AQA GCSE PHYSICS (HIGHER) · 8463

PHYSICS



MARK SCHEME

4.5.1.1 SCALAR AND VECTOR QUANTITIES (PACK 1)

SCORE	PERCENTAGE
/66	%

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Q1.

(a) distance

1

(b) BC

1

(c) DE

1

(d) 5.0 (s)

allow 5 (s)

1

(e) 6.0 (m/s)

allow 6 (m/s)

1

(f) 6.0 / 5.0

*allow ecf from parts **(d)** and **(e)***

1

= 1.2 (m/s^2)

1

*an answer of 1.2 scores **2** marks*

(g) about four times faster

1

[8]

Q2.

(a) 20 (degrees)

allow answers in the range 19−21 (degrees)

1

(b) vector

1

scalar

1

in this order only

(c) weight

allow gravity
*do **not** accept gravitational potential energy*

or

(normal) contact (force)

allow (normal) reaction (force)
allow air resistance
allow drag

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1

(d) the resultant force on the block is zero

1

(e) any **two** from:

*do **not** accept force*

- the (same) block

  allow named feature of block e.g. mass / weight

- speed (at which block is pulled)
- angle (of string)

2

(f) $\left(\frac{5.2 + 5.6 + 5.4}{3} = \right) 5.4 \text{ N}$

1

(g) glass

*allow ecf from part **(f)** if glass not given*

1

[9]

Q3.

(a) scalars have magnitude only

allow size for magnitude

1

vectors have magnitude and direction

1

(b) any **three** from:

- arrow pointing vertically downwards originating in the block, labelled weight

  allow gravity

- arrow pointing left along the surface labelled friction; part of the arrow must be between the block and the carpet
- arrow pointing to the left touching block labelled air resistance or drag
- arrow pointing vertically upwards from bottom surface of block, labelled (normal) contact force

  allow reaction (force) for contact (force)

  judge horizontal and vertical by eye

  allow 1 mark for three correctly labelled arrows, in correct directions but in incorrect positions

3

(c) clear attempt to draw horizontal **and** vertical components

horizontal line should extend beyond dashed line on diagram

1

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horizontal component: 2.6 (N)

allow a range from 2.5 to 2.7

1

vertical component: 1.7 (N)

allow a range from 1.6 to 1.8

1

*if 2nd and 3rd marking points not awarded, allow **1** mark for clear measurements of **both** 5.2 ± 0.2 cm and 3.4 ± 0.2 cm*

(d) $\frac{5.2 + X + 5.3}{3} = 5.4$

1

(X =) 5.7 (N)

1

*allow 5.6 (N) or 5.8 (N) for **2** marks*

*an answer of 5.7 (N) scores **2** marks*

(e) any **three** from:

- angle (of string)
- speed (at which block is pulled)

allow velocity (at which block is pulled)

- area of block in contact with surface
- mass / weight of block

ignore same block

3

[13]

Q4.

(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

(e) it is moving at a constant velocity

1

(f) 24.5 (m/s^2)

1

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

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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]

Q5.

(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

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[11]

Q6.

(a) weight = mass × gravitational field strength

1

(b) mass = weight ÷ g

1

= 1.4 ÷ 9.8

1

= 0.143 (kg)

*allow 0.143 with no working shown for **3** marks*

1

(c) momentum = mass × velocity

momentum before = momentum after

1

143 × 7.9 = 150 × v

1

$v = \frac{143 \times 7.9}{150}$

1

= 7.5 (m / s)

*allow 7.5 (m / s) with no working shown for **4** marks*

1

*incorrect number of sig. figs max. **3** marks*

(d) ball is falling / moving down

1

at terminal velocity

1

air resistance and weight have the same magnitude / size

1

so no acceleration / constant speed

1

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Q1.

(a) Nearly 34% scored this mark. The most common incorrect response was velocity.

(b) Almost 74% of students were able to identify the part of the graph that showed the woman moving at a constant velocity.

(c) 68% of students selected the correct response for the part of the graph where the woman was stationary. The most common incorrect response was BC.

(d) The most common response was to misread the scale with incorrect values of 2.5 or 4 often given. Nearly 45% gave the correct answer. A significant minority tried to use various equations of motion, producing incorrect answers.

(e) This required a more straightforward graph reading and almost 72% gave the correct answer.

(f) 66% gained two marks, with students either using the correct values read from the graph or correctly calculating using their previously incorrect values. A small number multiplied instead of dividing, despite the equation being shown.

(g) Almost 53% correctly stated that typical cycling speed would be about four times faster than the typical walking speed. The most common wrong answer was about twice as fast.

Q2.

(a) Around two thirds of students were able to measure the angle (20°) correctly.

A large proportion of the incorrect answers were either 70° (90 − 20) or 160° (180 − 20), indicating that students were measuring the correct angle but were not too familiar with reading a protractor. Around 3% of students did not attempt this question.

(b) Less than one third of students achieved both marks for this question. A fair number realised that vector and scalar went together but got the words in the wrong order.

All of the given words were used in a variety of combinations.

(c) Around 12% of students did not attempt this question. Of those who did, the most popular correct answers given were gravity and weight.

Incorrect answers included quantities which were not forces but were linked to the investigation in some way, such as kinetic energy, movement and mass. Also seen were words which appeared to be totally unrelated to the situation, such as electricity, light and fractional distillation.

(d) Twice as many students selected the incorrect response of ‘force is directly proportional to velocity’ than chose the correct response of ‘the resultant force on the block is zero’. The other two incorrect options had about the same number of responses as the correct one.

(e) Students who understood the term ‘control variable’ were usually able to give at least one correct answer. Around 9% of students gained both marks, with a further

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40% scoring one mark.

A large number of students thought that the nature of the surface and the force would be control variables, showing some confusion with independent and dependent variables. A small number of students gave random answers such as ‘oxygen’ and ‘valid’.

(f) Around 70% of students gained the mark for the correct calculation of the mean. The most frequent incorrect response was 16.2 N, the sum of the three numbers.

(g) Around 85% of students were able to identify glass as the surface with the lowest frictional force. The most common incorrect answer was ‘cardboard’. Nearly 10% did not answer this question.

Q3.

(a) Around one quarter knew the correct definitions of vector and scalar quantities, thereby scoring two marks.

Some students knew that vectors had both magnitude and direction, and realised that scalars don’t, but opted for them having direction rather than magnitude.

A number of students defined a scalar as speed and a vector as velocity, rather than these being examples of the different types of quantity.

(b) Fewer than 2% of students scored two or three marks, with a further 15% picking up one mark.

Many did not appear to be familiar with representing forces on diagrams, so did not realise that they were expected to draw labelled arrows to show the forces. A large number did not know what forces were acting in this situation, many indicating different types of energy, motion, speed or momentum.

Of those who were aware of forces, the most common ones shown were weight / gravity, air resistance and friction. Many did not realise that friction and air resistance act in the opposite direction to motion. In addition, a few seemed to think that gravity acts upwards or horizontally.

The main error amongst those who knew the forces and their directions, was to show them acting in random positions around the block rather than on the block itself; in such cases one mark was awarded.

(c) It appeared that many students did not know what components of a force are.

Of those who made some attempt, very few showed the components on the diagram. Some lines on the diagram were measured, usually the dotted horizontal line and the line representing the tension force, and the forces were calculated using the scaling factor.

Around 9 % gained all three marks.

(d) More than three quarters of students were able to calculate the missing value correctly, thereby gaining the two marks for this question. The method used by some students was to multiply the mean force by 3, then subtract the other two values from this figure. An alternative method, done by many more students, was a trial-and-error approach, substituting various values in turn as the missing ‘X’ and working out the mean, until they found a value of 5.4 N.

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Some students who did not know how to do this calculation ended up with very odd values, indicating that they either did not understand the concept of a mean value or they had not thought about whether their answer was sensible.

(e) Approximately 45 %of students achieved 1 mark, with a further 13 % gaining 2 marks, but very few gained all three marks. The most common answer was the weight of the block, with few students opting for the angle between the block and the string.

When asked for control variables, answers which include the same equipment or the same person doing the experiment are unlikely to gain credit. A large number of students included the independent variable, i.e. the type of surface, and / or the dependent variable, i.e. the force, as control variables.

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