AQA GCSE PHYSICS (HIGHER) · 8463

PHYSICS



MARK SCHEME

4.5.6.2.2 NEWTON'S SECOND LAW (PACK 1)

SCORE	PERCENTAGE
/89	%

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Q1.

(a) equal to

1

(b) weight = 85 × 9.8

1

weight = 833 (N)

allow weight = 830 (N)

1

*an answer of 833 (N) **or** 830 (N) scores **2** marks*

(c) work done = 833 × 0.63

*allow their calculated value from part **(b)** × 0.63*

1

work done = 525 (J)

*allow an answer that is consistent with their calculated value from part **(b)***

1

*an answer that rounds to 525 (J) scores **2** marks*

(d) work done = 0 (J)

1

(e) force = 62 × 11

1

force = 682 (N)

allow force = 680 (N)

1

*an answer of 682 (N) **or** 680 (N) scores **2** marks*

[8]

Q2.

(a) its acceleration would decrease to zero

1

the resultant force on it would decrease to zero

1

(b) any **one** from:

- move the second light gate closer to the first
- shorten the string length

allow use a taller table

1

(c) 1.26667 (m/s^2) (is wrong)

allow (mean value calculated at) 0.20 (N)

1

give value to 2 significant figures

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allow give value to 1 decimal place
allow 1.3 (m/s^2)

1

6.7 (m/s^2) (is wrong)

allow (mean value calculated at) 0.98 (N)
allow test 2 for 0.98 (N) or 7.2 is an anomaly

1

discard the anomalous result and recalculate the mean

allow repeat the anomalous test result and re-calculate the mean
allow 6.4 (m/s^2)

1

each mistake and its correction may be given in any order

(d) (resultant) force is directly proportional to acceleration

allow the larger the (resultant) force, the greater the acceleration

allow positive correlation between (resultant) force and acceleration

allow mass / weight (of the holder) for (resultant) force

1

(e) all points correctly plotted within ½ small square

*allow **1** mark for 3 or 4 points correctly plotted*

2

curved line of best fit

1

(f) inversely proportional

allow as mass increases, acceleration decreases

1

[12]

Q3.

(a) the arrows have different lengths

allow forces can have different sizes

1

the arrows point in different directions

allow forces can have different directions

1

(b) **D**

1

(c) **B**

1

(d) both variables are continuous

1

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(e) it is moving at a constant velocity

1

(f) 24.5 (m/s^2)

1

(g) 5 g = 49 (m/s^2)

1

49 m/s^2 > 24.5 m/s^2

1

so the ride is safe

allow ecf from (f) (ie if their answer to (f) was greater than 49, then the ride is unsafe)

1

(h) force = 58 × 24.5

allow ecf from (f)

1

force = 1421

1

Newtons

allow N

1

[13]

Q4.

(a) the forces of the bike on the trailer and the trailer on the bike are equal in size

allow the force of tension acts on the bike and the trailer

1

and opposite in direction

1

(b) any **two** from:

- the same trailer should be used
- the weather conditions should be the same

allow a description of this, eg the wind should be the same

- the same road (surface) should be used
- the same gradient road should be used
- the same speed should be used
- the cyclist should be at the same level of alertness throughout the experiment

allow a description of a cause of this eg the cyclist should not drink coffee between experiments

2

(c) straight line drawn above the original line, sloping upwards

1

(d) the cyclist's reaction time increased

1

so the thinking distance increased

1

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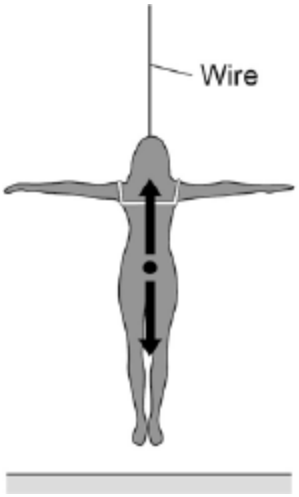
stopping distance is thinking distance plus braking distance

1

[8]

Q5.

(a)



arrow pointing vertically upwards

1

arrow pointing vertically downwards

1

(b) Gravitational force

*if more than **two** boxes ticked apply list principle*

1

Tension force

1

(c) 0 (N)

1

(d) weight = 70 × 9.8 (= 686)

1

weight = 690 (N)

1

*allow 690 (N) with no working shown for **2** marks*
*allow 686 (N) with no working shown for **1** mark*

(e) 34 (N) / 30 (N)

allow ecf from 05.4 correctly calculated

1

(f) resultant force = mass × acceleration

accept F = ma

1

accept equation correctly rearranged for a

(g) 25 = 65 × a

1

a = 25 / 65

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1

$a = 0.38(4615\ldots)\ (m / s^2)$

1

*allow 0.38 (m / s^2) with no working for **3** marks*

[12]

Q6.

(a) the time it took from seeing the green light to pressing a key

1

(b) he could have been distracted

1

(c) boys have a shorter reaction time than girls

or

reaction time improves with practice

1

(d) collect more data / larger sample size

must link to response in 1.3

or

take more repeat readings per person

1

(e) reaction time will have less effect (as distance increases)

1

because it is a smaller proportion of the total race time

1

(f) **Level 3 (5–6 marks):**
A coherent description of the race, which uses data from the graph, including discussion
of the meanings of the changing gradient of both of the lines.

Level 2 (3–4 marks):
Multiple pieces of data taken from the graphs used to evidence a comparison between
the runners. Likely to include discussion of the meaning of the (changing) gradient of one of the lines. Answer not coherently structured.

Level 1 (1–2 marks):
Some data taken from the graph, but may be limited to one aspect or simple readings.
Lack of coherence in answer.

0 marks:
No relevant content.

Indicative content

- A starts at constant speed *for 440 m / 60 s*
- A then slows down *from 60 s*

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- the gradient for B is lower at the start so B starts at a slower speed
- the gradient for B increases so B accelerates
- B overtook A *at 700 m / 114 s*
- B has a greater top speed because the maximum gradient is greater
- B won the race *in 126 s* / beat A *by 34 s*

6

(g) tangent drawn at 60s

1

data obtained using correct information

1

5.5(m / s)

accept answer in range 5.3 to 5.7

1

[15]

Q7.

(a) arrow of equal size pointing vertically downwards

judged by eye

1

labelled 'weight'

1

(b) the upwards force is greater than the downwards force

1

because air resistance increases

1

(c) $v^2 = (2 \times 2 \times 209) + 8^2$

1

$v = \sqrt{900}$

1

v = 30 (m / s)

1

*allow 30 (m / s) without working shown for **3** calculation marks*

(d) vertical force (300 N) drawn with a suitable scale

1

horizontal force (60 N) drawn to the same scale

1

resultant force drawn in correct direction

1

value of resultant in the range 304 N – 308 N

1

[11]

Q8.

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(a) acceleration = change in velocity / time taken

allow $a = \Delta v / t$

1

(b) $= \frac{(3 - 5)}{6}$

1

–0.33 (m / s^2)

1

*allow 0.33 m / s^2 with no working shown for **2** marks*

(c) force = mass × acceleration

allow $F = m\ a$

1

(d) 70 × 0.33

allow ecf from 4.3

1

23.1 (N)

*allow 23.1 with no working shown for **2** marks*

1

(e) before throwing the bag the momentum of the skater and bag is zero

1

when it is thrown the bag has momentum forwards

1

because momentum before = momentum after

1

the skater has equal backwards momentum so will move backwards

1

[10]

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Q1.

(a) Only 21% identified the downwards force of the man on the bar as being equal to the upwards force of the bar on the man. Many believed it to be more than.

(b) Nearly 90% of students were able to substitute the correct numbers into the given equation and calculate the correct value of weight.

(c) 68% took their answer from part **(b)** and multiplied by 0.63 m to obtain the correct answer for work done. Many incorrect answers were given when students used 9.8 N/kg × 0.63 m and a significant minority multiplied the part **(b)** by 0.32 m.

(d) Just over 40% demonstrated they understood that when the man was not moving the work done would be 0 J. Many put in their calculated values from other parts of the question.

(e) 85% gained two marks with most students able to substitute the correct numbers into the equation given.

Q2.

Foundation

(a) 25% of students gained both marks with a further 30% scoring one mark. The most common incorrect responses were where students thought acceleration and the resultant force would increase.

(b) Only 19% scored this mark, with many suggesting that altering the weight/mass on the holder would solve the problem. Others suggested that catching the holder before it hit the ground would be sufficient.

Most correct responses came from raising the table, with fewer suggesting shortening the string.

(c) Over 50% of students scored at least two marks, with a further 19% gaining three or four marks. Most were able to identify the mean calculated at 0.20 N as having too many significant figures and correctly suggesting that this should be rounded to 1 decimal place.

The anomalous reading of 7.2 m/s^2 was less commonly spotted and few stated what to do about it.

(d) 54% of students were able to identify a correct pattern between the variables in order to make a conclusion. Those that failed to score often referred to ‘faster’ or ‘quicker’ acceleration.

(e) 28% scored all 3 marks. The quality of the plotting was generally good, but lines of best fit were often mistakenly given as straight lines giving rise to 53% gaining 2 marks.

Those that struggled to plot points found the second, fourth and fifth points the most difficult. A minority of students used large ‘blobs’ rather than crosses to plot points resulting in these points going out of tolerance.

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Where a curve was drawn these were generally of a creditworthy standard although some did have a ‘feathered’ appearance with multiple lines.

(f) Just under 50% of students gained the mark, but few stated the relationship as being inversely proportional, rather stating that as mass increases acceleration decreases.

Common errors were to refer to “slower” acceleration. There were a number of answers which were insufficient, for example “negative correlation”.

Higher

(a) This was generally well answered with nearly 40% scoring both marks. The most common incorrect responses were that acceleration and the resultant force would increase.

(b) Many students did not realise that it was distance that was important and a significant number spoke of needing to have less weight so that the glider moved more slowly. About 40% scored this mark. Correct responses of raising the table and shortening the string were given fairly equally.

(c) Many students were not clear about how means were calculated and spoke of the mode being used instead at 0.59 N. There was widespread misunderstanding about accuracy with many stating that the more decimal places, the more accurate a result.

There were many references to recurring decimals. Those who scored in this question often did so by the 'decimal point' route rather than the 'significant figure' route.

Nearly 40% scored 2 marks, with a fairly even spread between those who identified one error and corrected it, or for identifying the 2 errors but not adequately describing how they would correct them.

(d) This was well done with over 80% scoring the mark, but common errors were to refer to 'faster' or 'quicker' acceleration. A few made reference to the investigation not being a fair test.

(e) 46% scored all 3 marks. The quality of the plotting was generally good, but lines of best fit were often mistakenly given as straight lines, 50% gaining 2 marks. Where a curve was drawn these were generally of a credit worthy standard.

(f) This was well done, with 73% gaining the mark, but a common error was to refer to “slower” acceleration. There were a number of answers which were insufficient, for example “negative correlation”.

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