Thermometers + Temperature (2)

A Physics

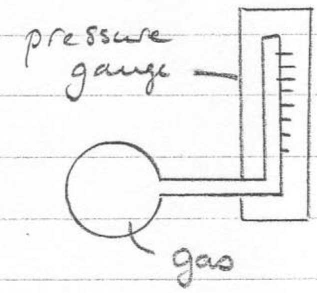
1K = 1°C
0°C = 273K

1 atmosphere pressure = 100,000 Pa = 1 bar.

1. It's a Gas.

The diagram shows a simple gas pressure thermometer.

Here is some data produced by the thermometer.



Temperature °C	Temperature K	Gas Pressure bar	Gas Pressure Pa
100	(c)	2.38	(d)
(e)	273	(f)	1.74×10^5
θ_1		1.87	(g)
θ_2		(h)	5×10^4

(a) What is a thermometric property? (1)

(b) What thermometric property is being used here? (1)

(c) – (h) Copy the table + fill in gaps (c) – (h) (6)

(i) Find temperature θ_1 in °C and K. (3)

(j) Find temp. θ_2 in °C and K (2)

(k) At what temperature, in °C and K, does the gas pressure become zero? (3)

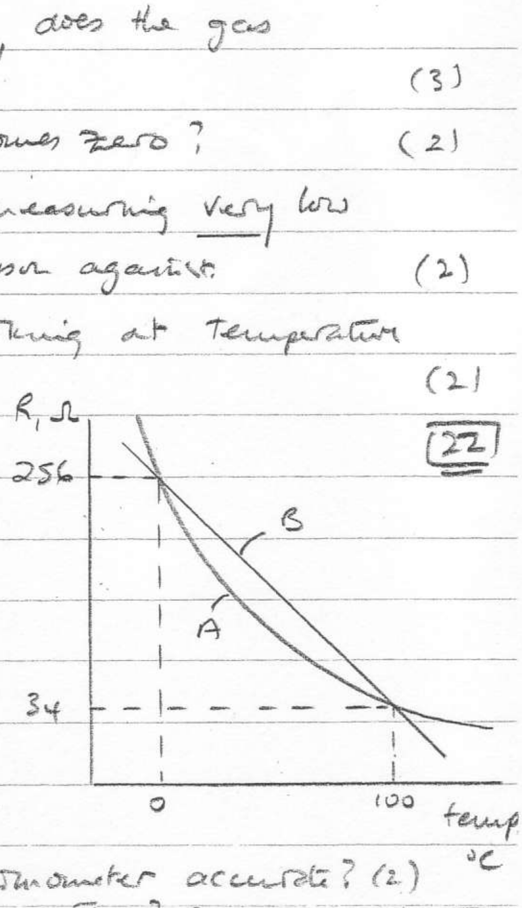
(l) Can you explain why gas pressure becomes zero? (2)

(m) Would this thermometer be useful for measuring <u>very</u> low temperatures? Give 1 reason for and 1 reason against. (2)

(n) Can you give a simple formula for working out temperature in kelvin from gas pressure? (2)

22

2. The resistance of a thermistor changes with temperature, as shown by curve A.



(a) What does line B represent? (1)

(b) When R = 82 Ω, what is the temperature given by thermistor? (2)

(c) Is the true temperature above or below this?

Draw a sketch graph to explain. (3)

(d) At what temperatures is the thermistor thermometer accurate? (2)

(e) In what temp. range is the thermistor most sensitive? Explain. (2)

10

TW 12.98.

Thermometers Answers 2 A Physics

1 (a) Thermometric property – one that varies regularly with temperature –(so you can use it as a measure of temp.) (1

(b) gas pressure (1

(c) 373 K (d) 238,000 Pa (2.38×10^5) (e) 0 °C (f) 1.74 bar

(g) 187,000 = 1.87×10^5 Pa (h) 0.5 bar (6)

(i) $\theta = \left(\dfrac{X_\theta - X_0}{X_{100} - X_0} \right) \times 100$ ① $= \left(\dfrac{1.87 - 1.74}{2.38 - 1.74} \right) \times 100 = \underline{20.3\,°C}$ ① (3

$= \underline{293\ K}$ ①

(j) $\theta = \left(\dfrac{0.5 - 1.74}{2.38 - 1.74} \right) \times 100 = \underline{-194\,°C}$ ① $= \underline{79\ K}$ ① (2

(k) Use $\theta = \left(\dfrac{0 - 1.74}{2.38 - 1.74} \right) \times 100$ ① $= \left(\dfrac{-1.74}{0.64} \right) \times 100 = \underline{-272\,°C}$ ① or $\underline{1\ K}$ ①

(accept small error) (3

(l) Gas pressure = 0 because all atomic motion stops ①, atoms not colliding with container walls ① (2)

(m) For :– gas can remain gaseous at v. low temps and not liquify or freeze (He is best) (1

against :– gas has v. low pressure, and so hard to measure low temps accurately (1

(n) P at 273 K = 1.74 bar.

so P at any temp T kelvin = $T \times 1.74/273 = T \times 0.0064$.

check with T = 373 K

$P = 373 \times 0.0064 = 2.38$ bar — matches data – correct! (2

$\underline{\underline{22}}$

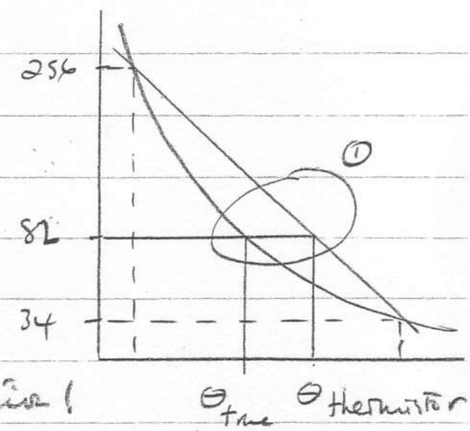
Lme Bu.

2. (a) The change of R with temp. – if the thermistor were linear. (1)

(b) Assuming a linear behaviour ...

$\theta = \left(\dfrac{R_\theta - R_0}{R_{100} - R_0} \right) \times 100$ ① $= \underline{21.6\,°C}$ ① (2)

(c) The true temp. θ_{true} is less than ① the temp. given, $\theta_{thermistor}$ (3)



$\underbrace{\theta_{true} \quad \theta_{thermistor}}_{①}$

(d) accurate at ... 0 °C ① and 100 °C ① by definition!

(e) most sensitive at ... low temperatures ①, because resistance changes most per °C ① (steepest curve ½) $\boxed{10}$

TJW
12.98