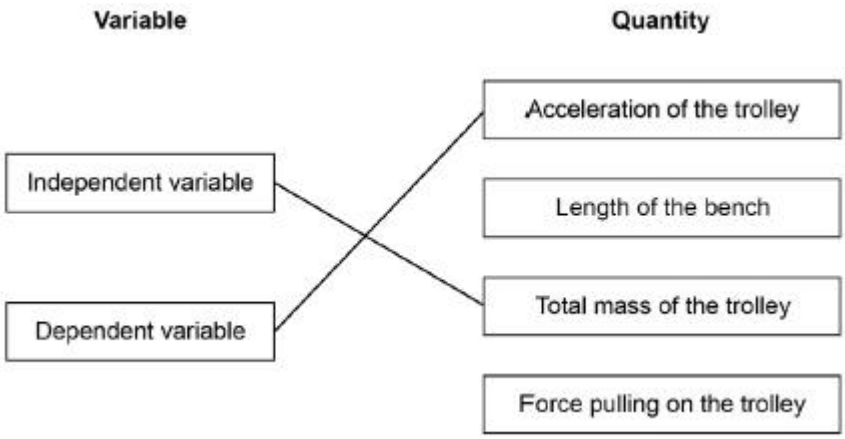
Mark schemes

Q1.

(a) friction

1

(b)



2

(c) $\frac{1.58 + 1.53 + 1.54}{3}$

1

1.55 (m/s^2)

1

(d) the acceleration is inversely proportional to the mass

allow as the mass increases the acceleration decreases

allow negative correlation

1

(e) $F = 1.5 \times 0.62$

1

= 0.93 (N)

1

[8]

Q2.

(a) distance

1

speed

1

(b) 3200 (m)

1

(c)

$$\text{average speed} = \frac{3200}{2000}$$

*allow ecf from question **b***

1

= 1.6 (m/s)

1

(d) B

1

It has the smallest gradient

MP2 is dependent on MP1

1

(e) gravity

1

(f) 3.0 m/s

1

[9]

Q3.

(a) $W = 25\,000 \times 9.8$

1

= 245 000 (N)

1

(b)

$$p = \frac{1\,960\,000}{49}$$

1

= 40 000

1

Pa

1

(c) B

1

(d)

$$a = \frac{1.3 - 0.7}{5.0}$$

1

$= 0.12$ (m/s^2)

1

(e)

$$\frac{0.21}{0.84} \times 100$$

1

25%

1

(f) force (applied to the spring) = spring constant × extension
or
$F = k \times e$

1

(g) $336 = k \times 0.21$

1

$$\frac{336}{0.21} = k$$

1

$k = 1600$ (N/m)

1

(h) $v^2 - 0 = 2 \times 9.8 \times 0.95$

1

$v^2 = 18.62$

allow $v = \sqrt{(18.62)}$

1

$v = 4.3150\ldots$

1

$= 4.3$ (m/s)

allow an answer correctly rounded to 2 significant figures from an incorrect calculation which uses the values in the question

1

[18]

Q4.

(a) 0 (N)

1

the child isn't accelerating (vertically)

MP2 dependent on MP1

or

upwards forces are equal to the downwards forces

allow forces are balanced

1

(b) work done = force × distance

or

$W = F \times s$

1

(c) $35 = F \times 2.8$

1

$$F = \frac{35}{2.8}$$

1

$F = 12.5$ (N)

allow 13 (N)

1

(d) the resistive force has decreased

allow friction (between the wheels and the floor) has decreased

1

so the resultant force increases

1

(e) moment = force × distance

or

$M = F \times d$

1

(f) 7.5 cm = 0.075 m

1

$M = 2.0 \times 0.075$

allow a correct substitution of an incorrectly / not converted value of d

1

M = 0.15 (Nm)

allow an answer consistent with an incorrectly / not converted value of d

1

(g) gear B rotates in the opposite direction (to gear A)
or
gear B rotates clockwise
or
gear B rotates faster than gear A

1

(because) gear A exerts a force on gear B
or
(because) gear A causes a moment about the pivot of gear B

1

[14]

Q5.

(a) kinetic

1

thermal

1

this order only

(b) (minimum braking) distance increases with increasing speed

allow positive correlation

1

(c) increases

1

(d) 12.5 - 5.0 = 7.5 (m/s)

1

$t = \frac{7.5}{0.25}$

this mark may be awarded if the change in velocity is incorrectly calculated

1

t = 30 (s)

allow a correctly calculated answer using a change in velocity incorrectly calculated

1

(e) F = 1600 × 0.25

1

F = 400 (N)

1

(f) initial height of the ruler above the person's hand

1

(g) there will be more variation in distances

allow reaction times for distances

allow the three students tested are not typical

1

(h) carry out the experiment listening to music

1

then not listening to music (and compare the results)

allow compare with original results

1

[13]

Q6.

(a) 7.1 (cm)

allow 7.0 to 7.3 (cm)

1

497 (m)

allow 70 × their measurement of displacement

1

(b) 0 (N)

1

(c) constant velocity

allow constant speed (in a straight line)

*do **not** accept stationary*

*allow constant acceleration if a **mathematical error** in (b) gives a non-zero value for resultant force*

1

(d) any **one** from:

- tension
- normal contact (force)
- upthrust

allow lift, thrust and water resistance

allow normal reaction (force)

ignore drag

1

(e) horizontal line drawn to 10s along the *x*-axis

1

line with a positive gradient starting from 10 s

allow an upward curving line with increasing gradient starting from 10 s

1

(f) line of best fit drawn and extrapolated to 10 km

*do **not** accept a straight line*

1

28 (kPa)

allow 26 to 32 (kPa)

allow a value correctly extrapolated from their line

allow 2 marks for a correct mathematically extrapolated value

1

(g) the average density of the air above the aeroplane decreases

1

[10]

Q7.

(a) gravitational force

1

(b) air resistance

1

(c) the resultant force on the hailstones is zero

1

(d) line extrapolated to 80 mm

allow a straight line

1

46 (m/s)

allow 44 − 48 but not if inconsistent with their extrapolated line

1

(e) it has a greater weight

1

(f) 0.48 (N)

1

(g) upwards

allow up

ignore north

1

[8]

Q8.

(a) any **two** from:

- capacity of the battery

  allow energy/charge stored in battery

  allow efficiency of battery

  ignore size of the battery

- speed
- mass / weight
- uphill / downhill

  allow terrain

- stopping at traffic lights
- condition of the road

  ignore 'the road' only

- (air) temperature

  ignore 'weather' only

- (incorrect) tyre pressure
- streamlining of the car

  allow efficiency of engine

  allow anything that would use charge from the battery
  or
  anything that will reduce the energy stored

2

(b) acceleration = change in velocity/time (taken)
or

$$a = \frac{\Delta v}{t}$$

allow any correct rearrangement

allow $a = \frac{v - u}{t}$

*do **not** accept* $a = \frac{v}{t}$

1

(c) $20 = \frac{28}{t}$

1

$t = \frac{28}{20}$

1

1.4 s

1

(d) $v^2 - 0^2 = 2 \times 10 \times 605$

1

$v^2 = 12\ 100$

1

$v = 110$ (m/s)

1

(e) work done = force × distance

or

$W = Fs$

allow any correct rearrangement

1

(f) $s = 7500$ (m)

1

$W = 4000 \times 7500$

allow correct substitution using incorrectly / not converted value of s

1

$W = 30\ 000\ 000$ (J)

allow correct calculation using incorrectly / not converted value of s

1

[13]