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
M2. (a) 572

allow 1 mark for correct substitution,
ie 220 × 2.6
allow 1 mark for
220 × 260 = 57 200
or
220 × 2600 = 572 000
but to score this mark the entire calculation must be shown

(b) (i) smooth curve drawn
accept a line that is extrapolated back to 0 degrees, but not through the origin
accept a straight line of best fit (point at 40 degrees can be treated as anomalous and line may stop at 30 degrees)
do not accept straight lines drawn ‘dot to dot’ or directly from first to last point or a line going through the origin

(ii) increases
accept a positive correlation
do not accept proportional

(iii) long plank
no mark for this, the marks are for the explanation
makes the angle small(er) (than a short plank)
accept increases the distance
accept small(er) slope

a small(er) force is needed or short plank
no mark for this, the marks are for the explanation
a large(r) force is used over a short(er) distance (1)
less work done (1)
accept less energy transfer
M3.  
(a) (i) 75 000  
accept correct substitution for 1 mark  
ie 7500 × 10  

newtons / N  
do not accept n  
full credit for using g = 9.8 or 9.81  

(ii) 60 000 000  
accept for both marks  
their (a)(i) × 800 correctly calculated  
accept correct substitution for 1 mark  
ie their (a)(i) × 800  

(b) (i) arrow drawn parallel (to) and down (the) slope  
accept arrow drawn anywhere on the diagram  

(ii) increases  
GPE transformed to KE or  
speed increasing  
accept is accelerating  
however ‘speed increasing’ only scores if correctly linked to  
increasing kinetic energy  

(c) so more likely to wear one  
or they know wearing a helmet is likely to / will reduce (risk) head injury  
or so can make an (informed) choice (about wearing one)  

(a) (i) friction

(ii) air resistance

   accept drag

   friction is insufficient

(iii) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5, and apply a 'best-fit' approach to the marking.

0 marks
No relevant content.

**Level 1 (1–2 marks)**
There is an attempt to explain in terms of forces A and B why the velocity of the cyclist changes between any two points
or
a description of how the velocity changes between any two points.

**Level 2 (3–4 marks)**
There is an explanation in terms of forces A and B of how the velocity changes between X and Y and between Y and Z
or
a complete description of how the velocity changes from X to Z.
or
an explanation and description of velocity change for either X to Y or Y to Z

**Level 3 (5–6 marks)**
There is a clear explanation in terms of forces A and B of how the velocity changes between X and Z and
a description of the change in velocity between X and Z.

**examples of the points made in the response**
extra information

**X to Y**

• at X force A is greater than force B
• cyclist accelerates
• and velocity increases
• as cyclist moves toward Y, force B (air resistance) increases (with increasing velocity)
• resultant force decreases
• cyclist continues to accelerate but at a smaller value
• so velocity continues to increase but at a lower rate

**Y to Z**

• from Y to Z force B (air resistance) increases
• acceleration decreases
• force B becomes equal to force A
• resultant force is now zero
• acceleration becomes zero
• velocity increases until...
• cyclist travels at constant / terminal velocity
  accept speed for velocity throughout

(b) (i) 3360
  allow 1 mark for correct substitution,
  ie 140 × 24 provided no subsequent step
  accept 3400 for 2 marks if correct substitution is shown
  joule / J
  do not accept j
  do not accept Nm

(ii) decreases
  accept an alternative word / description for decrease
  do not accept slows down

  temperature
  accept thermal energy
  accept heat

[13]
M5. (a) gravitational / gravity / weight
    do not accept gravitational potential

(b) accelerating
    accept speed / velocity increases

the distance between the drops increases

but the time between the drops is the same
    accept the time between drops is (always) 5 seconds
    accept the drops fall at the same rate

(c) (i) any one from:
    • speed / velocity
    • (condition of) brakes / road surface / tyres
    • weather (conditions)
    accept specific examples, eg wet / icy roads
    accept mass / weight of car friction is insufficient
    reference to any factor affecting thinking distance negates
    this answer

(ii) 75 000
    allow 1 mark for correct substitution, ie 3000 × 25 provided
    no subsequent step shown
    or allow 1 mark for an answer 75 or allow 2 marks for
    75 k(+ incorrect unit), eg 75 kN

joules / J
do not accept j

an answer 75 kJ gains 3 marks

for full marks the unit and numerical answer must be consistent
M6. (a) (i) gravitational potential (energy) 1

(ii) kinetic (energy) 1

(b) (i) slope or gradient 1

(ii) area (under graph)
   do not accept region 1

(iii) starts at same y−intercept 1

steeper slope than original and cuts time axis before original
the entire line must be below the given line
allow curve 1

(c) (i) 31 and 31
   correct answers to 2 significant figures gains 3 marks even if no working shown
   both values to more than 2 significant figures gains 2 marks:
   30.952......
   30.769....
   65 / 2.1 and / or
   80 / 2.6 gains 1 mark
   if incorrect answers given but if both are to 2 significant figures allow 1 mark 3

(ii) student 1 incorrect because 80 ≠ 65 1
student 2 correct because average velocities similar
ecf from (c)(i)

student 3 incorrect because times are different