MARK SCHEME

GCSE

PHYSICS

AQA - COMBINED SCIENCE

P5 - TEST 5

FORCES

Advanced

Mark schemes

1.

(a) D

allow 20 (N)
allow fourth (newtonmeter)

1

needs the greatest force to extend the spring the same amount

reason only scores if correct newtonmeter selected

1

(b) zero (error)

allow systematic (error)

1

any **one** from:

- record the value and subtract from readings taken

  allow subtract 1 from all readings)

- adjust the newtonmeter to zero

1

(c) $4.5 \times 10^{-2} = 0.5 \times 400 \times e^2$

this mark may be awarded if the standard form value is incorrectly converted

1

$$e = \sqrt{\frac{4.5 \times 10^{-2}}{0.5 \times 400}}$$

this mark may be awarded if the standard form value is incorrectly converted

allow $e^2 = \frac{4.5 \times 10^{-2}}{0.5 \times 400}$

1

e = 0.015 (m)

this answer only

1

2.0 = 400 × e

1

e = 0.005 (m)

this answer only

1

0.015 + 0.005 = 0.02 (m)

allow their initial extension + their additional extension correctly calculated

1

or

$4.5 \times 10^{-2} = 0.5 \times 400 \times e^2$ (1)

this mark may be awarded if the standard form value is incorrectly converted

$e = \sqrt{\frac{4.5 \times 10^{-2}}{0.5 \times 400}}$ (1)

this mark may be awarded if the standard form value is incorrectly converted

allow $e^2 = \frac{4.5 \times 10^{-2}}{0.5 \times 400}$

e = 0.015 (m) (1)

this answer only

F = 400 × 0.015

F = 6 (N) (1)

allow an answer of 400 × their calculated value of e

total force = 6 + 2

8 = 400 × e (1)

allow an answer that is consistent with their calculated value of e

e = 0.02 (m) (1)

*an answer of 0.02 (m) gains **6** marks*

[10]

2. (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]

3. (a) 600 kg = 5880 N **1**

power = $\frac{5880 \times 35}{45}$ **1**

= 4573.3 (W)

*this step without the previous steps stated gains **3** marks* **1**

% Eff. = $\frac{4573.3}{8000} \times 100$ **1**

= 57.17 (%)

*allow 57.17 with no working shown for **5** marks* **1**

(b) gpe = 600 × 9.8 × 35 **1**

= 205 800 **1**

gpe = KE = ½ m v^2 **1**

$v = \sqrt{\frac{2 \times kE}{m}}$ **1**

$= \sqrt{\frac{411\,600}{600}}$ **1**

= 26.2 (m / s)

*allow 26.2 with no working shown for **6** marks* **1**

[11]

4. (a) inertia

1

(b) 17 cm/s = 0.17m/s

1

$P = mv = 0.14 \times 0.17$

1

= 0.024 (kg m/s)

*an answer of 0.024 (kg m/s) scores **3** marks*

1

(c) the total momentum before the collision is zero

1

and momentum is conserved

1

so the total momentum after the collision is zero

1

so the speed after the collision is zero

1

(d) more than one car may pass through a beam at a time

allow a description of this eg cars overtaking, cars passing in opposite directions etc

1

(so) the light gate could not accurately measure the time for one car to pass

1

the length of each car would be unknown

allow cars come in different lengths.

1

(so) speed could not be calculated without the length

ignore references to the data logger

1

[12]

5. (a) mass

1

velocity

1

(b) kg m / s

1

(c) momentum before = momentum after

1

and before diving in the momentum of the diver and (small) boat is zero

1

after diving the diver has forwards momentum / momentum to the right

1

therefore the (small) boat has equal backwards momentum / equal momentum to the left

1

(d) the boat moves back more slowly

1

because there is more mass (but momentum stays the same)

1

(e) as she swims there is a drag force

1

as speed increases so does the drag force

1

she accelerates less

1

drag force = thrust force

accept resultant force = 0

1

the swimmer reaches terminal velocity

1

[14]

6. (a) air resistance

allow drag
ignore wind resistance

1

(b) B−C

1

(c) (velocity =) 12.2 (m/s)

1

(momentum =) 94.8 × 12.2

1

(momentum =) 1160 (kg m/s)

allow an answer that rounds to 1160 (kg m/s)
*an answer of 1147 / 1150 scores **2** marks*

1

*an answer of 1160 (kg m/s) scores **3** marks*

(d) tangent drawn at 12 s

1

correct readings of Δv and Δt from tangent

1

$$(\text{acceleration}) = \frac{\text{their value of } \Delta v}{\text{their value of } \Delta t}$$

1

−2.4 (m/s^2)

allow value in range −2.2 to −2.6 (m/s^2)

allow a correctly calculated answer from $-\frac{\textit{their value of } \Delta v}{\textit{their value of } \Delta t}$

1

m/s^2

allow m/s/s

1

(e) straight line (with gradient of 1.6) from origin to 6 s, 9.6 m/s

*allow **1** mark for a straight line below A−B with a positive gradient from origin to 6 s*

2

(f) (calculation of distance travelled by first athlete)

(2.2 × 12.2) = 26.84 (m)

1

(0.5 × 3.8 × 12.2) = 23.18 (m)

1

*an answer of 50.02 (m) scores **2** marks*

(calculation of distance travelled by second athlete)

(0.5 × 9.6 × 6 =) 28.8 (m)

*allow ecf from part **(e)***

allow (9.6^2 − 0 = 2 × 1.6 × s =) 28.8 (m)

1

(calculate difference) = 21.22 (m)

allow their distance for athlete 1 minus their distance for athlete 2

1

*an answer of 21.22 (m) scores **4** marks*

[16]