Mark schemes

(a) increases

increases  

(b) 23 (m)

accept 43 circled for 1 mark
accept 9 + 14 for 1 mark

(c) (i) all points correctly plotted

all to ± ½ small square
one error = 1 mark
two or more errors = 0 marks

line of best fit

(ii) correct value from their graph (± ½ small square)

(d) (i) 70

½ × 35 × 4 gains 2 marks

attempt to estimate area under the graph for 1 mark

(ii) line from (0.6,35)

sloping downwards with a less steep line than the first line

cutting time axis at time > 4.6 s

accept cutting x-axis at 6

(e) (i) 42 000

1200 × 35 gains 1 mark

kgm / s

Ns
(ii) 10 500 (N)
42 000 / 4 gains 1 mark
alternatively:
a = 35 / 4 = 8.75 m / s²
F = 1200 × 8.75

\[ \text{[19]} \]

(a) (i) X placed at 50 cm mark

(ii) point at which mass of object may be (thought to be) concentrated

(b) (i) Y placed between the centre of the rule and the upper part of mass

(ii) 16.5
allow for 1 mark
(16.5 + 16.6 +16.5) / 3

1.65
value consistent with mean value given
only penalise significant figures once

[2]
(iii) Marks awarded for this answer will be determined by the quality of communication as well as the standard of the scientific response. Examiners should apply a ‘best-fit’ approach to the marking.

0 marks
No relevant content

Level 1 (1 – 2 marks)
A description of a method which would provide results which may not be valid.

Level 2 (3 – 4 marks)
A clear description of a method enabling some valid results to be obtained. A safety factor is mentioned.

Level 3 (5 – 6 marks)
A clear and detailed description of experiment. A safety factor is mentioned. Uncertainty is mentioned.

Examples of the physics points made in the response:

Additional apparatus
- stopwatch

Use of apparatus
- measure from hole to centre of the mass
- pull rule to one side, release
- time for 10 swings and repeat
- divide mean by 10
- change position of mass and repeat

Fair test
- keep other factors constant
- time to same point on swing

Risk assessment
- injury from sharp nail
- stand topple over
- rule hit someone

Accuracy
- take more than 4 values of $d$
- estimate position of centre of slotted mass
- small amplitudes
- discard anomalous results
- use of fiducial marker

(c) (i) initial reduction in $T$ (reaching minimum value) as $d$ increases
after 30 cm $T$ increases for higher value of $d$

(ii) (no)

any two from:

- fourth reading is close to mean
- range of data 0.2 s / very small
- variation in data is expected

1

(a) (i) 100 (m)

(ii) stationary

(iii) accelerating

(iv) tangent drawn at $t = 45$ s

attempt to determine slope

speed in the range $3.2 - 4.2$ (m / s)

dependent on 1st marking point

1

(b) (i) 500 000 (J)

ignore negative sign

1

(ii) 20 000 (N)

ignore negative sign

allow 1 mark for correct substitution, ie

$500 000 = F \times 25$

or their part (b)(i) $= F \times 25$

provided no subsequent step

2

(iii) (kinetic) energy transferred by heating

to the brakes

ignore references to sound energy

if no other marks scored allow k.e. decreases for 1 mark

1

(a) make the rod longer

1
push down on the rod with a greater force

(b) particles are close together

so no room for more movement
dependent on 1st marking point

(c) (i) downward force produces pressure in liquid

reference to compression of liquid negates this mark

this pressure is the same at all points in a liquid
or
this pressure is transmitted equally through the liquid

and \( P = F / A \) or \( F = P \times A \)

area (at load) bigger (so force bigger)

(ii) the force acting on the car moves less distance than the effort force

(a) pitch

loudness

(b) (i) as length (of prongs) decreases frequency / pitch increases

accept converse
accept negative correlation
ignore inversely proportional

(ii) 8.3 (cm)

accept 8.3 ± 0.1 cm

(iii) (8.3 cm is) between 7.8 (cm) and 8.7 (cm)

ecf from part (ii)

so \( f \) must be) between 384 (Hz) and 480 (Hz)

410 (Hz) \( \leq f \leq 450 \) (Hz)

if only the estimated frequency given, accept for 1 mark an answer within the range
(c) (i) electronic

(ii) frequency is (very) high

accept frequency above
20 000 (Hz) or audible range

so tuning fork or length of prongs would be very small (1.2 mm)

(d) 285.7 (Hz)

accept any correct rounding 286, 290, 300
allow 2 marks for 285
allow 2 marks for correct substitution 0.0035 = 1 / f
allow 1 mark for T = 0.0035 s
allow 1 mark for an answer of 2000

(a) (i) any two from:

- length of coils increased
- coils have tilted
- length of loop(s) increased
- increased gap between coils
- spring has stretched / got longer
- spring has got thinner

(ii) remove mass

accept remove force / weight

observe if the spring returns to its original length / shape (then it is behaving elastically)

(b) (i) 8.0 (cm)

extension is directly proportional to force (up to 4 N)

for every 1.0 N extension increases by 4.0 cm (up to 4 N)

evidence of processing figures eg 8.0 cm is half way between 4.0 cm and 12.0 cm

allow spring constant (k) goes from to \( \frac{1}{4} \) to \( \frac{5}{22} \)

(ii) any value greater than 4.0 N and less than or equal to 5.0 N
the increase in extension is greater than 4 cm per 1.0 N (of force) added
dependent on first mark

(c) 
(i) elastic potential energy

(ii) misread stopwatch
timed too many complete oscillations

(iii) 4.3 (s)
accept 4.33 (s)

(iv) stopwatch reads to 0.01 s
reaction time is about 0.2 s
or
reaction time is less precise than stopwatch

(v) use more masses
smaller masses eg 50 g
not exceeding limit of proportionality

(a) 
(i) not moving

(ii) straight line from origin to (200,500)
ignore a horizontal line after (200,500)

(b) 35 000
allow 1 mark for correct substitution, ie 14 000 \times 2.5 provided no
subsequent step
an answer of 87 500 indicates acceleration (2.5) has been squared
and so scores zero
(a) Zero / 0
Accept none
Nothing is insufficient
velocity / speed = 0
accept it is not moving
paintball has not been fired is insufficient

(b) 0.27
allow 1 mark for correct substitution, ie \( p = 0.003(0) \times 90 \) provided
no subsequent step

(c) equal to

1
[5]