FORCE

1. (a) (i) • an arrow labelled R, to the right, drawn on the rope
   accept a labelled arrow to the right, drawn parallel to the rope

(ii) • an arrow labelled G, vertically downwards

(b) any one from
   • snow is smoother
   • snow is more slippery

   accept ‘snow is slippery’
   accept ‘concrete or the path is rough’
   ‘snow is soft’ or ‘concrete is hard’ are insufficient

2. (a) Mars

   accept ‘6 kg’
   do not accept ‘24 N’

(b) any one from
   • 4 kg weighs more on Earth
     accept the converse ‘different weights’ is insufficient
   • the weight of the object is greater on Earth
     accept the converse
     accept ‘Earth is 40 N and Venus is 36 N’
     accept ‘Earth is 40 and Venus is 36’
     accept ‘more newtons on Earth’ or ‘less newtons on Venus’
     accept ‘there is a greater force on Earth’
     do not accept ‘it has more mass on the Earth’

(c) answers must be in the correct order
   • less (than) or smaller (than) or lower (than)
   • the same (as) or equal (to)

(d) (i) • the greater the distance
      accept ‘it increases’
      the greater the time for one orbit

(ii) • an answer from 1.6 to 6 inclusive
award a mark for X marked on the orbit within the tolerances shown

3. (a) B 1 (L5) 
    (b) (i) A and C accept ‘lift and weight’ 1 (L5) 
        answers may be in either order both letters are required for the mark
    (ii) D and B accept A and C 1 (L5) 
        answers may be in either order both letters are required for the mark

4. (a) any one from 1 (L4)
    • the forces are balanced
    ignore references to gravity if the answer is in terms of balanced forces
    • the forces are equal or the same ‘the sides are equal’ is insufficient
    • the forces are both 1000 N accept ‘the forces are both 1000’ accept ‘the newtons are even’ do not accept ‘both teams weigh 1000 N’
    • they pull with the same force or equally hard accept ‘both teams have the same strength’

    (b) an arrow drawn to the right accept an arrow drawn to the right anywhere on the drawing
(c) any one from
• team A pulled harder than team B accept ‘team A pulled harder’ or ‘team A pulled more’ or ‘they pulled harder’ accept the converse
• team A was stronger accept ‘they used more strength’
• team A was pulling with more than 1000
• team B was pulling with less than 1000
• there was more force to the left accept ‘there are more newtons to the left’

(d) 1200 N ✓ 1 (L4)
if more than one is ticked, award no mark

(e) friction 1 (L4) [5]

5. (a) (i) point plotted for (150, 1.5) to ± half a small square 1 (L5)
(ii) line of best fit 1 (L6)
the anomalous point should be avoided the line need not be drawn through the origin

(b) point at (300, 3.8) circled accept this result circled in the table 1 (L6)

(c) (i) a number from 640 to 660 1 (L6)
(ii) a number from 0.4 to 0.6 consequential marking applies to both c i and c ii accept answers consistent with the graph drawn
(d) any one from

- the pattern is revealed or observed more easily
- it tells you the pattern without working it out
- it gives readings between the recorded readings
- you can see if there are results that are wrong or do not fit the pattern

the answer must refer to the results or the pattern shown by the results

- accept ‘it allows you to see a pattern’
- accept ‘you can tell the rule by looking at it’
- accept ‘it is easier to make predictions’
- accept ‘it shows better or more quickly the more mass the more weight’
- accept ‘the data is continuous’
do not accept ‘it is more accurate or precise’

6. (a) 3 (L3)

if more than one line is drawn from any one force award no mark for that force

(b) 800 1 (L4)

accept ‘80 x 10’

(c) any one from 1 (L4)

- it weighed more
- the mass was greater
- it weighed less at the end

accept ‘it was heavier’
accept ‘it only weighed 130 at the end’
accept ‘there was more food or fuel or supplies’
accept ‘more pressure’
(d) any one from
- they spread out the weight accept 'they do not sink into the snow'
accept 'wheels sink'
- they have a bigger surface or area
- they can slide easily accept 'they reduce the pressure'
accept 'less friction'
'they are bigger' is insufficient 'it can slide' is insufficient

(e) any one from
- there is a bigger surface or area
- there is a bigger force
- it catches more air or wind do not accept 'there is more air resistance'

7. (a) (i) C 1 (L3)
(ii) B 1 (L3)
(b) 20 1 (L3)
(c) any one from
- friction
- air resistance or drag
- reaction accept 'upthrust'
do not accept 'gravity'

8. (a) (i) 12.5 m/s accept \( \frac{400}{32} \) m/s 1 (L7)
accept 'metres per second' or 'ms\(^{-1}\)' for m/s
the unit is required for the mark
do not accept 'mps'
(ii) they are equal or the same accept 'they are balanced' 1 (L7)
(b) the forward force is greater than the backward force

accept the converse

accept ‘the forward force is greater’ or ‘the backward force is smaller’

do not accept ‘the forward force becomes greater or increases’

any one from

• because air resistance or drag is smaller or reduced

• because there is a smaller surface area

‘she is more streamlined’ is insufficient as it is given in the question

9. (a) (i) any two from

• gravity or weight

• friction

• reaction

• air resistance

accept ‘upthrust’

accept ‘drag’

do not accept ‘centrifugal force’ or ‘centripetal force’ or ‘g-force’

(ii) any one from

• constant speed

• steady speed

• it stays the same

accept ‘it is the same’ or ‘it does not change’

(b) friction is less

‘it is smoother’ or ‘it is slippery’ are insufficient

(c) it increases

accept ‘he goes more quickly’

because there is less air resistance or friction

accept ‘he is streamlined or aerodynamic’
10. (a) Both the correct ball and the correct reason are required for the mark.
the bowling ball because it has the greatest mass or it is the heaviest 1 (L5)
do not accept ‘because it is bigger’
‘the bowling ball because it is bigger’
insufficient

(b) any one from 1 (L5)
• they are the same diameter accept ‘they are the same size’
• they produce the same air resistance or friction

(c) (i) they would both reach the ground at the same time 1 (L5)
(ii) air resistance accept ‘friction’ 1 (L5)
(iii) either
  • the feather and the hammer landed at the same time 1 (L6)
  there is no atmosphere or air resistance or air on the moon 1 (L6)
  or
  • they would take longer to fall on the moon 1 (L6)
because there is lower gravity than on the Earth 1 (L6)
do not accept ‘there is no gravity on the moon’

11. (a) they are equal accept ‘they are balanced’ 1 (L5)
(b) (i) weight is greater than friction accept ‘they are not equal or balanced’ 1 (L5)
(ii) it increases 1 (L6)
   it decreases 1 (L6)
(iii) it increases or it gets faster 1 (L6)

12. (a) gravity or weight 1
accept any straight line which goes through or below both points A and B and through or above both points C and D the line does not have to extend to an axis

(ii) 11.5 accept any answer from 10.0 to 13.0

13. (a) (i) any one from

• when the weight increases, the number of masses increases accept 'they increase together' or 'they decrease together'

• the number of masses goes down if the weight goes down

• the number of masses increases with weight

(ii) 12

(b) (i) she would need fewer masses accept 'it would slide more easily' do not accept 'less friction'

(ii) put oil or water on the glass accept a named lubricant for oil accept 'lubricate the surfaces' accept 'polish the block of wood' accept 'put the block of wood on rollers or ball bearings' or on any objects used as rollers do not accept 'tilt the glass'

14. (a) (i) they hit the front of the car accept 'the car has to push the air molecules out of the way' accept 'air hits the front of the car'

(ii) any one from

1 (L6)
• molecules or particles hit the car faster or harder

   accept ‘the car hits the air particles faster’

• more molecules or particles hit the car

   accept ‘the car has to push more air each second’ or ‘the pressure gets greater at the front of the car’ or ‘the pressure difference increases’

(b) (i) larger than the air resistance accept ‘larger’ or ‘bigger’ 1 (L6)

(ii) the same as the air resistance accept ‘the same’ or ‘equal’ 1 (L6)

(c) any one from

• it has to balance the air resistance

• air resistance is larger accept ‘more molecules hit the car’ or ‘molecules hit the car faster’ or ‘the car has to push more air each second’

(d) friction 1 (L5)

15. (a) (i) 1 (L3)

(ii) 1 (L3)

the first mark is for an arrow pointing to the right,
with or without the label A
the arrow may be separate from, but parallel to, the rope
accept an arrow placed on the second drawing provided it is labelled A

the second mark is for an arrow pointing vertically downwards, with or without the label B

(b) any two from

• air resistance or wind resistance accept ‘wind’ 2 (L4)

• friction or water resistance

• upthrust accept ‘buoyancy’

• lift accept ‘drag’ as an alternative to wind
resistance or water resistance, but not both
accept 'weight of the skis'
do not accept 'weight' or 'gravity' or water pressure or 'resistance'
the mark is for an arrow pointing to the left, with or without the label C the arrow may be separate from, but parallel to, the rope accept an arrow placed on the first drawing provided it is labelled C

(d) any one from
- it increases it accept ‘makes it accelerate’ 1 (L3)
- it speeds it up
- it makes it go faster accept ‘faster’
  do not accept ‘it changes it’

16. (a) the weight of the bricks ✓ if more than two boxes are ticked, 1 (L3)
deduct one mark for each incorrectly ticked box
the push of the man’s hands on the handles ✓ 1 (L3)
minimum mark zero

(b) friction 1 (L4)

(c) any one from 1 (L3)
- speeds it up
- makes it bigger
- it accelerates accept ‘makes it go faster’ or ‘faster’
  do not accept ‘it falls quickly’

17. (a) The tension equals the weight. ✓ if more than one box is ticked, 1 (L6)
award no mark
(b) tension is greater than weight  

accept ‘tension is bigger’ or ‘weight is less’ 1 (L6)

or ‘the upward force is bigger’ or ‘the downward force is smaller’

(c) tension equals weight

accept ‘they are the same’ 1 (L6)

(d) tension is less than weight

accept ‘tension is less’ or ‘weight is more’

or ‘the upward force is less’ or ‘the downward force is bigger’

18. (a) B 1 (L3)

(b) D 1 (L3)

(c) (i) 1 (L3)

one mark for the arrow pointing to the left

the arrow may be anywhere on the diagram
accept ‘D’ on the diagram

accept arrows pointing diagonally downwards and to the left

do not accept arrows pointing vertically downwards
(ii) answers should refer to a force pulling or the effect of pulling any one from

- because Megan is pulling it
- because there is a force on it
- because the force is unbalanced
- force D is still acting

accept ‘because it was stretched’ or ‘because the dog isn’t pulling it any more’
accept answers referring to gravity, weight or falling only if the arrow in (c) (i) points diagonally or vertically downwards
do not accept ‘it is not attached to the dog any more’

[4]

19. (a)  

(i)  

![Diagram of a train](image)

the mark is for an arrow pointing to the left as shown
the arrow may be anywhere on the diagram
accept an arrow pointing to the left, drawn in the space beneath the question

(ii) equal to

accept ‘equal’

(b) (i) backwards

accept ‘in the opposite direction to the movement’
or ‘in the opposite direction’ or ‘to the left’
accept an arrow drawn pointing to the left either on the diagram, if labelled clearly, or in the space beneath the question

(ii) between 0 and 5000 N ✓

if more than one box is ticked, award no mark

(c) 5000 N ✓

if more than one box is ticked award no mark

[5]