M1. (a) 450

allow 1 mark for correct substitution,

*ie* $18 \times 10 \times 2.5$ provided no subsequent step shown

(b) (i) friction between child ('s clothing) and slide

accept friction between two insulators

accept child rubs against the slide

accept when two insulators rub (together)

causes electron / charge transfer (between child and slide)

accept specific reference, eg electrons move onto / off the child / slide

reference to positive electrons / protons / positive charge / atoms transfer negates this mark

answers in terms of the slide being initially charged score zero

(ii) all the charges (on the hair) are the same (polarity)

accept (all) the charge/hair is negative / positive

accept it is positive/negative

charges / hairs are repelling

both parts should be marked together

(iii) charge would pass through the metal (to earth)

accept metal is a conductor

accept metal is not an insulator

accept there is no charge / electron transfer

accept the slide is earthed

accept metals contain free electrons

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M2. (a) (i) Ends have charge
Which is opposite on each rod

(ii) Attracts

(b) (i) Repulsion

(ii) Ends have same charge

(c) Electrons move between cloth and rod
Where gather is negative
Where move from is positive
M3. (a) clothing and seat rub together
   accept friction between clothing and seat

   electrons transfer from seat to driver
   or
   electrons transfer from driver to seat
   accept electrons transfer on its own if first mark scores
   an answer in terms of rubbing, between clothing and seat
   and charge transfer without mention of electrons gains 1 mark
   an answer in terms of friction / rubbing and electron transfer
   without mention of clothing and seat gains 1 mark

(b) (i) how wet the air is affects charge (build up)
   accept humidity affects charge
   or
   damp air is a better conductor
   or
   damp air has a lower resistance
   do not accept fair test or as a control unless explained

(ii) No – it was only the lowest under these conditions
    accept answer in terms of changing the conditions may change the results
    or
    No – there are lots of other materials that were not tested
    or
    Yes – the highest value for cotton is smaller than the lowest value for the other materials
    do not accept results show that it is always less / smallest
M4.  (a)  3rd box

The negative charge in the water is repelled by the rod and the positive charge is attracted.

(b)  (i)   friction between bottles and conveyor belt / (plastic) guides
         accept bottles rub against conveyor belt / (plastic) guides
         charge transfers between bottles and conveyor belt / (plastic) guides
         accept specific reference
         eg electrons move onto / off the bottles
         reference to positive electrons / protons negates this mark

(ii)   an atom that has lost / gained electron(s)
        do not accept a charged particle

(iii)  charge will not (easily) flow off the conveyor belt
        accept the conveyor belt / bottle is an insulator / not a conductor
        accept conveyor belt is rubber

[5]
M5. (a) electrons transfer / removed

*do not* accept negatively charged atoms for electrons
this only scores if first mark given

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1

1

to the rod / from the cloth
this does not score if there is reference to any original charge on cloth or rod
‘it’ refers to the rod
accept negative charge transfer to rod / removed from cloth for 1 mark
transfer of positive charge / positive electrons scores zero

(b) (i) rods / charges repel

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1

creating downward / extra force (on the balance)
accept pushing (bottom) rod downwards
do not accept increasing the weight / mass
charges attracting scores zero

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1

(ii) the (repulsion) force increases as the distance between the charges decreases
accept there is a negative correlation between (repulsion) force and distance between charges or (repulsion) force and distance between charges are inversely proportional for both marks
examples of 1 mark answers
force increases as distance decreases
force and distance are inversely proportional
negative correlation between force and distance
repels more as distance decreases
if given in terms of attracting or attraction force this mark does not score

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2 [6]

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Page 6

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M6. (a) (i) friction between the beads and pipe
    accept beads rub against the pipe
    (cause) electrons to transfer
    accept electrons are lost/gained
    do not accept negatively charged atoms for electrons
    3rd mark point only scores if 2nd mark scores
    from the pipe
    do not accept from the (negatively) charged pipe
    or to the beads
    do not accept to the (positively) charged beads
    accept negative charge transfer to the beads for 1 mark
    provided 2nd or 3rd marking point not awarded
    mention of positive charge transfer negates last 2 marking points

(ii) volume of beads
    accept (75)cm$^3$
    or
    length of pipe
    accept use the same pipe
    or
    speed the beads are poured
    poured the same way is insufficient
    or
    angle of pipe

(b) (i) the larger the beads the less charge
    do not accept inversely proportional
    negative correlation is insufficient

(ii) (total) charge decrease
results would be lower/smaller would be insufficient

beads in contact with pipe (walls) for less time
accept less contact (between beads and pipe)
accept beads in pipe for less time
or
smaller surface area (to rub against)
accept less pipe to rub against
less friction is insufficient

(c) (i) (pumping very) fine powders
reason only scores if (very) fine powders given
greater charge (build up)
accept more static (electricity)
accept an answer that correctly relates back to the experimental data
or
higher pd/voltage or greater energy
accept larger surface area to volume (ratio)

(ii) idea of earthing (the pipe)
accept use metal pipes
do not accept use larger particles

(d) to compare (the relative risks)
fair test is insufficient
you can only have one
independent variable is insufficient
ordifferent conditions change the MIE value
accept different conditions change the results
do not accept avoid bias
M7. (a) 3rd box
The negative charge in the water is repelled by the rod and the positive charge is attracted to the rod.

(b) (i) friction between bottles and conveyor belt / (plastic) guides
   accept bottles rub against conveyor belt / (plastic) guides
   charge transfers between bottles and conveyor belt / (plastic) guides
   accept specific reference eg electrons move onto / off the bottles
   reference to positive electrons / protons negates this mark

(ii) (the atom) loses or gains one (or more) electrons

(iii) charge will not (easily) flow off the conveyor belt / bottles
   accept the conveyor belt / bottles is an insulator / not a conductor accept conveyor belt is rubber