Newtons Laws

Mark Scheme

Name: _____

Class: _____

Date: _____

Time: **100 minutes**

Marks: **98 marks**

Comments:

Mark schemes

1 12 100

correct answer with no working = 3
if answer incorrect, allow 1 mark for force = mass × acceleration
1210 × 10 = 2 force / weight = mass × gravity is neutral
N.B. no marks for correct answers with incorrectly recalled relationship

[3]

2 (a) resultant force = zero
or
upward force = downward force

accept forces are balanced
accept weight for downward force

1

(b) (i) 84

*allow **1** mark for correct substitution ie 840 = m × 10*

2

(ii) 12

accept 12.02 for both marks

or

1010 ÷ their (b)(i) correctly calculated

*a resultant force of 1010 (N) gains **1** mark*
an answer 22(.02) gains 1 mark

2

m/s^2

accept m/s/s

1

[6]

3 (i) force = mass × acceleration

accept F = m × a
*accept upper **or** lower case letters*
accept equation using correct units
accept

if subsequent method correct

1

(ii) 0.007

*allow **1** mark for correct transformation or substitution*

2

[3]

4 (a) (i) a single force that has the same effect as all the forces combined

accept all the forces added / the sum of the forces / overall force

1

(ii) constant speed (in a straight line)

*do **not** accept stationary*

or constant velocity

1

(b) 3

*allow **1** mark for correct substitution into transformed equation*
*accept answer 0.003 gains **1** mark*
*answer = 0.75 gains **1** mark*

2

m/s^2

1

(c) as speed increases air resistance increases

accept drag / friction for air resistance

1

reducing the resultant force

1

[7]

5 (a) the forces are equal in size and act in opposite directions

1

(b) (i) forwards / to the right / in the direction of the 300 N force

answers in either order

1

accelerating

1

(ii) constant velocity to the right

1

(iii) resultant force is zero

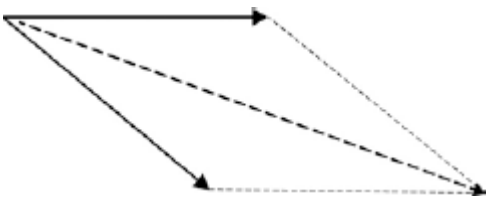
accept forces are equal / balanced

1

so boat continues in the same direction at the same speed

1

(iv) parallelogram or triangle is correctly drawn with resultant



3

value of resultant in the range 545 N – 595 N

*parallelogram drawn without resultant gains **1** mark*

If no triangle or parallelogram drawn:

*drawn resultant line is **between** the two 300 N forces gains **1** mark*

*drawn resultant line is between and longer than the two 300 N forces gains **2** marks*

1

[10]

6 (a) the distance travelled under the braking force

1

(b) the reaction time will increase

1

increasing the thinking distance (and so increasing stopping distance)

(increases stopping distance is insufficient)

1

(c) No, because although when the speed increases the thinking distance increases by the same factor the braking distance does not.

1

eg

increasing from 10 m / s to 20 m / s increases thinking distance from 6 m to 12 m but the braking distance increases from 6 m to 24 m

1

(d) If the sled accelerates the value for the constant of friction will be wrong.

1

(e) only a (the horizontal) component of the force would be pulling the sled forward

1

the vertical component of the force (effectively) lifts the sled reducing the force of the surface on the sled

1

(f) $-u^2 = 2 \times -7.2 \times 22$

award this mark even with 0^2 and / or the negative sign missing

1

$u = 17.7(99)$

1

18

1

*allow 18 with no working shown for **3** marks*

*allow 17.7(99) then incorrectly rounded to 17 for **2** marks*

[11]

7 (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)***

1

student 3 incorrect because times are different

1

[12]

8 (a) (i) 9.5

accept ±1 mm

1

10.5

1

(ii) 9.5

*ecf from **(a)(i)***

1

(iii) 190

*20 × **(a)(ii)** ecf*

1

(iv) medium

*ecf from **(a)(iii)***

1

(b) (i) any **two** from:

- position of ball before release
- same angle **or** height of runway
- same ball
- same strip of grass

2

(ii) long
or
longer than in part **(a)**
or
uneven

*do **not** allow reference to speed*

1

(c) (i) as humidity increases mean distance decreases

accept speed for distance

1

(ii) 71 × 180 = 12780
79 × 162 = 12798
87 × 147 = 12789

*all three calculations correct with a valid conclusion gains **3** marks*

or
find k from R = k / d

*all three calculations correct gains **2** marks*

or
87 / 71 × 147 = 180.1 ~ 180
87 / 79 × 147 = 161.9 ~ 162

*two calculations correct with a valid conclusion gains **2** marks*

conclusion based on calculation

*one correct calculation of k gains **1** mark*

3

(iii) only three readings **or** small range for humidity

accept not enough readings

accept data from Internet could be unreliable

ignore reference to repeats

1

(d) distance is a scalar **or** has no direction **or** has magnitude only

allow measurements from diagram of distance and displacement

1

displacement is a vector **or** has direction

1

[15]

9

(a) there is a (maximum) forward force
drag/friction/resistance (**opposes** motion) (**not** pressure)
increases with speed
till forward and backward forces equal
so no net force/acceleration

any 4 for 1 mark each

4

(b) (i) $F = ma$
$10\ 000 = 1250a$
$a = 8$
m/s^2

for 1 mark each

4

(ii) $ke = 1/2\ mv^2$
$ke = 1/2\ 1250.48^2$
$ke = 1\ 440\ 000$
J

for 1 mark each

4

(iii) $W = Fd$
$W = 10\ 000.144$
$W = 1\ 440\ 000$
J

for 1 mark each

4

[16]

10

(a) double

1

(b) the hypothesis does not say how increasing / decreasing the force
increases / decreases the acceleration

1

(c) appropriate equipment to apply and measure force

*eg newtonmeter **or** slotted masses + string + pulley*

1

appropriate equipment to measure change in velocity and time

*eg ticker timer + tape **or** light gates + datalogger*

1

(d) to reduce the effect of friction on the trolley

1

(e)

Level 3: The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5-6
Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.	3-4
Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1-2
No relevant content	0
Indicative content • method by which the trolley is to be accelerated • how the accelerating force is varied to give a suitable range of results • how the accelerating force is measured • the use of suitable apparatus to measure the change in velocity of the trolley over a given distance or time • what data is to be collected in order to calculate acceleration • how the data required is to be measured	

6

(f) so that the mass is constant

fair test is insufficient

1

as changing mass would change the acceleration (produced by a given force)

or

so there is only one independent variable

1

(f) hypothesis A because

A *must be identified to gain either mark*

1

the results give a straight line that passes through the origin

showing direct proportionality

1

[15]