(a) field

*correct order only*

1

current

1

force

*accept motion*

*accept thrust*

1

(b) (i) arrow pointing vertically downwards

1

(ii) increase current / p.d.

*accept voltage for p.d.*

1

increase strength of magnetic field

*accept move poles closer together*

1

(iii) reverse (poles of) magnets

1

reverse battery / current

1

(c) (i) 1.5 or 150%

\[
\text{efficiency} = \frac{120}{80} \times 100
\]

*gains 1 mark*

*an answer of 1.5 % or 150*

*gains 1 mark*

2

(ii) efficiency greater than 100%

*or*

output is greater than input

*or*

output should be 40 (W)

1

(iii) recorded time much shorter than actual time

*accept timer started too late*

*accept timer stopped too soon*

1

12
Nickel

(b) **Either**
   - put iron filings
   - on a piece of paper
   - over the magnet

or
   - use (plotting) compass(es) (1)
   - around the magnet (1)
   - with the needle showing the direction (1)

(c) all points plotted correctly
   \[2 \text{ points plotted correctly for 1 mark}\]

   correctly drawn line of best fit
   \[allow \ ecf \ from \ incorrectly \ drawn \ points\]

(d) as the number of turns increases so does the amount of paper clips picked up
   \[linear / directly proportional\]
   \[allow \ doubling \ the \ number \ of \ turns \ doubles \ the \ number \ of \ paper \ clips \ picked \ up\]

(e) 32
   \[allow \ number \ correctly \ extrapolated \ from \ student's \ graph\]

[11]
(a) (i) increase

(ii) A and B and B and C

*both required for the mark either order*

(iii) any two from:

- size of nail or nail material
  *allow (same) nail*

- current
  *allow (same) cell* *allow p.d.*

  *same amount of electricity is insufficient*

- (size of) paper clip

- length of wire
  *accept type / thickness of wire*

(b) 4

B picks up the same number as C, so this electromagnet would pick up the same number as A or direction of current does not affect the strength of the electromagnet

*allow it has got the same number of turns as A*

(c) 2

*allow 1 or 3*
4 (a) (i) Iron

(ii) 50

*ignore references to current*

*reason only scores if 50 chosen*

*there are more turns on the secondary coil (than the primary coil)*

*accept it is a step-up transformer*

*not more coils*

(b) (i) 200

(ii) any one from:

- Lighter
- smaller
- use very little power / current (when switched on with no load / phone attached).

*accept more efficient*

*do not accept uses no power / current*

*a disadvantage of a traditional transformer is insufficient on its own*

5 (a) induced

(b) any two from:

- use the same (strength) magnet
  
  *same size magnet is insufficient*

- the speed that the magnet is moved
  
  *accept movement of the magnet*

- the area of the turns
  
  *same type / length of wire is insufficient*

- the magnetic pole being moved towards the coil (of wire).
  
  *use the same voltmeter is insufficient*

(c) (i) voltmeter misread

*or*

number of turns miscounted

*result misread is insufficient*

*human error is insufficient*

*allow the magnet was moved at a (slightly) different speed (into the coil) than for the other readings*

*allow spacing between the turns had changed*
(ii) line of best fit passing through all points except (100, 0.034)

\[ \text{line does not need to go back to origin} \]

(d) any one from:
- can re-check data / readings.
  \[ \text{accept can go back to data} \]
- can take more readings (in a given time)
  \[ \text{can store data is insufficient} \]
- easier to identify maximum value.
  \[ \text{automatically records data is insufficient} \]
  \[ \text{accept is more accurate} \]
  \[ \text{accept eliminates human error} \]

(a) north (pole)

\[ \text{accept N} \]

north (pole)

\[ \text{both needed for mark} \]

(b) reverses

\[ \text{accept changes direction} \]

(c) (i) first finger:
(direction of) (magnetic) field

\[ \text{second finger:} \]
(direction of) (conventional) current

(ii) into (plane of the) paper

(iii) less current in wire

\[ \text{accept less current / voltage / more resistance / thinner wire} \]

weaker field

\[ \text{allow weaker magnets / magnets further apart} \]
\[ \text{do not accept smaller magnets} \]

rotation of magnets (so) field is no longer perpendicular to wire

(d) (i) reverse one of the magnets

\[ \text{do not accept there are no numbers on the scale} \]
(ii) systematic or zero error
   accept all current values will be too big
   accept it does not return to zero
   accept it does not start at zero

(a) \( \text{Fe}_2\text{O}_3 + 3 \text{ CO} \rightarrow 2\text{Fe} + 3 \text{ CO}_2 \)
   \textit{correct formulae of reactants}

   \textit{correct formulae of products}

   \textit{correct balancing}

(b) iron loses oxygen – reduction
   carbon gains oxygen – oxidation

(c) any four from:
   - resources for manufacture are limited
   - recycling reduces the use of resources
   - reduces energy consumption in extraction / manufacture
   - reduces waste from processing and extraction
   - reduces environmental impact of extraction

(d) field lines going through and around coil
   \textit{correct directional arrows}
(e) any two from:

1 mark for suggestion, 1 mark for correctly linked explanation

• use many coils or tight coils or long wire (1)
• to give a strong magnetic field for lifting heavy objects (1)

explanation must be correctly linked to the suggestion to gain the mark

or

• add an iron core
• to increase field circuit for lifting

or

• include a switch in circuit
• so can drop / pick up cars

(a) (i) (closing the switch makes) a current (through the wire)

1 (the current flowing) creates a magnetic field (around the wire)

1 this field interacts with the permanent magnetic field

accept links / crosses attracts / repels is insufficient

1

(ii) arrow drawn showing upwards force on XY

judge vertical by eye the arrow must be on or close to the wire XY

1

(iii) motor

accept catapult

1

(b) (i) the wire moves up and down

or

the wire vibrates

back and forth or side to side is insufficient for vibrate

1

(ii) the force (continually) changes direction (from upwards to downwards, on the wire)

accept the direction of the magnetic field (of the wire) changes

1 [7]