Motion along a line

Mark Scheme

Name: _____

Class: _____

Date: _____

Time: **76 minutes**

Marks: **75 marks**

Comments:

Mark schemes

1 (a) 48

*allow for **1** mark correct method shown, ie 6 × 8*

***or** correct area indicated on the graph*

2

(b) diagonal line from (0,0) to (6,48) / (6, their (a))

if answer to (a) is greater than 50, scale must be changed to gain this mark

1

horizontal line at 48m between 6 and 10 seconds

accept horizontal line drawn at their (a) between 6 and 10 seconds

1

[4]

2 (a) 7.5

correct answer with no working = 3 if incorrect allow 1 mark for (change in velocity from graph =) 15

1 mark for $\frac{change\ in\ velocity}{time\ taken}$

2 marks for $\frac{15}{2}$

N.B. correct answer from the incorrectly recalled relationship $\frac{distance}{time}$ *= 2 marks*

3

(b) (4 – 5 seconds) the bungee jumper slows down (decelerates)

1

(the rubber cord) stops the fall

1

(5 – 6 seconds) the bungee jumper starts moving (accelerating) upwards (in the opposite direction)

max 2 marks if no correct indication of time

1

[6]

3 (a) **D** – **E**

reason only scores if D – E chosen

1

shallowest slope / gradient

accept smallest distance in biggest time
accept longest time to travel the same distance
accept the line is not as steep
accept it is a less steep line
*do **not** accept the line is not steep*

1

(b) 80 000

*allow **1** mark for correct substitution, ie 16 000 × 5 provided no subsequent step shown*

2

(c) (i) straight line starting at origin

accept within one small square of the origin

1

passing through t = 220 and d = 500

1

(i) 186

accept any value between 180 and 188
accept where their line intersects given graph line correctly read ±4 s

1

[7]

4 (a) any **two** from:

- (acceleration occurs when) the direction (of each capsule) changes
- velocity has direction
- acceleration is (rate of) change of velocity

2

(b) to(wards) the centre (of the wheel)

1

(c) the greater the radius / diameter / circumference (of the wheel) the smaller the (resultant) force (required)

accept 'the size' for radius
both parts required for the mark

1

[4]

5 (a) distance is a scalar and displacement is a vector

or

distance has magnitude only, displacement has magnitude and direction

1

(b) 37.5 km

accept any value between 37.0 and 38.0 inclusive

1

062° or N62°E

accept 62° to the right of the vertical

1

accept an angle in the range 60° −64°

accept the angle correctly measured and marked on the diagram

(c) train changes direction so velocity changes

1

acceleration is the rate of change of velocity

1

(d) number of squares below line = 17

accept any number between 16 and 18 inclusive

1

each square represents 500 m

1

distance = number of squares × value of each square correctly calculated − 8500 m

1

[8]

6 (a) acceleration = $\frac{\text{change in speed/velocity}}{\text{time taken}}$

or $\frac{10}{4}$

gains 1 mark
do not penalise if <u>both</u> of these present
but 'change in' omitted from formula

but
2.5

gains 2 marks

unit m/s^2 **or** metres per second squared

or metres per second per second

or ms^{-*}

for 1 mark

3

(b) *evidence* of using area under graph or distance <u>average</u> speed × time
or

$10 \times 4 \times \frac{1}{2}$

gains 1 mark

but
20

gains 2 marks

units metres / m^{-2}*

for 1 mark

3

(c) force = mass × acceleration **or** 75 × 25

gains 1 mark

but
1875

gains 2 marks

**NB Correct unit to be credited even if numerical answer wrong or absent.*

2

[8]

7

(a) any sensible suggestion eg

- theory supported by results from other experiments
- could not believe the 'theory' could be wrong
- 'theory' is the basis of many other ideas

1

(b) any **two** from:

- to allow peer review of data
- to assess the reproducibility of the data
- to promote further enquiry / experiments
- to encourage other scientists to develop explanations / new theories

2

(c) 730 000 = 300 007 400 × time

1

$$\text{time} = \frac{730\,000}{300\,007\,400}$$

*this step without the previous step stated gains **2** marks*

1

$2.43(3273) \times 10^{-3}$ s

accept 0.00243(3273) s

1

*allow 2.43(3273) × 10^{-3} with no working for **4** marks*

(d) 60 × 10^{-9} s

1

(e) systematic error

1

(f) add on 60 nanoseconds to each time recorded (then recalculate)

1

[9]

8

(a) more streamlined

accept decrease surface area

1

air resistance is smaller (for same speed)

accept drag for air resistance

friction is insufficient

1

so reaches a higher speed (before resultant force is 0)

ignore reference to mass

1

(b) (i) 1.7

*allow **1** mark for correct method, ie* $\frac{5}{3}$

***or** allow **1** mark for an answer with more than 2 sig figs that rounds to 1.7*

***or** allow **1** mark for an answer of 17*

2

(ii) 7.5

*allow **1** mark for correct use of graph, eg* $\frac{1}{2} \times 5 \times 3$

2

(iii) air (resistance)

accept wind (resistance)

drag is insufficient

friction is insufficient

1

[8]

9

(a) arrow vertically down – same size as lift – labelled weight

judge by eye

1

arrow to the left – same size as drag - labelled thrust

judge by eye

*two correct arrows without labels gains **1** mark*

1

(b) $34^2 - (0^2) = 2 \times 4.0 \times s$

1

$$\frac{34 \times 34}{8} = s$$

1

s = 144.5

1

s = 140 (2 sig figs)

*an answer of 140 scores **4** marks*

*an answer of 144.5 scores **3** marks*

1

(c) tension force drawn to a suitable scale and in correct direction

1

triangle completed showing correct components

1

scale used to determine both component forces

1

horizontal component = 1900 N
vertical component = 680 N

allow 1850 to 1925 inclusive

allow 660 to 700 inclusive

1

[10]

10 (a) (i) 100 (m)

1

(ii) stationary

1

(iii) accelerating

1

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

1

attempt to determine slope

1

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 × 25

***or** their part (b)(i) = F × 25*

provided no subsequent step

2

(iii) *(kinetic) energy* transferred by heating

1

to the brakes

ignore references to sound energy

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

1

[11]