EXAM PAPERS PRACTICE

Boost your performance and confidence with these topic-based exam questions

Practice questions created by actual examiners and assessment experts

Detailed mark scheme

Suitable for all boards

Designed to test your ability and thoroughly prepare you

Time allowed
43 Minutes

Score /36

Percentage %

Physics

Mark Scheme

AQA
AS & A LEVEL

3.6 Further mechanics and thermal physics (A-level only)

1 (a) $\Delta T = \left(\frac{\Delta Q}{mc} =\right) \frac{8.5 \times 10^3}{4200 \times 0.12}$ ✓

17 K ✓

2

(b) $\left(\frac{\Delta T}{\Delta t} = \frac{\frac{\Delta Q}{\Delta t}}{mc}\right) = \frac{100 - 26}{\Delta t} = \frac{8.5 \times 10^3}{0.41 \times 4200}$ ✓

t = 15 s ✓

2

[4]

2.(i) (heat supplied by glass = heat gained by cola)

(use of $m_g\ c_g\ \Delta T_g = m_c\ c_c\ \Delta T_c$)

1st mark for RHS or LHS of substituted equation

$0.250 \times 840 \times (30.0 - T_f) = 0.200 \times 4190 \times (T_f - 3.0)$ ✓

2nd mark for 8.4°C

$(210 \times 30 - 210\ t_f = 838\ T_f - 838 \times 3)$

$T_f = 8.4(1)$ (°C) ✓

Alternatives:

8°C is substituted into equation (on either side shown will get mark)✓

resulting in 4620J~4190J ✓

or

8°C substituted into LHS ✓ *(produces ΔT = 5.5°C and hence)*

= 8.5°C ~ 8°C ✓

8°C substituted into RHS ✓

(produces ΔT = 20°C and hence)

= 10°C ~ 8°C ✓

2

(ii) (heat gained by ice = heat lost by glass + heat lost by cola)

NB correct answer does not necessarily get full marks

(heat gained by ice = $mc\Delta T + ml$)
heat gained by ice = $m \times 4190 \times 3.0 + m \times 3.34 \times 10^5$ ✓
(heat gained by ice = $m \times 346600$)

3rd mark is only given if the previous 2 marks are awarded

heat lost by glass + heat lost by cola
= $0.250 \times 840 \times (8.41 - 3.0) + 0.200 \times 4190 \times (8.41 - 3.0)$ ✓
(= 5670 J)

(especially look for m × 4190 × 3.0)

the first two marks are given for the formation of the substituted equation not the calculated values

m (=5670 / 346600) = 0.016 (kg) ✓

if 8°C is used the final answer is 0.015 kg

or (using cola returning to its original temperature)
(heat supplied by glass = heat gained by ice)
(heat gained by glass = $0.250 \times 840 \times (30.0 - 3.0)$)
heat gained by glass = 5670 (J) ✓
(heat used by ice = $mc\Delta T + ml$)
heat used by ice = $m(4190 \times 3.0 + 3.34 \times 10^5)$ ✓ (= $m(346600)$)

m (=5670 / 346600) = 0.016 (kg) ✓

3

[5]

3 (a) the energy required to change the state of a unit mass of water to steam / gas ✓
when at its boiling point temperature / 100°C / without a change in temperature) ✓

allow 1 kg in place of unit
allow liquid to vapour / gas without reference to water
don't allow 'evaporation' in first mark

2

(b) (i) thermal energy given by copper block (= $mc\Delta T$)
= 0.047 × 390 × (990 – 100)
= 1.6×10^4 (J) ✓
2 sig figs ✓

can gain full marks without showing working
a negative answer is not given credit
sig fig mark stands alone

2

(ii) thermal energy gained by water and copper container
(= $mc\Delta T_{water} + mc\Delta T_{copper}$)
= 0.050 × 4200 × (100 – 84) + 0.020 × 390 × (100 – 84)
or
= 3500 (J) ✓ (3485 J)
available heat energy (= 1.6×10^4 – 3500) = 1.3×10^4 (J) ✓

allow both 12000 J and 13000 J

allow CE from (i)
working must be shown for a CE
take care in awarding full marks for the final answer – missing out the copper container may result in the correct answer but not be worth any marks because of a physics error
(3485 is a mark in itself)
ignore sign of final answer in CE
(many CE's should result in a negative answer)

2

(iii) (using Q = ml)
$m = 1.3 \times 10^4 / 2.3 \times 10^6$
= 0.0057 (kg) ✓
Allow 0.006 but not 0.0060 (kg)

allow CE from (ii)
answers between 0.0052 → 0.0057 kg resulting from use of 12000 and 13000 J

1

[7]

4 (a) (i) Appreciates *pV* should be constant for isothermal change (by working or statement) $W = p\Delta V$ is TO

Allow only products seen where are approximately 150 for 1 mark
Penalise J as unit here

M1

Demonstrates *pV* = constant using 2 points (on the line) set equal to each other or conclusion made or **shows** that for V doubling that *p* halves (worth 2 marks)
need to see values for p and V

Products should equal 150 to 2 sf
Accept statement that products are slightly different so not quite isothermal

A1

Demonstrates *pV* = constant using 3 points (on the line) with conclusion
Need to see values for p and V

Products should equal 150 to 2 sf
Accept statement that products are slightly different so not quite isothermal

A1

3

(ii) Adiabatic therefore no heat transfer **or**
Adiabatic therefore *Q* = 0

B1

Work is done by gas therefore *W* is negative **or**
Work is done by gas therefore energy is removed from the system

ΔU is negative therefore internal energy of gas decreases **or** energy is removed from the system therefore internal energy of gas decreases or work done by the gas so internal energy decreases

B1

Allow
$-\Delta U = -W \text{ or } \Delta U = -W$

B1

3

(iii) Uses pV / T = *constant or uses* $pV=nRT$ *or uses* $pV=NkT$

e.g. makes T subject or substitutes into an equation with p_A and V_A or p_C and V_C (condone use of n = 1) or their $\frac{(pV)_A}{(pV)_C}$

V_a *read off range*
= 2.5 to 2.6 (× 10⁻⁴)
p_A *= 600 × 10³*
V_C *read off range*
= 8.5 to 8.6 (× 10⁻⁴)
p_C *= 140 × 10³*

C1

Correct substitution of coordinates (inside range) into $\frac{(pV)_A}{(pV)_C}$
With consistent use of powers of 10

$(pV)_A$ range is 150 to 156 and $(pV)_C$ range is 119 to 120.4

C1

1.2(5) Allow range from 1.2 to 1.3

Accept decimal fraction : 1 **3**

A1

(b) Energy per large square = 10(J) **or** states that work done is equal to area under curve (between A and B)
or energy per small square = 0.4(J)
or square counting seen on correct area

Must be clear that area represents energy either by subject of formula or use of units on 10 or 0.4

Alternative:
W = area of a trapezium
(with working)
or *W =* $P_{mean} \times \Delta V$ ***or***
W = 450 × 10^3 × 2.5 × 10^{-4}
or *W = area of a rectangle + area of a triangle (with working)*

B1

Number of large squares = 10.5 to 11.5 seen and (W) =
number of squares × area of one square (using numbers)
Range = 105 to 115 (J)
Or

Number of small squares = 263 to 287 seen and (W) =
number of squares × area of one square (using numbers)
Range = 105 to 115 (J) **2**

States that actual work done would be lower because of curvature of line B1

(c) (Total energy removed per s =) 4560 (J)
or number of cycles per s = 40
or (Mass per second =) 114 ÷ 68400 in rearranged form
or their energy ÷ (c ΔT) **or** their energy ÷ 68400

C1

0.067 (kg) seen Allow 0.066 (kg) here
or allow V / t = $1.67 \times 10^{-3} \div 1100$

or $\left(\frac{V}{t}\right) = \frac{E}{\rho c \Delta\theta}$ and correct **substitution** seen

Condone E = 114 (J) **or** temperature = 291(K)

C1

$= 0.061 \times 10^{-3}$ or 6.06×10^{-5} (m^3)

A1

3

[14]

5 B

[1]

6 A

[1]

7.(a) (it takes) 130 J / this energy to raise (the temperature of) a mass of 1 kg (of lead) by 1 K / 1 °C (without changing its state) ✓

1 kg can be replaced with unit mass.

Marks for 130J or energy.

+1 kg or unit mass.

+1 K or 1 °C.

Condone the use of 1 °K

1

(b) (using $Q = mc\Delta T + ml$)
$= 0.75 \times 130 \times (327.5 - 21) + 0.75 \times 23000$ ✓
(= 29884 + 17250)
= 47134 ✓
$= 4.7 \times 10^4$ (J) ✓

For the first mark the two terms may appear separately i.e. they do not have to be added.

Marks for substitution + answer + 2 sig figs (that can stand alone).

3

[4]