MARK SCHEME

GCSE

PHYSICS

AQA - COMBINED SCIENCE

P5 - TEST 4

FORCES

Intermediate

1.

(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

stopping distance is thinking distance plus braking distance

1

[8]

2.

(a) **A** constant speed / velocity

accept steady pace

*do **not** accept terminal velocity*

*do **not** accept stationary*

1

B acceleration

accept speeding up

1

C deceleration

accept slowing down

accept accelerating backwards

accept accelerating in reverse

*do **not** accept decelerating backwards*

1

(b) (i) the distance the car travels under the braking force

accept braking distance

1

(ii) speed/velocity/momentum

1

(c) (i) 5000 (N) to the left

***both** required*

accept 5000(N) with the direction indicated by an arrow drawn pointing to the left

accept 5000(N) in the opposite direction to the force of the car (on the barrier)

accept 5000(N) towards the car

1

(ii) to measure/detect forces exerted (on dummy / driver during the collision)

1

(iii) 4

*allow **1** mark for showing a triangle drawn on the straight part of the graph*

***or** correct use of two pairs of coordinates*

2

m/s^2

*do **not** accept mps^2*

1

[10]

3. (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]

4. (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

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]

5. (a) any **two** from:

- length of coils increased
- increased gap between coils
- spring has become longer
- spring has become thinner

2

(b) **B** and **C**

either order

1

(c) weight = mass × gravitational field strength

allow W = m g

1

(d) 5.5 (N)

allow any value in the range 5.0 to 5.8 (N)

1

up to that point force and extension are (directly) proportional

allow the line starts to curve

1

(e) use smaller intervals (for applied force)

allow any value for interval between 0.1 N and 0.2 N

1

between a total applied force of 5 to 6 Newtons

1

(f) force = spring constant × extension

1

(g) 0.064 m

1

18 × 0.064

1

= 1.152 (N)

*an answer of 1.152 (N) scores **3** marks*

allow 115.2 (N)

1

[12]

6. (a) 3.3×10^2 m / s

1

(b) **Level 2 (3–4 marks):**
A detailed and coherent explanation of the shape of the graph and what it says about the motion of the car between each point is given. Values from the graph are clearly referred in a logical and consistent way.

Level 1 (1–2 marks):
An attempt at an explanation of the motion of the car is given, which may be incomplete or not in a logical sequence. Values from the graph may not be referred to or referred to incorrectly.

0 marks:
No relevant content.

Indicative content

- between **A** and **B** car is moving from origin
- the gradient of the line shows it's moving at a constant speed
- speed between these points is 250 / 20 = 12.5 m / s
- between **B** and **C** car is stationary / not moving
- because between these points the graph is flat
- showing that the car's speed is 0 m / s
- between **C** and **D** car is moving further from origin
- at a constant speed
- speed is 250 / 20 = 12.5 m / s
- movement between these points is the same as at **A–B**
- because the gradient is the same
- between **D** and **E** moves towards origin
- at a constant speed
- speed is 500 / 30 = 16.7 m / s
- gradient between **D** and **E** shows that car moves faster **or** at a greater speed than between any other points

4

(c) kinetic energy = 0.5 × mass × (speed)^2

allow $E_k = ½ mv^2$

1

(d) ½ × 1 650 × 30^2

1

= 742.5 (kJ)

answer must be in kJ for mark

1

*allow 742.5 with no working shown for **2** marks*

(e) **Level 3 (5–6 marks):**
A detailed and coherent explanation is given of why the man may not be able to stop in time, clearly and logically linking factors that could affect the braking in the situation given

Level 2 (3–4 marks):
An explanation is given, with an attempt at linking factors affecting braking distance to the situation given. Links made between factors and explanation may not be complete and the logic may be unclear.

Level 1 (1–2 marks):
Simple relevant statements made about factors affecting braking, but no attempt to link to explanations of how they are relevant in the situation given

0 marks:
No relevant content.

Indicative content

- overall stopping distance related to thinking distance and braking distance
- factors affecting thinking distance:
  - driver could be distracted
  - driver could be tired
  - driver could be on medication that affects thinking (eg make drowsy)
  - driver could have drunk alcohol
  - mean that reaction time will be longer so will not brake as quickly
- factors that affect braking distance:
  - condition of car (eg worn brakes means can't stop as quickly, wear on tyres reduces friction with road)
  - speed car is travelling (faster means more kinetic energy)
  - condition of the road (eg the road is wet so friction between tyres and road reduced)

6

[14]