

10	D is the correct answer (s.h.c. of solid = s.h.c. of gas) A is not correct because gradient for solid is greater than gradient for liquid B is not correct because gradient for solid is equal to gradient for gas C is not correct because gradient for solid is greater than gradient for liquid	1
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8	A is the only correct answer ($\frac{1}{\sqrt{2}}$) B is not the correct answer, as $\frac{1}{2}m\langle c^2 \rangle = \frac{3}{2}kT$ C is not the correct answer, as $\frac{1}{2}m\langle c^2 \rangle = \frac{3}{2}kT$ D is not the correct answer, as $\frac{1}{2}m\langle c^2 \rangle = \frac{3}{2}kT$	1
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8	D is the only correct answer A is not the correct answer, as the mean kinetic energy is the same for both gases B is not the correct answer, as the mean kinetic energy is the same for both gases C is not the correct answer, as He molecules are more massive than H molecules	(1)
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6	A is the correct answer (1/4) B is not correct because $\frac{1}{2}m\langle c^2 \rangle = \frac{3}{2}kT$ C is not correct because $\frac{1}{2}m\langle c^2 \rangle = \frac{3}{2}kT$ D is not correct because $\frac{1}{2}m\langle c^2 \rangle = \frac{3}{2}kT$	1
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Question Number	Answer	Mark
1	B is the only correct answer A is not the correct answer, as molecular potential energy increases C is not the correct answer, as molecular kinetic energy doesn't change and molecular potential energy increases D is not the correct answer, as molecular kinetic energy doesn't change	(1)

9	C is the correct answer A is not correct, as the pressure, volume and temperature of each gas is the same B is not correct, as the temperature of each gas is the same D is not correct, as the temperature and the number of molecules is the same for each gas	(1)
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Question Number	Answer	Mark
16(a)	Use of $\rho = \frac{m}{v}$	(1)
	Use of $\Delta E = mc\Delta\theta$	(1)
	Use of $P = \frac{\Delta E}{\Delta t}$	(1)
	$P = 1630$ (W) [at least 3 sig fig required] [rounded data may give 1640 W] [If reverse calculation shown then MAX 3 marks] [Do not allow intermediate rounding to less than 3 sig figs for m or ΔE]	(1)
	<u>Example of calculation</u> $m = 4.25 \times 10^{-4} \text{ m}^3 \times 998 \text{ kg m}^{-3} = 0.424 \text{ kg}$ $\Delta E = 0.424 \text{ kg} \times 4190 \text{ J kg}^{-1}\text{K}^{-1} \times (100 - 22) \text{ K} = 1.386 \times 10^5 \text{ J}$ $P = \frac{1.386 \times 10^5 \text{ J}}{85 \text{ s}} = 1631 \text{ W}$	4

16(b)	Use of $\Delta E = L\Delta t$	(1)	
	Use of $P = \frac{\Delta E}{\Delta t}$	(1)	
	$t = 440$ s (ecf from (a)) [show that value for P gives 449 s]	(1)	3
	<u>Example of calculation</u>		
	$\Delta E = 0.75 \times 0.424 \text{ kg} \times 2.26 \times 10^6 \text{ J kg}^{-1} = 7.19 \times 10^5 \text{ J}$		
	$t = \frac{7.19 \times 10^5 \text{ J}}{1630 \text{ W}} = 441 \text{ s}$		

Question Number	Answer	Mark	
19(a)	Use of $pV = NkT$ Use of 75% $N = 2.4 \times 10^{21}$ <u>Example of calculation</u> $N = \frac{pV}{kT} = \frac{0.75 \times 1.03 \times 10^5 \text{ Pa} \times 1.25 \times 10^{-4} \text{ m}^3}{1.38 \times 10^{-23} \text{ J K}^{-1} \times (290) \text{ K}} = 2.41 \times 10^{21}$	(1) (1) (1)	3
19(b)	Use of $pV = NkT$ [Allow ratio of pressures equated to ratio of temperatures] Conversion of temperature from Celsius to kelvin Temperature of gas is $48^\circ\text{C} < 60^\circ\text{C}$ so statement is inaccurate Or Temperature of gas is $321 \text{ K} < 333\text{K}$ so statement is inaccurate (ecf from (a) if candidates use N) <u>Example of calculation</u> $\frac{p_1}{T_1} = \frac{p_2}{T_2}$ $T_2 = \frac{p_2}{p_1} \times T_1 = \frac{0.83}{0.75} \times 290 \text{ K} = 321 \text{ K}$ $\theta = 321 - 273 = 48^\circ\text{C}$	(1) (1) (1)	3
19(c)(i)	Use of $\lambda_{\text{max}}T = 2.898 \times 10^{-3} \text{ m K}$ Use of $L = \sigma AT^4$ $L = 42 \text{ W}$ <u>Example of calculation</u> $T = \frac{2.898 \times 10^{-3} \text{ m K}}{1100 \times 10^{-9} \text{ m}} = 2635 \text{ K}$ $L = 5.67 \times 10^{-8} \text{ W m}^{-2} \text{ K}^{-4} \times 1.55 \times 10^{-5} \text{ m}^2 \times (2635 \text{ K})^4$ $\therefore L = 42.4 \text{ W}$	(1) (1) (1)	3
19(c)(ii)	The filament may not be a perfect black body emitter (of radiation) Or Some energy may be absorbed by the glass (of the bulb)	(1)	1
Total for question 19			10

Question Number	Answer	Mark
15(a)	Energy is transferred from banana to liquid nitrogen	(1)
	<p>The molecular potential energy of nitrogen molecules increases (as the nitrogen boils)</p> <p>Or This provides the latent heat of vaporisation (of the nitrogen)</p> <p>Or This provides the latent heat to change state (of the nitrogen)</p>	(1)
15(b)	Use of $\Delta E = mc\Delta\theta$	(1)
	Use of $\Delta E = mL$	(1)
	<p>$m = 0.23$ kg, which is less than 0.5 kg so the teacher's estimate was inaccurate</p> <p>Or 9.9×10^4 J $>$ 4.5×10^4 J so the teacher's estimate was inaccurate</p>	(1)
	<p><u>Example of calculation</u></p> <p>$\Delta E = 0.118 \text{ kg} \times 1.76 \times 10^3 \text{ J kg}^{-1} \text{ K}^{-1} \times (292 - 77.4) \text{ K} = 4.46 \times 10^4 \text{ J}$</p> <p>$m = \frac{4.46 \times 10^4 \text{ J}}{1.98 \times 10^5 \text{ J kg}^{-1}} = 0.225 \text{ kg}$</p>	(1)
Total for question 15		5