

Work Done

Q1.(2018)

C ✓

Q2.(2018)

C ✓

Q3.(2018)

B ✓

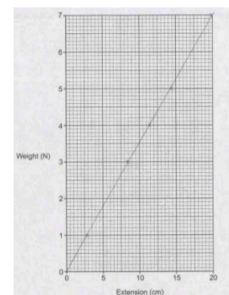
Q4.a(2018)

All 5 points correctly plotted to within $\pm \frac{1}{2}$ a square ✓

1

2.2

Ignore line but if line covering plotting assumes plots are under the line



plots are:

Weight of cube (N)	Extension of spring (cm)
1.0	2.9
3.0	8.4
4.0	11.4
5.0	14.4
7.0	20.0

IGNORE extra marks and dots on the grid as they may be from answering the next question

Q4.b(2018)

	<p>3</p> <p>Question asks candidates to show that the spring constant is 35 N/m so DO NOT credit an answer of 35 with no workings</p> <p>1.2 ALLOW evidence of gradient on graph</p> <p>2.1 Examples of correct numbers: $3.5 \div 10$ ✓✓ $7 \div 20$ ✓✓ any pair of numbers from the table</p> <table border="1"> <thead> <tr> <th>Weight of cube (N)</th> <th>Extension of spring (cm)</th> </tr> </thead> <tbody> <tr> <td>1.0</td> <td>2.9</td> </tr> <tr> <td>3.0</td> <td>8.4</td> </tr> <tr> <td>4.0</td> <td>11.4</td> </tr> <tr> <td>5.0</td> <td>14.4</td> </tr> <tr> <td>7.0</td> <td>20.0</td> </tr> </tbody> </table> <p>2.1 Examples of correct conversion: $3.5 \div 0.1$ ✓✓✓ $7 \div 0.2$ ✓✓✓</p> <p>ALLOW correct calculation using proportion</p> <p>Correct numbers from table and calculates extension per N e.g. $20 \div 7 = 2.857$ (cm/N) ✓ Understanding of k = force to give one metre extension ✓ Calculate force needed for extension of 100cm $100 \div 2.857 = 35$ ✓✓✓ or $2.857 \times 35 = 100$ ✓✓✓</p>	Weight of cube (N)	Extension of spring (cm)	1.0	2.9	3.0	8.4	4.0	11.4	5.0	14.4	7.0	20.0
Weight of cube (N)	Extension of spring (cm)												
1.0	2.9												
3.0	8.4												
4.0	11.4												
5.0	14.4												
7.0	20.0												

Q4.c(2018)

FIRST CHECK THE ANSWER ON ANSWER LINE
If answer = 0.7 (J) award 2 marks

$$E = 0.5 \times 35 \times 0.2^2 \quad \checkmark$$

$$E = 0.7 \text{ (J)} \quad \checkmark$$

2	2 × 2.1	ALLOW 7000 (J) ✓
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Q5.a(2018)

Any two from:

Stir the water ✓

Make sure immersion heater is completely in the water / the immersion heater is in the same position ✓

Insulate the beaker / fit lid to beaker / cover the beaker ✓

Do not lift thermometer out of water when taking temperature reading ✓

Read the thermometer at eye level ✓

Use a digital thermometer ✓

Make sure the thermometer only touches the water (not the sides of the container) ✓

Measure the mass or volume of the water before adding the thermometer or immersion heater ✓

2	<p>3.3a 3.3b</p> <p>IGNORE take an average / repeat the readings / use a power source</p> <p>ALLOW named insulation around beaker ALLOW 'don't let the heat escape' IGNORE 'don't let room temperature affect it'</p> <p>ALLOW do not remove the thermometer (to read it)</p>
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Q5.b(2018)

No
AND
points lie close to the line of best fit / little scatter of points
about line / AW ✓

1

3.1b

BOTH needed

ALLOW no **AND** points are only slightly off the line / the line passes though or close to all the points / points are all close together / points following the pattern / points are following the line of best fit / no outliers

IGNORE it shows a positive correlation / no value out of range

Q5.c(2018)

No
AND
point not far enough from line of best fit / point fits in with trend shown by data / AW ✓

1

3.2a

BOTH needed

ALLOW no **AND** it is only slightly off the line / the line passes though or close to it / it is following the pattern / it is close to the line of best fit / it is still connected to the line / it is not an outlier

IGNORE it is not out of range

Q5.d(2018)

FIRST CHECK THE ANSWER ON ANSWER LINE
If answer = 0.028 - 0.036 (°C / s) award 2 marks

2

Gradient calculation from line of best fit ✓

Gradient = 0.0317 (°C / s) ✓

1.2

Each small square is 0.4 °C on the scale
ALLOW a tolerance of + or – 0.2 °C

e.g. $1.6 \div 50 / 8 \div 250 / 7.6 \div 240$

2.1

ALLOW answers in the inclusive range
0.028 - 0.036

Q5.e(2018)

<p>FIRST CHECK THE ANSWER ON ANSWER LINE If answer = (inclusive range of) 3555 – 4571 (J/kg °C) award 4 marks</p> <p>$P \times t = m \times c \times \Delta T$ ✓</p> <p>(P x t) 12.8 × time from graph used in (c)(i) or correct time from graph or table ✓</p> <p>0.1 × c × ΔT from graph in (c)(i) or matching temperature from graph or table ✓</p> <p>c value calculated (J/kg °C) ✓</p>	<p>4</p>	<p>1.2</p> <p>3 x 2.1</p>	<p>ALLOW ECF from (c)(i) ALLOW e.g. 4042 (J/kg °C) as answer ✓✓✓✓ ALLOW other numbers in the range as correct answers but DO NOT ALLOW 4200 without workings</p> <p>e.g. 12.8 x 300 or 12.8 x 60</p> <p>ALLOW e.g. 12.8 × 240 = 0.1 × c × 7.6 ✓✓✓</p> <p>e.g. using values from graph: E = P × t = 12.8 × 240 = 3072 (J) ✓ E = m × c × ΔT = 0.1 × c × 7.6 (J) ✓ 3072 = 0.76 × c ✓ c = 4042 (J/kg °C) ✓</p> <p>Possible values from the graph (+ or - 0.2 for temperature)</p> <table><tr><th>time</th><th>matching temp</th></tr><tr><td>50</td><td>1.6</td></tr><tr><td>60</td><td>2.0</td></tr><tr><td>100</td><td>3.2</td></tr><tr><td>150</td><td>4.8</td></tr><tr><td>200</td><td>6.4</td></tr><tr><td>240</td><td>7.6</td></tr><tr><td>250</td><td>8.0</td></tr><tr><td>300</td><td>9.5</td></tr></table>	time	matching temp	50	1.6	60	2.0	100	3.2	150	4.8	200	6.4	240	7.6	250	8.0	300	9.5
time	matching temp																				
50	1.6																				
60	2.0																				
100	3.2																				
150	4.8																				
200	6.4																				
240	7.6																				
250	8.0																				
300	9.5																				

Q6.(2019)

B ✓

Q7.(2019)

D ✓

Q8.(2019)

D ✓

Q9.(2020)

B

Q10.(2020)

C

Q11.a(2020)

FIRST CHECK THE ANSWER ON ANSWER LINE
If answer = 2 (°C / min) award 3 marks

10 ✓
10 / 5 ✓
= 2 (°C / min) ✓

3

2.2
2.2
2.2

ALLOW 60/5 for 1 mark

Q11.b(2020)

(As time increases), temperature decreases / ORA ✓

2

3.1a

ALLOW examples e.g. (in the first minute) it goes down (from 70°C to 67°C)

ALLOW inverse relationship

IGNORE negative correlation

Decrease in temperature rapid at start / temperature decreases at a decreasing rate / ORA ✓

3.1a

ALLOW value for temperature getting smaller as time increases

ALLOW not linear / not proportional / change is less gradual / (change) slower at end / ORA

ALLOW comparison of two data points

Q11.c(2020)

FIRST CHECK THE ANSWER ON ANSWER LINE
If answer = 8000 (J) award 3 marks

$0.2 \times 4200 \times 10$ ✓
8400 (J) ✓
= 8000 (J) (1sf) ✓

3

2.1
2.1
1.2

ECF from 11(a) for temperature change

ALLOW answer of = 1680 (J) for 1 mark

ALLOW answer of = 2000 (J) for 2 marks

ALLOW correct sf from candidate's calculation

Q11.d(2020)

Thermal/energy/heat store (in water) decreases / AW ✓

2

1.1

Thermal/energy/heat store in surrounding/air increases / AW ✓

1.1

ALLOW energy is transferred from the thermal/energy/heat store (of the water) to the surroundings for 2 marks

Q11.e(2020)

Any line with a smaller gradient than the line on the graph ending at a temperature between 61 °C and 69 °C ✓

1

3.2a

DO NOT ALLOW horizontal line at 70 °C

Q11.f(2020)

Increase thickness of the beaker or insulation / decrease thermal conductivity of the beaker or insulation / put the insulation on the top of the beaker / use a lid / put insulation under the beaker / AW ✓

1

1.1

ALLOW increase the temperature of the room / keep the room temperature the same as the water

IGNORE reduce the temperature of the water / put in the sun / use a (hot) water bath

Q12.(2021)

B

Q13.(2021)

Energy cannot be created/destroyed / AW ✓

Energy can only be transferred/changed/shifted (between stores) ✓

Q14.a(2021)

	At the bottom of the ramp	At the top of the ramp	4	4 x 2.1	6 correct ✓✓✓✓ 4 or 5 correct ✓✓✓ 2 or 3 correct ✓✓ 1 correct ✓
Magnetic energy store	MAXIMUM	MINIMUM			
Gravitational energy store	MINIMUM	MAXIMUM			
Thermal energy store	MINIMUM	MAXIMUM			

Q14.b(2021)

FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 4 (m / s) award 3 marks	3		
Rearranges: $v^2 = KE / (0.5 \times m)$ ✓ $v^2 = 0.024 / (0.5 \times 0.003)$ or $v^2 = 16$ ✓ $v = 4$ (m / s) ✓		1.2 2.1 2.1	ALLOW $v = \sqrt{2KE/m}$ ✓ ALLOW $v = \sqrt{(2 \times 0.024)/0.003}$ ✓

Q14.c(2021)

Any two from:

Kinetic energy (store) decreases ✓

Energy would be transferred to a thermal store ✓

(Transferred/dissipated) into the surroundings / ground / air ✓

Q15.(2021)

Any two from: Temperature rise very small ✓ Requires precise or high resolution thermometer ✓ (idea that) Joule's equipment may not have been precise or good enough ✓ The water "sprays" out so it is difficult to measure accurately / AW ✓	2	2 x 3.2a	ALLOW he only has a simple/normal thermometer
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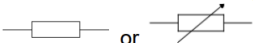
Q16.a(2022)

	3	3 × 1.2	ALLOW mistakes in any order ALLOW corrections written on the mistake lines Note this mark is for the correction (no mark for the mistake) IGNORE use a measuring cylinder IGNORE add a lid
(Mistake – measure volume / use a balance) Correction – measure <u>mass</u> / find <u>mass</u> / calculate <u>mass</u> ✓ Mistake – (only) measure starting temperature / (only) measure one temperature ✓ Correction – measure final temperature / measure temperature change / calculate temperature change ✓			

Q16.b(2022)

Any one from: Take repeat readings (and average) ✓ Add a lid / cover the top ✓ Stir the water ✓ Include the specific heat capacity of the saucepan in the calculation ✓ Use a digital thermometer ✓	1	3.3b	 IGNORE in a closed system / same size saucepan
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Q16.c(2022)

Any three from: Correct symbol for resistor (heater) ✓ Voltmeter to measure pd or voltmeter in parallel with heater ✓ Ammeter to measure current or ammeter in series with heater ✓ (Stopwatch) to measure time / use a set amount of time e.g. 10 minutes ✓ Any one from: Power = potential difference x current ✓ Energy = power x time ✓ Charge = current x time ✓ Energy = charge x potential difference ✓ Power = (current) ² x resistance ✓	4	3 × 3.3a 1.2	ALLOW variable resistor symbol, so symbols  or ALLOW voltmeter to measure voltage IGNORE voltmeter to measure volts IGNORE ammeter to measure amps ALLOW (stopwatch) to measure a unit of time e.g., minutes or seconds ALLOW voltage or pd for potential difference ALLOW voltage or pd for potential difference ALLOW energy = potential difference x current x time ALLOW symbol equation
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Q17.a(2022)

B or C or D ✓	1	3.2b	ALLOW one or more of the possible correct answers
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Q17.b(2022)

B ✓

Q17.c(2022)

FIRST CHECK THE ANSWER ON ANSWER LINE
If answer = 0.48 (J) award 3 marks

(Kinetic energy =) $0.5 \times \text{mass} \times \text{speed}^2 / \frac{1}{2}mv^2$ ✓

(Kinetic energy =) $0.5 \times 0.06 \times 4^2$ ✓

(Kinetic energy =) 0.48 (J) ✓

3

1.2

ALLOW symbol equation / equation in any form

2.1

2.1

ECF for incorrect mass conversion, so any power of ten difference e.g.
4.8 (J) = 2 marks
0.048 (J) = 2 marks
but not when time used instead of speed e.g.
0.4 is the time so $(0.4)^2 \times 0.5 \times 0.06$ is not correct

Q17.d(2022)

FIRST CHECK THE ANSWER ON ANSWER LINE
If answer = 0.75 (J) award 4 marks

Area under graph of ABC = height or = $0.5 \times 5 \times 0.5$ ✓

(Height =) 1.25 (m) ✓

(Potential energy =) $0.06 \times 10 \times 1.25$ ✓

(Potential energy =) 0.75 (J) ✓

4

1.2

2.1

2.1

ALLOW ecf from incorrect height calculated e.g.
height 2.5 gives 1.5 (J) = 2 marks

2.1

ALLOW 4 marks for 0.735 or 0.74 if 9.8 used for gravitational field strength

DO NOT ALLOW height = 0 (m) so 0 marks for question

Q17.e(2022)

FIRST CHECK THE ANSWER ON ANSWER LINE
If answer = 0.6 award 3 marks

(Efficiency =) $\frac{\text{useful output energy transfer}}{\text{input energy transfer}}$ ✓

(Efficiency =) $\frac{0.45}{0.75}$ ✓

(Efficiency =) 0.6 (no units) ✓

3

1.2

ALLOW ecf from (c)(i) e.g. 0 in part (c)(i) gives answer of infinity

ALLOW $\frac{\text{output}}{\text{input}}$

2.1

2.1

DO NOT ALLOW unit e.g. 0.6 J = 2 marks
ALLOW answer with percentage sign e.g.
60% = 3 marks
0.6% = 2 marks

Q18.(2023)

C

Q19.(2023)

C

Q20.(2023)

C

Q21.(2024)

A

Q22.(2024)

C

Q23.(2024)

D

Q24.(2024)

C

Q25.(2024)

D

Q26.a(2024)

<p>(Energy transferred) From chemical (store) ✓</p> <p>To kinetic (store) / to gravitational (potential) (store) ✓</p>	2	2 × 1.1	<p>ALLOW chemical decreases</p> <p>ALLOW kinetic/gravitational increases ALLOW kinetic (store) as ball is moving ALLOW gravitational (potential) (store) as increasing in height</p> <p>ALLOW chemical to kinetic/gravitational for 2 marks</p> <p>IGNORE thermal / heat / sound / nuclear</p>
<p>Q26.b(2024) Any two from:</p> <p>Start timing when see flash/light/explosion / start timing when he sees it fired ✓</p> <p>Stop timing when hear bang/sound ✓</p> <p>Use $s = \frac{d}{t}$ to calculate speed ✓</p>	2	2 × 3.3a	<p>IGNORE just 'when it is fired' DO NOT ALLOW counting</p> <p>DO NOT ALLOW counting</p> <p>ALLOW (measure/calculate) time between flash/light/fired and bang/sound for 2 marks</p> <p>equation with speed/velocity as the subject only ALLOW (speed =) distance divided by time ALLOW $v = s \div t$</p>
<p>Q26.c(2024) Smaller percentage error / the effect of the (reaction) time error is smaller / (reaction) time error has a smaller effect ✓</p>	1	3.3b	<p>ALLOW to make the uncertainty in the time measurement small / to make time (value more) accurate</p> <p>ALLOW idea that a short time is too difficult to measure if the cannon was closer / sound needs to be a long distance away to be measured</p> <p>IGNORE references to safety</p>
<p>Q26.d(2024) First check the answer on the answer line If answer = 364.65 (m/s) award 2 marks</p> <p>(1122 feet / s =) $1122 \times (32.5 \div 100)$ ✓</p> <p>(1122 feet / s =) 364.65 (m / s) ✓</p>	2	2 × 1.2	<p>ALLOW 364.7 or 365 (m / s)</p>
<p>Q26.e(2024) (% difference =) $(1122 - 1056) \div 1056 \times 100$ ✓</p> <p>(% difference =) 6.25 (%) ✓</p> <p>Either: Accurate as % difference is small/<10% Or Inaccurate as % difference is large/>5% ✓</p>	3	<p>2 × 1.2</p> <p>3.1b</p>	<p>ALLOW $(36465 - 34320) \div 34320 \times 100$</p> <p>ALLOW 6.25 on its own for 2 marks ALLOW 0.0625 for 1 mark</p> <p>ALLOW quite accurate as % difference is small/<10%</p>