Mark schemes

Q1.

(a) stretched length – original length
1

(b) $E_e = 0.5 \times 800 \times 7.5^2$
1

$E_e = 22\ 500$ (J)
1

(c) kinetic energy = $0.5 \times 240 \times 15^2$
1

kinetic energy = 27 000 (J)
1

(d) $E_p = m \times g \times h$
1

(e) $24\ 000 = 240 \times 9.8 \times h$
1

$$h = \frac{24\ 000}{(240 \times 9.8)}$$
1

$h = 10.2$ (m)

allow 10 (m)

allow a correct answer given to more than 3 s.f.
1

(f) energy is transferred to the surroundings
1

work is done against air resistance
1

[11]

Q2.

(a) the mean speed of the particles increases

1

(b) $0.0130 = 2.60 \times 10^{-8} \times 1010 \times \Delta\theta$

1

$$\Delta\theta = \frac{0.0130}{(2.60 \times 10^{-8} \times 1010)}$$

1

$\Delta\theta = 495$ (°C)

allow a correct answer given to more than 3 s.f.

1

[4]

Q3.

(a) thermal / internal (energy)
or
kinetic (energy of the water particles)

ignore heat
allow E_k

1

(b) gravitational potential (energy)

allow E_p / GPE
allow kinetic / E_k

1

(c) **Level 2:** Scientifically relevant features are identified; the way(s) in which they are similar / different is made clear and (where appropriate) the magnitude of the similarity / difference is noted.

3−4

Level 1: Relevant features are identified and differences noted.

1−2

No relevant content

0

Indicative content

Method A:

- heated water needs insulating (to maintain high temperature)
- energy stored by heating water is much greater (per 100 kg)
- useful energy from heating 100 kg of water = 20 160 (kJ)
- energy wasted (per 100 kg) = 13 440 (kJ)
- efficiency = 60 %

Method B:

- suitable location needed to pump water uphill
- pumping water efficiency is higher
- useful energy from pumping 100 kg of water = 367.5 (kJ)
- energy wasted (per 100kg) = 122.5 (kJ)
- efficiency = 75 %

A level 2 answer should use the data in a relevant calculation that compares the two methods.

[6]

Q4.

(a) other energy resources = 95 (%)

1

hydroelectric = 5 (%)

1

(b) E_p = 2 500 000 × 9.8 × 15

1

E_p = 367 500 000 (J)
or
E_p = 3.675 × 10^8 (J)

allow 370 000 000 (J)
or
E_p = 3.7 × 10^8 (J)

1

(c) energy = power × time
or
$E = P \times t$

1

(d) t = 3600 (s)

1

E = 3000 × 3600

allow a correct substitution using an incorrectly/not converted value for t

1

E = 10 800 000 (J)
or
E = 1.08 × 10^7 (J)

allow an answer consistent with their incorrectly/not converted value for t

allow a correct answer given to 2 s.f.

1

(e) the level of the water in the river varies
or
the amount of rainfall varies

1

and is lower in the summer months

allow specified months or range of months eg April to September

1

MP2 dependent on scoring MP1

[10]

Q5.

(a)

Energy store	Less than at A	The same as at A	More than at A
The student's gravitational potential energy	✓		
The student's kinetic energy			✓
The bungee cord's elastic potential energy			✓

additional tick in a row negates the mark for that row

3

(b) $E_e = 0.5 \times 78.4 \times 25^2$

1

$E_e = 24\,500$ (J)

1

(c) greatest spring constant

allow needs largest force (per metre) to stretch the cord

1

(d) A

1

greatest extension before snapping

MP2 dependent on scoring MP1

1

[8]

Q6.

(a) so the thermometer temperature was the same as the temperature of the iron block

1

(b) $\Delta\theta = (54 - 28) = 26$ (°C)

1

$26\,000 = 2.0 \times c \times 26$

allow a correct substitution using an incorrect value of Δθ obtained from the graph

1

$$c = \frac{26\,000}{2.0 \times 26}$$

allow a correct rearrangement using an *incorrect value of Δθ obtained from the graph*

1

c = 500 (J/kg °C)

allow an answer consistent with their value of Δθ obtained from the graph

1

(c) the calculated specific heat capacity will be more accurate

1

the iron block will transfer thermal energy to the surroundings at a lower rate

1

[7]

Q7.

(a) gravitational potential

1

kinetic

1

this order only

(b) $E_e = 0.5 \times 120\,000 \times 0.015^2$

1

E_e = 13.5 (J)

1

(c) E = 540 (J)

*allow their answer from part **(b)** × 40*

1

(d) $E_k = 0.45 \times 600$

1

E_k = 270 (J)

1

(e) energy is transferred to the surroundings

1

[8]

Q8.

(a) tape measure
or
metre rule

allow ruler
ignore metre stick

1

(b) $E_p = 50 \times 9.8 \times 1.7$

1

$E_p = 833$ (J)

1

(c) $P = \frac{1800}{1.44}$

1

$P = 1250$ (W)

1

(d) stop-clock C

1

(e) $E_k = 0.5 \times 70 \times 2.0^2$

1

$E_k = 140$ (J)

1

[8]

Q9.

(a) 0.1 °C

1

(b) a bigger

1

(c) identifies 75 (°C) **and** 62.5 (°C)

1

$\Delta\theta$ = 12.5 (°C)

allow a correct calculation of temperature change from misread values

1

E = 0.12 × 4200 × 12.5

allow a correct substitution using an incorrect temperature change

1

E = 6300 (J)

allow an answer consistent with an incorrect temperature change

1

(d) point at 7 minutes for material **X** ringed

1

(e) any **two** from:

- water wrapped in material X cooled more slowly

  allow water wrapped in material X transfers less energy to the surroundings (in 10 minutes)

  allow water wrapped in material X has a higher final temperature

- material X is a better insulator

  or

- the thermal conductivity of material X is lower

  allow material X is a worse (thermal) conductor

- the rate of cooling decreased with time (for both X and Y)

  allow temperature decreased with time (for both X and Y)

  allow converse answers for material Y

2

(f) the rate of cooling would be lower

1

(g) the temperature would be higher

1

[11]