M1. (a)   induced

                                                                    1

(b)   bar 2

                                                                    1

(the same end) of bar 1 attracts both ends of bar 2

or

only two magnets can repel so cannot be bar 1 or bar 3

                                                                    1

(c)   so the results for each magnet can be compared

or

so there is only one independent variable
>   *fair test is insufficient*
>   *allow different thickness of paper would affect number of*
>   *sheets each magnet could hold*
>   *accept it is a control variable*

                                                                    1

(d)   because the magnet with the biggest area was not the strongest
>   *accept any correct reason that confirms the hypothesis is*
>   *wrong eg smallest magnet holds more sheets than the*
>   *largest*

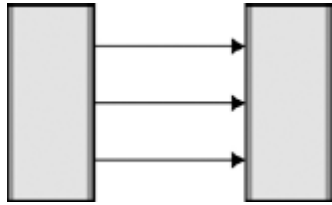   **1**
                                                                   [5]

M2. (a) (i)   field pattern shows:
            some straight lines in the gap

                                                                                    1

            direction N to S

                                                                                    1

       (ii)   north poles repel

                                                                                    1

              (so) box will not close

                                                                                    1

(b) (i)   as paper increases (rapid) decrease in force needed

                                                                                    1

            force levels off (after 50 sheets)

                                                                                    1

     (ii)   the newtonmeter will show the weight of the top magnet

                                                                                    1

     (iii) (top) magnet and newtonmeter separate before magnets separate
                accept reverse argument

                                                                                    1

            (because) force between magnets is greater than force between magnet
            and hook of newtonmeter

                                                                                    1

(iv)   any **three** from:

- means of reading value of force at instant the magnets are pulled apart
- increase the pulling force gently
  or
  use a mechanical device to apply the pulling force
- clamp the bottom magnet
- use smaller sheets of paper
- fewer sheets of papers between readings (smaller intervals)
- ensure magnets remain vertical
- ensure ends of magnet completely overlap
- repeat the procedure several times for each number of sheets and take a mean
- make sure all sheets of paper are the same thickness

3

(v)   3 (mm)

30 × 0.1 ecf gains **2** *marks*

2.1 N corresponds to 30 sheets gains **1** *mark*

3
[15]

M3.   (a)   (i)   increase

1

           (ii)   A and B
                and
                B and C

                    both required for the mark
                    either order

1

           (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

2

   (b)   4

1

          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

1

   (c)   2

                   allow 1 or 3

1

[7]