

Mark schemes

1

(a) any **two** from:

- bungee rope may snap
- rope may extend too much
- student may land in the river

2

(b) gravitational potential

correct order only

1

kinetic

1

elastic potential

1

(c) $\frac{1}{2} \times 40 \times 35^2$

1

24 500 (J)

accept 25 000 (J) (2 significant figures)

1

allow 24 500 (J) with no working shown for 2 marks

[7]

2

(a) 0.1 (°C)

1

(b) power = energy transferred / time

allow $P = E / t$

1

allow $E = P \times t$

(c) 1050 / 300

1

3.5 (W)

1

accept 3.5 (W) with no working shown for 2 marks

(d) $1050 = m \times 4200 \times 0.6$

1

$m = 1050 / (4200 \times 0.6)$

1

$m = 0.417$ (kg)

1

accept 0.417 (kg) with no working shown for 3 marks

(e) any **one** from:

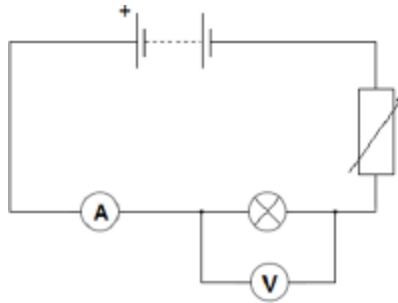
- energy used to heat metal pan (as well as the water)
- energy transfer to the surroundings (through the insulation)
- angle of solar radiation will have changed during investigation
- intensity of solar radiation may have varied during investigation

1

[8]

3

(a)



battery in series with bulb and ammeter

1

voltmeter in parallel with bulb

1

variable resistor

or

variable power pack

or

potentiometer

1

(b) A is brighter because it has a higher current (than lamp B at any p.d.)

1

(therefore A has a) higher power output (than bulb B)

accept higher energy output per second

1

(c) lower current (than lamp A) for the same potential difference

accept answer in terms of $R = V / I$

1

lower gradient (than lamp A)

1

(d) 0 – 2 Volts

allow a range from 0 V up to any value between 1 and 2 V.

1

(for an ohmic conductor) current is directly proportional to potential difference
allow lines (of best fit) are straight and pass through the origin

1

(so) resistance is constant

1

[10]

4

- (a) g.p.e. = mass \times gravitational field strength \times height
accept $E_p = mgh$

1

- (b) $E_p = 50 \times 9.8 \times 20$

1

9800 (J)

allow 9800 (J) with no working shown for 2 marks
answer may also be correctly calculated using $W = Fs$
ie allow $W = 490 \times 20$ for 1 mark
or answer of 9800 (J) using this method for 2 marks

1

- (c) 7840 (J)

allow ecf from '11.2'

1

- (d) $7840 = \frac{1}{2} \times 50 \times v^2$

1

$$v = \sqrt{\frac{7840}{1/2 \times 50}}$$

allow $v^2 = \frac{7840}{(1/2 \times 50)}$ for this point

1

17.7(0875) (m / s)

1

18 (m / s)

allow ecf from '11.3' correctly calculated for 3 marks
allow 18 (m / s) with no working for 2 marks
answer may also be correctly calculated using $v^2 - u^2 = 2as$

1

- (e) extension = 35 (m) and conversion of 24.5 kJ to 24500 J

1

$$24\,500 = \frac{1}{2} \times k \times 35^2$$

1

40

1

allow 40 with no working shown for 3 marks
an answer of '16.2' gains 2 marks

[11]

5

(a) It will have a constant speed.

1

(b) distance travelled = speed \times time

1

(c) $a = \frac{18 - 9}{6}$

6

1

$a = 1.5$

allow 1.5 with no working shown for 2 marks

1

(d) resultant force = mass \times acceleration

1

(e) $F = (1120 + 80) \times 1.5$

1

$F = 1800 \text{ (N)}$

allow 1800 with no working shown for 2 marks

1

accept their 10.3×1200 correctly calculated for 2 marks

(f) $18^2 - 9^2 = 2 \times 1.5 \times s$

1

$s = \frac{18^2 - 9^2}{2 \times 1.5}$

1

$s = 81 \text{ (m)}$

1

allow 81 (m) with no working shown for 3 marks

accept answer using their 10.3 (if not 1.5) correctly calculated for 3 marks

(g) **Level 2 (3–4 marks):**

A detailed and coherent explanation is provided. The response makes logical links between clearly identified, relevant points that include references to the numerical factor.

Level 1 (1–2 marks):

Simple statements are made. The response may fail to make logical links between the points raised.

0 marks:

No relevant content.

Indicative content

- doubling speed increase the kinetic energy
- kinetic energy increases by a factor of 4
- work done (by brakes) to stop the car increases
- work done increases by a factor of 4
- work done is force \times distance and braking force is constant
- so if work done increases by 4 then the braking distance must increase by 4

4

[14]

6

(a) 46 200

accept 46 000

allow 1 mark for correct substitution

ie $0.5 \times 4200 \times 22$ provided no subsequent step

2

(b) Energy is used to heat the kettle.

1

[3]

7

(a) it would decrease the time

1

(b) 720 (J)

allow 1 mark for correct substitution ie 12×60 provided no subsequent step

2

(c) decreases

1

decreases

1

decreases

1

more than one tick in any row negates the mark

[6]

8

(a) 78 (°C)

*allow 2 marks for correct temperature change ie 22 °C**allow 1 mark for correct substitution**ie $46\,200 = 0.5 \times 4200 \times \theta$* **or**

$$\frac{46200}{0.5 \times 4200} = \theta$$

3

(b) 6.4 (W)

*allow 2 marks for an answer that rounds to 6.4**allow 1 mark for correct substitution**ie $46\,200 = P \times 7200$* *an answer of 23 000 or 23 100 or 385 gains 1 mark*

2

[5]**9**

(a) gravity

*accept weight for gravity**air resistance is insufficient*

1

(b) (i) 800

allow 1 mark for correct substitution ie

$$P = \frac{2240}{2.8}$$

provided no subsequent step

2

(ii) 2240 J

1

(c) (i) (vertical) height

accept (height of) stairs

1

(ii) a fast / short time (for a lighter student) may give the greatest power

*accept time is a factor***or**

a slow / long time (for a heavy student) may give the least power

fitness is insufficient

1

[6]**10**

(a) elastic potential

1

(b) (i) line is straight

accept line does not curve

1

(ii) 400

allow 1 mark for correct substitution of any pair of numbers correctly taken from the graph e.g. $160 = k \times 0.40$

2

newtons per metre **or** N/m

if symbols are used they must be correct

1

(iii) 300

allow 1 mark for correctly obtaining force on 1 spring = 100N

2

(c) 52

allow 2 marks for calculating change in gpe for 1 chin-up as 260 (J) or for 12 chin-ups as 3120 (J)

an answer 4.3 gains 2 marks

allow 1 mark for correct substitution into gpe equation ie $gpe = 65 \times 10 \times 0.4 (\times 12)$

or

correct use of power equation with an incorrect value for energy transferred

3

[10]

11

(a) resultant force = zero

or

upward force = downward force

accept forces are balanced

accept weight for downward force

1

(b) (i) 84

allow 1 mark for correct substitution ie $840 = m \times 10$

2

(ii) 12

accept 12.02 for both marks

or

1010 \div their (b)(i) correctly calculated

a resultant force of 1010 (N) gains 1 mark

an answer 22(.02) gains 1 mark

2

m/s²

accept m/s/s

1

[6]

12	(a) energy required to raise the temperature of a substance by 1 °C <i>accept heat for energy</i>	1
	unit mass / 1 kg	1
	(b) (i) 7 140 000 (J) <i>allow 2 marks for a correct substitution, ie</i> $E = 20 \times 420 \times 850$ <i>provided no subsequent step</i> <i>850 gains 1 mark if no other mark awarded</i>	3
	(ii) particles in the air have more (kinetic) energy than the particles in the steel <i>allow particles in the air have a greater speed.</i>	1
	steel particles vibrate (about fixed positions)	1
	air particles move freely	1
	(ii) the most energetic particles <i>accept molecules for particles throughout</i> <i>accept the fastest particles</i>	1
	have enough energy to escape from (the surface of) the water	1
	therefore the mean energy of the remaining particles decreases <i>accept speed for energy</i>	1
	as energy decreased, temperature has decreased	1
		[12]
13	(a) any two from: <ul style="list-style-type: none"> • wood falls off ropes • child falls off • wood hits child standing at side. <i>accept any reasonable suggestion</i>	2

(b) (i) 7.77

1

0.78

0.777 or 0.77 gain 1 mark

their mean value / 10 gains 1 mark

2

(ii) use longer lengths (so longer times)

or

do both with the same lengths (so comparison can be made)

timing more than 10 cycles is insufficient

1

(iii) **1** value of k from **table 4**

k values 3.969...

4.056...

4.05

$$k = T^2 / l$$

allow full credit for an equivalent correct method

eg. allow inverse of

$$k = l / T^2 = 0.25$$

1

1 value of k from **table 5**

k values 4

4.03...

4.046

allow if average time for 10 cycles used

1

conclusion that matches student's results

1

(c) 720 N

$$180 = F \times 0.25 \text{ gains 2 marks}$$

work done = maximum kinetic energy gains 1 mark

3

[12]

14	(a) 20 790 (J)	<i>an answer of 21 000 (J) (2 s.f.) gains 2 marks</i> <i>allow 1 mark for correct substitution:</i> <i>ie $E = 0.33 \times 4200 \times 15$ provided no subsequent step shown</i>	2
	(b) temperature		1
	(c) (top pan) balance	<i>accept scales</i> <i>do not accept a scale</i> <i>do not accept weighing scales</i> <i>do not accept newtonmeter</i> <i>do not accept spring balance</i>	1
	(d) dark / black / (dark) grey		1
	convection	<i>correct order only</i>	1
	(e) (i) created	<i>accept made</i>	1
	(ii) increases		1
			[8]
15	(a) (i) high levels of infrared radiation (from the Sun)	<i>allow lots of (solar) energy (available)</i> <i>do not accept 'heat' for infrared</i> <i>'it is hot' is insufficient</i> <i>'lots of sunlight' is insufficient</i>	1
	(ii) reflected		1
	(iii) boiler	<i>correct order only</i>	1
	turbine		1
	transformer		1

(b) 2 100 000 (kWh)

allow 1 mark for correct substitution i.e. 140 000 × 15 provided no subsequent step

2

(c) (i) only 1 wind turbine was considered

accept only one location is considered

1

or

other wind turbines may have generated more electricity

accept insufficient sample size

only 1 week's weather was reported on

or

wind speed varies from one week to another

'wind speed varies' is insufficient

1

(ii) any **one** from:

- wind speed is too high / low

allow no wind

allow too windy

- wind is unreliable.

allow wind is variable

1

(iii) any **one** from:

- wind is a renewable energy source
- do not use fuel
- energy source is free
- do not release carbon dioxide
- do not release greenhouse gases
- do not release sulfur dioxide
- do not cause acid rain
- do not cause climate change
- do not cause global warming
- do not cause global dimming.

answer must be an advantage of wind, converse answers in terms of fossil fuels are insufficient

accept do not release pollutant gases

'no pollution' is insufficient

1

[11]

16

- (a) (i) infrared (radiation)
accept IR (radiation) 1
- (ii) (heated) water turns to steam
ignore reference to fossil fuels
*do **not** accept water evaporates to steam* 1
- steam turns a turbine 1
- turbine turns a generator
accept turbine connected to a generator 1
- (b) (i) (so the molten salts) can store large amounts of energy
accept there is a small temperature change for a large energy transfer
accept heat for energy 1
- (ii) 16 (hours)
an answer that rounds to 16 gains 2 marks eg 15.71
allow 1 mark for a correct substitution ie $2\,200\,000 = 140\,000 \times t$ 3
- (iii) the number of daylight hours varies
less sunlight is insufficient 1
- the (mean) power (received from the Sun per square metre) varies
accept an answer in terms of maximum possible electrical output only possible during Summer for 1 mark 1

- (c) (i) non-renewable power stations have higher Capacity Factors than renewable power stations

1

fuel (for non-renewable power stations) is always available

reference to non-renewable power stations operating all the time is insufficient

non-renewable energy sources are reliable is insufficient

1

(most) renewable energy sources are unpredictable / unreliable

accept (most) renewable energy sources depend on the weather

1

- (ii) the (proportion of) time that solar storage power stations can generate electricity is greater (than for other renewable energy sources)

1

[14]

17

- (a) 4200

allow 2 marks for correct substitution

ie $6930 = 0.330 \times c \times 5.0$

answers of 1050 or 840

or

correctly calculated answer from correct substitution of incorrect temperature change

or

identification of temperature change ie 5 °C

gain 1 mark

3

J / kg°C

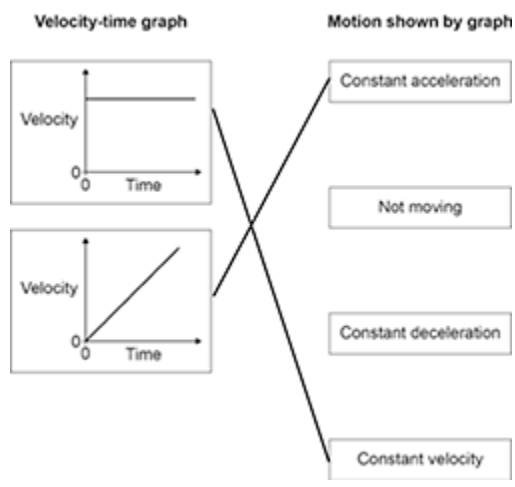
accept J / kg K

1

- (b) (in a metal) free electrons
to gain full credit the answer must be in terms of free electrons 1
- gain kinetic energy
accept move faster 1
- (free electrons) transfer energy to other electrons / ions / atoms
*do **not** accept particles* 1
- by collision
allow a maximum of 2 marks for answers in terms of atoms / ions / particles
 - *gaining kinetic energy or vibrating faster / more*
 - *transferring energy by collisions* 1
- (c) (air) particles spread out 1
- (which causes the) air to become less dense / expand
*do **not** accept particles become less dense* 1
- (so the) warm air rises
*do **not** accept heat rises*
particles rise is insufficient 1
- (d) large surface area
ignore references to type of metal or external conditions 1
- black / dark (colour) 1

[13]

18 (a)



if more than one line is drawn from a graph then all those lines are wrong allow 1 mark for 1 correct line

2

(b) speed

1

(c) (i) 2.25

allow 1 mark for correct substitution i.e.

$$a = \frac{9 - 0}{4} \text{ or } a = \frac{9}{4}$$

provided no subsequent step

2

(ii) the air resistance increases

1

(d) 2000 J

1

mass is half

or

kinetic energy depends on mass

*do **not** accept weight for mass*

1

[8]

19	(a) (i) decreases (to zero)	1
	resultant force acts in opposite direction to motion <i>accept air resistance and weight for resultant force</i> <i>accept resultant force acts downwards</i> <i>do not accept air resistance increases</i>	1
	(ii) velocity includes direction or velocity is a vector (quantity)	1
	(b) (i) 3.6 <i>allow 1 mark for correct substitution i.e.</i> $\frac{1}{2} \times 0.05 \times 12^2$ provided no subsequent step	2
	(ii) 3.6 or their (i)	1
	(iii) 7.2 or their (ii) $\div 0.5$ correctly calculated <i>allow 1 mark for correct substitution i.e.</i> 3.6 or their (ii) = $0.05 \times 10 \times h$	2
	(iv) B	1
	(c) range increases up to 45°	1
	range decreases from 45° <i>the range is a maximum at 45° gains both marks</i> <i>for any two angles that add up</i> <i>to 90° the range is the same gains both marks</i> <i>the range increases then decreases gains 1 mark</i>	1
		[11]

20	(a) (i) 150	1
	(ii) transferred to the surroundings by heating <i>reference to sound negates mark</i>	1

(iii) 0.75

450 / 600 gains 1 mark

accept 75% for 2 marks

maximum of 1 mark awarded if a unit is given

2

(iv) 20 (s)

correct answer with or without working gains 2 marks

correct substitution of 600 / 30 gains 1 mark

2

(b) (i) to avoid bias

1

(ii) use less power and last longer

1

1 LED costs £16, 40 filament bulbs cost £80

or

filament costs (5 times) more in energy consumption

1

(iii) any **one** from:

- availability of bulbs
- colour output
- temperature of bulb surface

1

[10]

21

(a) dark matt

1

light shiny

1

(b) B A C

1

biggest temperature difference (80 °C)

dependent on first mark

1

(c) (i) (the can that is) dark matt

1

best absorber (of infrared radiation)

1

(ii) any **three** from:

- same area / shape of can
- surrounding temperature is the same for all cans
- same surface underneath cans
- same position in the room

3

(d) fox A

smaller ears

1

thicker fur

1

these minimise energy transfer

dependent on first 2 marks

1

[12]

22

(a) conduction

must be in correct order

1

convection

1

(b) (i) 70

*accept \pm half a square
(69.8 to 70.2)*

1

(ii) 15

*accept 14.6 to 15.4 for 2 marks
allow for 1 mark 70 – 55
ecf from (b)(i) \pm half a square*

2

(iii) C

1

biggest drop in temperature during a given time

accept it has the steepest gradient this is a dependent

1

(iv) starting at 70 °C and below graph for C
must be a curve up to at least 8 minutes

1

(v) because 20 °C is room temperature

accept same temperature as surroundings

1

(c) (i) 6720

correct answer with or without working gains 3 marks

6 720 000 gains 2 marks

correct substitution of $E = 0.2 \times 4200 \times 8$ gains 2 marks

correct substitution of $E = 200 \times 4200 \times 8$ gains 1 mark

3

(ii) the fastest particles have enough energy

accept molecules for particles

1

to escape from the surface of the water

1

therefore the mean energy of the remaining particles decreases

accept speed for energy

1

the lower the mean energy of particles the lower the temperature (of the water)

accept speed for energy

1

[16]

23

(a) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information in the [Marking guidance](#).

0 marks

No relevant content.

Level 1(1-2 marks)

There is a basic explanation of **one** feature

or

a simple statement relating reduction in energy transfer to **one** feature.

Level 2(3-4 marks)

There is a clear explanation of **one** feature

or

a simple statement relating reduction in energy transfer to **two** features.

Level 3(5-6 marks)

There is a detailed explanation of at least **two** features

or

a simple statement relating reduction in energy transfer to all **four** features.

Examples of the points made in response

extra information

accept throughout:

heat for energy

loss for transfer

plastic cap:

- plastic is a poor conductor
accept insulator for poor conductor
- stops convection currents forming at the top of the flask so stopping energy transfer by convection
- molecules / particles evaporating from the (hot) liquid cannot move into the (surrounding) air so stops energy transfer by evaporation
- plastic cap reduces / stops energy transfer by conduction / convection / evaporation

glass container:

- glass is a poor conductor so reducing energy transfer by conduction
- glass reduces / stops energy transfer by conduction

vacuum:

- both conduction and convection require a medium / particles
- so stops energy transfer between the two walls by conduction and convection
- vacuum stops energy transfer by conduction / convection

silvered surfaces:

- silvered surfaces reflect infrared radiation
accept heat for infrared
- silvered surfaces are poor emitters of infrared radiation
- infrared radiation (partly) reflected back (towards hot liquid)
- silvered surfaces reduce / stop energy transfer by radiation

6

- (b) (the ears have a) small surface area
ears are small is insufficient

1

so reducing energy radiated / transferred (from the fox)

accept heat lost for energy radiated

do not accept stops heat loss

1

[8]

24

(a) conduction

1

(b) (i) there is a bigger temperature difference between the water and the surrounding air

accept the water is hottest / hotter

1

so the transfer of energy (from hot water) is faster

accept heat for energy

ignore temperature falls the fastest

1

(ii) 120

allow 1 mark for converting kJ to J correctly, ie 4 032 000

or

correctly calculating temperature fall as 8°C

or

allow 2 marks for correct substitution, ie $4\,032\,000 = m \times 4200 \times 8$

answers of 0.12, 19.2 **or** 16.6 gain 2 marks

answers of 0.019 **or** 0.017 gain 1 mark

3

(iii) water stays hot for longer

1

so heater is on for less time

accept so less energy needed to heat water

1

so cost of the jacket is soon recovered from) lower energy costs / bills

accept short payback time

1

[9]

25

(a) potential

1

(b) (i) 13 200

allow 1 mark for correct substitution, ie 660×20 provided no subsequent step shown

2

(ii) 16.5
allow 1 mark for correct

or

their (b)(i) correctly calculated
800

substitution, ie $\frac{13\,200}{800}$ or $\frac{\text{their (b)(i)}}{800}$

provided no subsequent step shown

2

[5]

26

(a) (i) 24

*allow 1 mark for converting time to 600 seconds
or showing method ie 14400/10*

or $\frac{14400}{10 \times 60}$

provided no further steps shown

2

(ii) 24

ignore any unit

or

their (a)(i)

1

(b) (i) 20 45

both required – either order

1

(ii) the block transfers energy to the surroundings

1

[5]

27

(a) (i) kinetic (energy)

*allow gravitational potential (energy) / gpe
movement is insufficient*

1

(ii) dissipates into the surroundings

allow warms up the surroundings / air / motor

accept lost to the surroundings

accept lost as heat

ignore reference to sound

it is lost is insufficient

1

- (b) energy (required) increases with load
accept positive correlation
*do **not** accept (directly) proportional*
- 1

further amplification eg increases slowly at first (or up to 4 / 5 N),
then increases rapidly

simply quoting figures is insufficient
an answer that only describes the shape
of the line gains no marks

1

- (c) (i) $E = P \times t$

2880

*accept £28.80 for all **3** marks*
*an answer £2880 gains **2** marks*
*allow **1** mark for obtaining 48 h **or** converting to kW*
*allow **2** marks for correct substitution*
ie $4 \times 48 \times 15$
note: this substitution may be shown as two steps
*an answer 2 880 000 gains **2** marks*
*an answer £4.80 / 480 gains **2** marks*
an answer of 192 (ie calculation of energy without subsequent
*calculation of cost) gains **1** mark)*

3

- (ii) any sensible suggestion eg

conserves fossil fuels

less (fossil) fuels burned

less pollutant gas (produced)

accept a named pollutant gas

less greenhouse gas (produced)

saves energy is insufficient

1

[8]

28

- (a) 13 500 (J)

*allow **1** mark for correct substitution, ie $90 \times 10 \times 15$ provided no*
subsequent step shown

2

(b) 17

or

$$\sqrt{\frac{\text{their (a)}}{45}}$$

correctly calculated and answer given to 2 or 3 significant figures

accept 17.3

allow 2 marks for an answer with 4 or more significant figures, ie 17.32

or

allow 2 marks for correct substitution, ie $13\,500 / \text{their (a)} = \frac{1}{2} \times 90 \times v^2$

or

allow 1 mark for a statement or figures showing $KE = GPE$

3

(c) work is done

1

(against) friction (between the miner and slide)

accept 'air resistance' or 'drag' for friction

1

(due to the) slide not (being perfectly) smooth

accept miners clothing is rough

or

causing (kinetic) energy to be transferred as heat/internal energy of surroundings

accept lost/transformed for transferred

accept air for internal energy of surroundings

1

[8]

29

(a) (i) 720

allow 1 mark for correct substitution,

ie 72×10 provided no subsequent step shown

2

(ii) 720

or

their (a)(i)

1

(b) (i) gravitational potential

allow gravitational

allow potential

1

(ii) 432

allow 1 mark for correct substitution, ie $\frac{21600}{50}$ provided no subsequent step shown

2

watt / W

1

[7]

30

(a) 1 080 000

allow 1 mark for correct substitution
ie $\frac{1}{2} \times 15\,000 \times 12 \times 12$

2

(b) any **one** from:

- KE (of wind) more than doubles
- mass of air (hitting blades) more than doubles
- area swept out by blades more than doubles
do **not** accept blades are larger / have a bigger area
- area swept out by blades increases x 4

1

[3]

31

(a) (i) 2.1

correct answer only

1

(ii) 3.15

or

their (a)(i) $\times 1.5$ correctly calculated

allow 1 mark for correct substitution

ie 2.1×1.5

or

their (a)(i) $\times 1.5$

2

kilowatt-hour

accept kWh

or

a substitution 2100×5400 scores **1** mark

2100×5400 incorrectly calculated with answer in joules scores **2** marks

an answer of 11 340 000 scores **2** marks

an answer of 11 340 000 J scores **3** marks

1

(iii) most (input) energy is usefully transformed

accept does not waste a lot of energy

accept most of the output / energy is useful

do **not** accept it does not waste energy

1

(b) the room is losing energy / heat

1

at the same rate as the heater supplies it

this mark only scores if the first is scored

do **not** accept heater reaches same temperature as room / surroundings

rate of heat gain = rate of heat loss scores both marks

1

[7]

32

(a)



accept 'the humpback bridge' symbol

accept circle with cross but no lines

if more than one symbol drawn, no mark unless lamp is labelled

1

(b) (i) 24

allow **1** mark for correct substitution ie $\frac{2800}{120}$

allow **1** mark for an answer 1440

ignore any unit

2

(ii) watt

1

(c) larger than

accept correct indication inside the box

accept an answer meaning larger than ie greater than

1

[5]

33

(a) product of mass and velocity

1

(b) (i) 4kg or 4000g

1

(ii) $M = 8\text{kgm/s}$ or Ns

for 3 marks

else $M = 8$

for 2 marks

else $M = mv$ or 4×2

for 1 mark

3

(iii) 8 kgm/s (watch e.c.f.)

1

(iv) $v = 400$

for 3 marks

else $v = 8/0.02$

for 2 marks

else $M = mv$, $v = M/m$ or $8 = 0.02v$

for 1 mark

3

(v) $ke = 8$

for 3 marks

else $ke = 1/2 (4 \times 2^2)$

for 2 marks

else $ke = 1/2 (mv^2)$

for 1 mark

3

- (vi) transferred to heat and sound
or does work against wood/pushing wood aside/deforming bullet

1

[13]

34

newton **or** N

metre **or** m

joules **or** J

*all three correct 2 marks
two or one correct 1 mark*

[2]

35

- (a) *any evidence of:* momentum = mass \times velocity (words, symbols or numbers) appropriate re-arrangement mass as 0.05kg

each gains 1 mark

but 800

gains 4 marks

4

- (b) (i) *any reference to* friction with air/air resistance
gains 1 mark

but *idea that* friction with air/air resistance is high (at high speed)

gains 2 marks

2

- (ii) *any evidence of: k.e. $\propto v^2$ or k.e. = $\frac{1}{2} mv^2$*
final k.e.
initial k.e.
either initial or final k.e. correctly calculated (i.e. 16000; 10240)
each gains 1 mark

but $(0.8)^2$
gains 3 marks

but 64%(credit 0.64)
gains 4 marks (also credit e.c.f)

4

[10]