   correct positions only
   primary
   secondary

(b) (it) decreases the p.d.
   accept it would increase current
   accept voltage for p.d.
   the voltage goes from 230(V) to 20(V) is insufficient
   do not accept decreases current / energy / power
   do not accept decreases p.d. / voltage and current

(c) an environmental

(a) (i) 9000
   an answer of 9 k(N) gains 1 mark

(ii) increase
   accept other comparative terms, eg give a bigger
   affect / change is insufficient

(iii) smaller
   accept other comparative terms, eg less

(b) Q N M
   all three in correct boxes
   one statement in correct box gains 1 mark
(c) any two from:

- increase the current / p.d. (supplied to the coil)
  accept reduce the resistance of the coil or increase cross sectional area of wire
  accept more cells / batteries or turn up the power supply
  increase power is insufficient

- increase number of turns (on the coil)

- increase the area (of the coil)
  accept increase the width of the coil
  increase width / size is insufficient

- increase the (strength of the permanent) magnetic field
  accept move the magnets closer to the coil
  accept use stronger magnets
  do not accept use larger magnets

(d) an economic

(a)  (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

  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

  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

(ii)  12000 (N)
  or
  12 k(N)
(b) (i) the current (in the coil) creates a magnetic field (around the coil)

   accept the coil is an electromagnet

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

(ii) vertically downwards arrow on side A

   one arrow insufficient

   and

   vertically upwards arrow on side C

(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

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

   accept decrease resistance

   accept voltage for p.d.

   accept increase strength of magnetic field / electromagnet

(d) 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

[10]

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

(magnetic field) in the (iron) core

   accept that links with the secondary coil

   current in the core negates this mark
(causing a) potential difference (to be) induced in / across secondary coil
accept voltage for p.d.

(b) (i) 20

allow 1 mark for correct substitution, ie

\[ \frac{V_s}{230} = \frac{50}{575} \]

(ii) 0.3

or
correct calculation using 230 \times I_p = their (b)(i) \times 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

\[ \frac{I_p}{I_s} = \frac{N_s}{N_p} \]

(c) 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

(a) a force
(b) any two from:

- more powerful magnet
  
  *do not allow* ‘bigger magnet’

- reduce the gap (between magnet and coil)

- increase the area of the coil

- more powerful cell
  
  *do not allow* ‘bigger cell’

  accept battery for cell

  accept add a cell

  accept increase current / potential difference

- more turns (on the coil)
  
  *allow* ‘more coils on the coil’

  *do not allow* ‘bigger coil’

(c) reverse the (polarity) of the cell

  *allow* ‘turn the cell the other way round’

  accept battery for cell

reverse the (polarity) of the magnet

  *allow* ‘turn the magnet the other way up’

(a) 400 000

*allow 1 mark for correct substitution* ie

\[
\frac{25000}{?} = \frac{800}{12800}
\]

*or*

\[
\frac{25}{?} = \frac{800}{12800}
\]

(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
(ii) (easily) magnetised (and demagnetised)

- accept ‘(it’s) magnetic’
- do not accept ‘because it’s a conductor’

(iii) alternating current in the primary (coil)

- produces a changing magnetic field (in the core)
- this induces an (alternating) potential difference across the secondary (coil)

(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

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

- (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

- potential difference / p.d. / voltage induced across the coil
- do not credit just ‘current induced’
(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

(a) aluminium cannot be magnetised

*accept aluminium is not magnetic*

"it" refers to aluminium

*do not accept aluminium is not easily magnetised*

reference to conduction and aluminium negates mark

*iron can be magnetised is insufficient*

(b) (i) 10 to 50

*either order"

1

(ii) (data is) anomalous

*accept does not fit the pattern*

*it is an error is insufficient*

1

(iii) 21

*accept 22*

*do not accept any fraction of a turn ie 20.1*

1

secondary p.d. (just) larger than primary p.d.

*accept output (just) larger than input/2V*

or

there must be more turns on the secondary coil than primary coil

*do not accept coil for turns*
(c) to reduce/step-down the (input) p.d./voltage
   mains p.d. is too high is insufficient
   step-down transformer is insufficient
   answers in terms of changing/stepping-up current or fuse blowing
   or not working with 230 volts are insufficient
   any mention of step-up negates mark
   stepping down both voltage/p.d. and current negates mark
1

9 (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

10 (a) (i) current produces a magnetic field (around XY)
   accept current (in XY) is perpendicular to the (permanent) magnetic field
   (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’*

(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 $F \times 8 = 0.04$

(a) iron

*accept any unambiguous correct indication*

(b) (i) step-down (transformer)

*do not accept down step or a description*

(ii) less than

*accept any unambiguous correct indication*

(c) (i) 2000

(ii) There is no pattern.

(a) (i) an electric motor

(ii) force
(b) any two from:

- more powerful magnet
  
  do not allow ‘bigger magnet’

- reduce the gap (between magnet and coil)

- increase the area of the coil

- more powerful cell
  
  do not allow ‘bigger cell’

  accept battery for cell

  accept add a cell

  accept increase current / potential difference

- more turns (on the coil)
  
  allow ‘more coils on the coil’

  do not allow ‘bigger coil’

(c) reverse the (polarity) of the cell

  allow ‘turn the cell the other way round’

  accept battery for cell

reverse the (polarity) of the magnet

  allow ‘turn the magnet the other way up’

(a) 10

\[
\frac{230}{V_s} = \frac{4600}{200}
\]

allow 1 mark for correct substitution ie

2

(b) any one from:

- to prevent short circuiting

- to ensure that the current flows / goes round the coil

- to prevent the current entering the core

  do not accept electrocution

  do not accept electricity for current

  answers including heat / energy loss negate mark

1
(c) (i) (soft) iron

do not accept ‘steel’

1

(ii) can be magnetised

because it is magnetic

answers including it’s a conductor negate mark

1

[5]

14 (a) (i) an electrical conductor

1

(ii) increase current

accept increase p.d. / voltage

or

use stronger magnets

accept move magnets closer

do not accept use larger magnets

1

(iii) reverse the poles / ends (of the magnet)

either order

reverse the connections (to the power supply)

1

(b) (i) environmental

1

(ii) ethical

allow political (instability)

allow economic (migration)

1

[6]

15 (a) 400 000

allow 1 mark for correct substitution ie

\[ \frac{800}{25000} = \frac{800}{12800} \]

or

\[ \frac{800}{25} = \frac{800}{12800} \]

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

(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

(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

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

induces (alternating) p.d. across the secondary (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
(a) centre of the X midway between the poles
   intention correct as judged by eye
   example

(b) move the poles further apart
   accept turn for move
   accept ends / magnets for poles
   accept use weaker magnets
   do not accept use smaller magnets

(c) (i) add more cells (to the battery)
   do not accept ‘use a bigger battery’
   accept increase the potential difference / voltage
   accept increase the current
   or
   reduce the resistance (of the variable resistor)
   do not accept any changes to the magnets, to the wire or to their relative positions

(ii) reverse (the polarity of) the battery
   accept turn the battery / cells round
   accept swap the connections to the battery
   do not accept any changes to the magnets, to the wire or to their relative positions