Mark schemes

Q1.

(a) elastic potential (energy)

allow E_e / EPE

1

(b) $E_e = 0.5 \times 735 \times 8.0^2$

allow a correct substitution using
k = 1470 (N/m) and e = 8 (m)
or
k = 1470 (N/m) and e = 16 (m)
or
k = 735 (N/m) and e = 16 (m)

1

E_e = 23 520 (J)

this answer only

1

total E_e = 47 040 (J)

this answer only

1

47 040 = 240 × 9.8 × *h*

allow a correct substitution of their calculated value of E_e (using $E_e = 0.5ke^2$)

1

$$h = \frac{47\,040}{(240 \times 9.8)}$$

allow a correct rearrangement using their calculated value of E_e (using $E_e = 0.5ke^2$)

1

h = 20 (m)

allow an answer consistent with their value of E_e (using $E_e = 0.5ke^2$)

1

(c) air resistance (opposes the motion of the pod upwards)

1

(so) not all of the elastic potential energy will be transferred to gravitational potential energy

allow the energy transfer is not 100% efficient
allow some energy is transferred to the surroundings
allow some energy is dissipated
ignore energy is wasted
ignore reference to mass of person in pod

1

[9]

Q2.

(a) the mean kinetic energy of the particles increases

1

(b) c = 1010 (J/kg °C)

allow full credit for a correct method using E = 0.0000130 (kJ)

1

$0.0130 = 2.60\times10^{-8} \times 1010 \times \Delta\theta$

allow a correct substitution of an incorrectly / not converted value of c

1

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

allow a correct rearrangement of an incorrectly / not converted value of c

1

$\Delta\theta$ = 495 (°C)

allow an answer consistent with an incorrectly / not converted value of c

allow a correct answer given to more than 3 sig figs

1

[5]

Q3.

(a) E_p = 367 500 000 (J)

1

367 500 000 = 2 500 000 × 9.8 × h

allow a correct substitution using an incorrectly/not converted value of E_p

1

$$h = \frac{367\,500\,000}{2\,500\,000 \times 9.8}$$

allow a correct rearrangement using an incorrectly/not converted value of E_p

1

h = 15 (m)

allow an answer consistent with their value of E_p

1

(b) 3 kW = 3000 W

1

$$3000 = \frac{2.16 \times 10^7}{t}$$

all subsequent marks can score using an incorrectly / not converted value of P

1

$$t = \frac{2.16 \times 10^7}{3000}$$

1

t = 7200 (s)

1

$t = 7.2 \times 10^3$ (s)

allow an answer given in standard form from a calculation using data given in the question

1

(c) in the summer the power output from the hydroelectric generator is lower but the solar power output would be greater

*allow power output of hydroelectric generator depends on rainfall **and** power output of solar power system depends on light intensity*

1

so less variation in total power output (which improves the reliability of the supply)

allow electricity supply for total power output

1

allow reference to specific months eg April to September

[11]

Q4.

(a) spring may become permanently extended

ignore reference to limit of proportionality

allow the harness / spring / chain may break

or

extension of the spring may be too great (so the baby's feet are always on the floor)

ignore baby may be injured / harmed / may hit doorframe

1

(b) (in position **A**) the baby has gravitational potential energy

allow E_p for gravitational potential energy

1

(as the baby moves down this) is transferred to kinetic energy

allow E_k for kinetic energy

(of the baby) and / then elastic potential energy (of the spring)

allow E_e for elastic potential energy

1

(in position **B**) all the energy is elastic potential energy

ignore energy dissipated to the surroundings

1

(c) $e = 0.080$ (m)

1

$4.0 = ½ \times k \times 0.080^2$

allow a correct substitution using an incorrectly / not converted value of e

1

$$k = \frac{4.0}{(0.5 \times 0.080^2)}$$

allow a correct rearrangement using an incorrectly / not converted value of e

1

$k = 1250$ (N/m)

allow an answer consistent with their value of e

1

[8]

Q5.

(a) independent variable: (type of) insulation / material

do not accept thickness of material

1

dependent variable: time

1

(b) 0.1 (ºC)

1

(c) viewing angle affects measurement

or

parallax error

allow judgement needed in reading the position (of the liquid in the thermometer)

allow the level of the liquid may be between lines

allow number of lines may be miscounted

ignore harder to read

ignore lines are close together

ignore human error

1

(d) E = 10 500(J)

1

$$m = \frac{10\,500}{4200 \times (85\text{-}65)}$$

*allow a correct substitution **and** rearrangement using an incorrectly / not converted value of E*

1

m = 0.125 (kg)

allow a correct calculation using an incorrectly / not converted value of E

1

(e) (same) temperature decrease in a shorter time means a higher thermal conductivity

allow converse answer

1

(because) the rate of energy transfer is higher

1

[9]

Q6.

(a) h = 1.75 (m)

1

E_p = 60 × 9.8 × 1.75

allow a correct substitution using an incorrectly / not converted value of h

1

E_p = 1029 (J)

allow a correct calculation using an incorrectly / not converted value of h

1

$$P = \frac{1029}{1.40}$$

allow a correct substitution using their calculated value of E_p

1

P = 735 (W)

allow an answer consistent with their value for E_p

1

(b) girl increases her kinetic energy (as well as increasing her gravitational potential energy)

1

some energy is wasted in her muscles
or
some energy transferred as thermal energy (to surroundings)

allow some energy transferred due to air resistance

ignore unqualified references to friction

ignore references to sound

1

(c) the boy's mass was greater than the girl's mass

1

[8]

Q7.

(a) $E_e = 0.5 \times 50 \times 0.12^2$

1

$E_e = 0.36$ (J)

1

$0.36 = 0.5 \times 0.020 \times v^2$

allow a correct substitution of their calculated value of E_e

1

$$v^2 = \frac{0.36}{0.5 \times 0.020}$$

allow a correct rearrangement of their calculated value of E_e

or

$v^2 = 36$

1

speed = 6.0

allow an answer consistent with their calculated value of E_e

1

m/s

or

metres/second

1

Alternative approach:
(F = ke)
(F = 50 × 0.12)
(maximum) F = 6.0 (N) (1)

(F = ma)
(6.0 = 0.020 × a)
(maximum) a = 300 (m/s²) (1)
mean a = 150 (m/s²) (1)
($v^2 - u^2 = 2as$)
$v^2 = 2 \times 150 \times 0.12$ (1)
or
$v^2 = 36$
v = 6.0 (1)
m/s (1)
or
metres/second

(b) kinetic

1

(c) increasing the extension of the spring
or
more elastic potential energy
or
increase the angle of release (to the horizontal by a small amount)

allow other factors that would increase the horizontal distance travelled eg a tail-wind

ignore factors without a change specified e.g. extension unqualified would not score

ignore changing the spring or changes to the toy aeroplane

1

[8]