Practice Question Set For A-Level
Subject : Physics
Paper-3 Topic: Section A(Practical Skills Set-1)

Name of the Student:____

Max. Marks : 26 Marks **Time : 26 Minutes**

Mark Schemes

Q1.

class="var"

(a) technique:

at least one instance seen where a metre ruler is made vertical using a set-square in contact with the floor $_1$✔

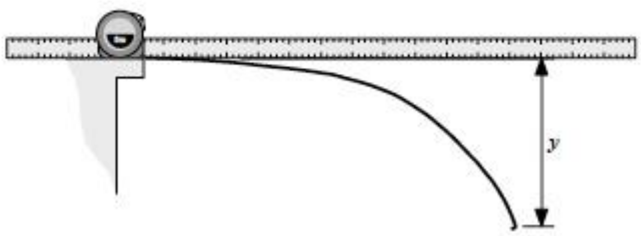
strategy:

(use a metre ruler to) measure the height of the free end of the tape (above the floor) and the height of the tape at the bench [height of the bench];

y = <u>difference</u> between these heights $_2$✔

OR

use a metre ruler or straight edge placed alongside the tape measure and overhanging the (horizontal) bench, eg



y is measured directly using this method using **additional** ruler $_1$✔

using **additional** ruler made vertical (as before) or using set-square placed against horizontal ruler $_2$✔

for $_1$✔ allow use of plumb line or spirit level;

don't insist on the set-square being used against two mutually perpendicular faces of the metre ruler

the floor is assumed to be horizontal if the deflection is found from the difference between two vertical measurements

for $_2$✔ allow metre ruler B made horizontal by use of set-square against vertical ruler A; ruler B establishes vertical position of free end of tape; ruler A is used to measure y directly

*either or both marks can be earned for suitable annotation to **Figure 1***

reject suggestions that y can be found without making at least one vertical measurement

(b) (for $x \leq 70$ cm y is small so) percentage/fractional uncertainty in y is (too) large **OR**

(for $x > 70$ cm) percentage/fractional uncertainty in y not (too) large ✔

percentage or fractional and in y are essential;
accept 'error' for 'uncertainty';
reject 'small distances are hard to measure'

1

(c) **continuous ruled** best-fit line drawn (at least) between 1st and 6th points;

line **must** pass below 2nd point and above 5th point;

line **must** pass above 1st point and below 6th point $_1$✔

gradient calculated from their best-fit line;

result, minimum 2 sf, in range 3.5 to 4.7 $_2$✔

result for n correctly rounded from their gradient to the nearest integer (expect $n = 4$) $_3$✔

for $_1$✔ 'pass below' is taken to mean below the intersection of the cross-hairs defining the position of a point; a line that intersects (any of) the cross-hairs of the 1st, 2nd, 5th or 6th points loses this mark

for $_1$✔ the line must not be thicker than half a grid square, must not vary in thickness and must not be too faint; do not allow two lines unless these are drawn to calculate maximum and minimum gradients from which an average is then calculated

for $_2$✔ accept answers to greater than 2 sf which round to 2 sf in range 3.5 to 4.7

do not penalise for small steps or read off errors

for $_3$✔ it must be clear that final result is for n if this is not on the answer line

allow ecf for unexpected gradient result that is then correctly rounded to the nearest integer

if no line is drawn (losing $_1$✔ and $_2$✔) allow $_3$✔ if n given as nearest integer to a gradient result obtained using two points on ***Figure 2***

3

(d) $\log A$ = (y) intercept seen

OR

$\log A = \log y$ when $\log x = 0$

OR

$\log y = n \log x + \log A$ (or correctly rearranged) seen $_1$✔

indirect method to find (vertical) intercept described, eg

using (values for) a point on line;

substitute into equation (for the line); allow 'into $y = mx + c$';

find $\log A$ (don't penalise incorrect algebra) $_2$✔

$A = 10^{(\text{y intercept})}$

OR

$A = 10^{(\log y - n \log x)}$ $_3$✔

treat ln A = (y) intercept in $_1$✔ as a slip and don't penalise but then insist that following work is consistent, eg insist on use of ln $y = n$ ln x + ln A (if seen) to earn $_2$✔

and

$A = e^{(\text{y intercept})}$ to earn $_3$✔

for $_1$✔ allow sensible use of y = mx + c idea;

reject 'log A is where line crosses y axis'

for $_2$✔ allow 'use a point on line to find x and y then sub into equation etc';

accept valid similar triangles idea;

reject anything such as extrapolating the line to suggest that the intercept can be found directly;

for $_3$✔ accept '(take/find) anti-log of (log y) intercept';

condone 'inverse log of (log y) for anti-log'; reject 'convert'

accept A = $10^{(\log A)}$ providing $_1$✔ awarded

accept substitution of n, eg A = $10^{(\log y - 4 \log x)}$

reject A = $10^{(-\text{y intercept})}$

alternative method:

using a point on line find log x, log y;

<u>anti-log</u> to find x, y $_1$✔

use $A = \frac{y}{x^n}$ *(equation seen with A the subject or equivalent description of process) $_2$✔*

repeat (to find A) using a different point on line;

calculate average (A) $_3$✔

reject averaging of x and y or of log x and log y

3

(e) *A* evaluated using $A = \frac{y}{x^n}$ **OR** using $A = 10^{(\log y - n \log x)}$;

correct substitution of n (from part (c)) and of y and x in cm from any row in the table (likely values shown opposite),

A evaluated correctly to minimum 2 sf and correct POT $_1$✔

order of magnitude of A = –7 **OR** 10^{-7} (accept index or of power of ten) $_2$✔

cm^{-3} $_3$✔

OR

$\text{cm}^{(1-n)}$ where n is result given for part (c)

for $_1$✔ ECF for non-integer n

values that may be seen in working:

x/cm	y/cm	A when $n = 4$	A when $n = 3.879$ *
132.4	61.2	1.99E-07	3.60E-07
116.8	33.7	1.81E-07	3.22E-07
105.1	24.3	1.99E-07	3.50E-07
94.5	15.6	1.96E-07	3.39E-07
84.3	11.0	2.18E-07	3.72E-07
73.2	5.7	1.99E-07	3.34E-07

**equation of best-fit line gives vertical intercept = 3.879*

for $_2$✔ accept 1×10^{-7} (cm^{-3}) but reject 1.0×10^{-7} or 2×10^{-7} etc;

ECF order of magnitude correct for their value of A;

POT must be consistent with unit given eg if cm^{-3} is converted into m^{-3};

for $_3$✔ CAO;

use of non-integer, eg n = 3.6 requires A in $cm^{-2.6}$

withhold $_2$✔ and $_3$✔ if A is not evaluated

alternative approaches:

A evaluated from $A = \frac{y}{x^n}$ **OR** from A = $10^{(\log y - n \log x)}$;

correct substitution of n (from part (c)) and of y and x in (in m) etc;

A evaluated correctly to minimum 2 sf and correct POT $_1$✔

order of magnitude of A = –1 **OR** 10^{-1} $_2$✔

m^{-3} $_3$✔

x/m	y/m	A when $n = 4$	A when $n = 3.879$ *
1.324	0.612	1.99E-01	2.06E-01
1.168	0.337	1.81E-01	1.85E-01
1.051	0.243	1.99E-01	2.00E-01
0.945	0.156	1.96E-01	1.94E-01
0.843	0.110	2.18E-01	2.13E-01
0.732	0.057	1.99E-01	1.91E-01

alternative approaches:

A evaluated from $A = \frac{y}{x^n}$ **OR** from A = $10^{(\log y - n \log x)}$;

correct substitution of n (from part (c)) and of y and x in (in mm) etc;

A evaluated correctly to minimum 2 sf and correct POT $_1$✔

order of magnitude of A = –10 **OR** 10^{-10} $_2$✔

mm^{-3} $_3$✔

x/mm	y/mm	A when $n = 4$	A when $n = 3.879$ *
1324	612	1.99E-10	4.75E-10
1168	337	1.81E-10	4.26E-10
1051	243	1.99E-10	4.62E-10
945	156	1.96E-10	4.48E-10
843	110	2.18E-10	4.92E-10
732	57	1.99E-10	4.41E-10

ecf for wrong or non-integer value of n, ie for cm$^{(1-n)}$

3

[12]

Q2.

(a) pressure (of air) in **Figure 1c** is greater than (pressure of air) in **Figure 1d**

OR

pressure in **Figure 1d** is lower than pressure in **Figure 1c** $_1$✔

(since) temperature is the same

OR

Boyle's Law applies

OR

PV = constant; $_2$✔

any suggestion that pressure is constant **OR** the volume is constant **OR** the temperature changes **OR** the amount of air in the flask increases as flask is raised loses both marks

for $_1$✔ must refer to either of the relevant figures or give other detail, eg 'when flask is lifted' so their meaning is unambiguous;

*allow 'when volume decreases pressure increases' but must be comparing **1c** with **1d***

*allow 'water pressure decreased in **1d**'*

*treat 'air was compressed' (in **1c**) as neutral*

*reject 'pressure released (in **1d**)'*

for $_2$✔ allow mean KE of molecules is the same

accept $P \propto \frac{1}{V}$ *;*

allow nRT = constant;

reject PV = k (unless k = constant is also seen)

2

(b) same (air) pressure $_1$✔

same mass of air $_2$✔

any suggestion that temperature is constant **OR** that volume is constant **OR** that pressure has changed **OR** the amount of air in the flask decreases as flask is moved from H to C loses both marks

for $_1$✔ and $_2$✔ accept constant/unchanged = same and condone *'assume same pressure/mass of gas'*

for $_2$✔accept same (number of) moles or same amount of gas

no credit for stating 'volume increases as temperature increases'

'temperature is in equilibrium' is neutral

2

(c) relevant quantity and instrument seen:

volume(s) (of liquid) measured using a measuring cylinder **OR** graduated beaker $_1$✔

reject 'measuring beaker' and 'burette'

eye level with the bottom of the meniscus (allow suitable sketch showing eye) $_2$✔

'measure at eye level' **OR** 'eye level with graduation' **OR** 'eye perpendicular to graduation' are not enough to avoid parallax error $_3$✔

see alternative opposite; if both approaches are given record the mark to whichever scores most

alternative

for $_1$✔mass (of liquid/flask) measured using a balance

reject 'scales' and reject 'weigh/find weight/weigh the mass'

for $_2$✔valid method to account for the mass of flask eg tare/zero balance (ECF 'scales') with (same) empty flask on balance and then measure mass of flask with liquid ***OR***

subtract mass of empty flask from mass of flask containing liquid; don't penalise 'weigh' twice ***OR***

ensure the balance is on a horizontal surface for $_3$✔find volume(s) using $V = \frac{m}{\rho}$ *; V must be subject*

3

(d) suitable vertical scale for their data points covering at least half the grid;

false origin on the vertical scale correctly marked;

vertical scale marked at sensible intervals, based around intervals of 1, 2, 4 or 5 etc; graduations no further than 2 major divisions apart $_1$✔

19, 207 plotted to nearest ½ grid square $_2$✔

86, 255 plotted to nearest ½ grid square $_3$✔

for $_1$✔ the two correct data points a suitable scale is 10 cm^3 for each major division

an unmarked origin is be assumed to be (0, 0); if a broken scale symbol is not used and the V scale becomes non-linear, withhold the mark

award $_{23}$✔ = 1 MAX for thick or poorly-marked points eg thicker than half a grid square;

reject blobs, dots and circles

3

(e) **continuous ruled** best-fit line of positive gradient through intersection of cross-hairs of their points ✔

apply same criteria for judging line quality as in part (c); don't penalise thick line if thick points are penalised in part (d)

1

(f) legitimate method to <u>calculate</u> horizontal intercept

eg gradient calculated from ΔV divided by $\Delta\theta$ ie numerical evidence of 2 steps required; don't penalise read off errors or small steps

reads (to within 1 grid square) **OR** uses a point on the line to calculate (with correct use of $y = mx + c$) the vertical intercept; sensible values are shown on the right $_1$✔

correct use of their vertical intercept and their gradient to calculate the horizontal intercept using –1 × vertical intercept divided by gradient $_2$✔

OR

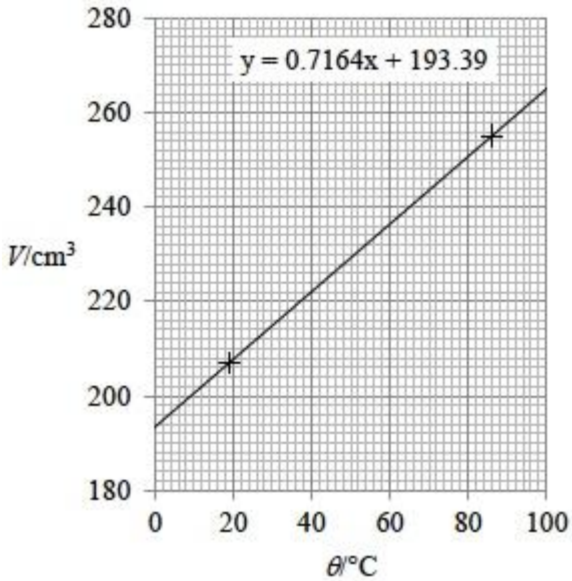
similar triangles, eg

$\frac{255-207}{86-19} = \frac{207-0}{19-\theta}$ or similar seen $_1$✔

minimum $\Delta\theta$ = 86 – 19 (= 67as in example above) $_2$✔

result in range –260°C to –285°C $_3$✔

withhold mark for missing sign; no credit for unsupported answer



in $_1$✔ condone V changed to m^3 when calculating gradient and finding intercept values

for a graph with a negative gradient allow credit for $_1$✔ only = 1 MAX

no credit for non-linear graph = 0 MAX

data which may be seen in working include

V = 193 cm^3, θ = 0 °C; V = 265 cm^3, θ = 100 °C;

V = 207 cm^3, θ = 19 °C; V = 255 cm^3, θ = 86° C

3

[14]