Question	Answers	Extra information	Mark	AO / Specification reference
01.1	volume before = 72 cm^3 volume after = 97 cm^3 difference in volume = volume of clay = 97 cm^3 - 72 cm^3 =15 cm^3		1 1	AO1 AO2 4.3.1.1
01.2	resolution = $\frac{1}{2}$ smallest division = $\frac{1}{2}$ × 5 = 2.5 cm^3		1 1	AO1 A02
01.3	digital balance		1	AO2
01.4	density = $\frac{\text{mass}}{\text{volume}}$	allow $\rho = \frac{m}{v}$	1	AO1
01.5	density = $\frac{23.41}{15}$ = 1.56 g/cm^3	accept 1.56 or 1.6 with no working shown for two marks	1 1	AO2 4.3.1.1
01.6	measure the length of each side (in cm)/measure the length, breadth and height cube the answer/multiply the length, breadth and height		1 1	AO1 4.3.1.1
02.1	vibrating potential moving fast kinetic		1 1 1 1	AO1 4.3.2.1

Question	Answers	Extra information	Mark	AO / Specification reference
02.2	the internal energy changes from mainly potential to mainly kinetic/more kinetic	do not accept answers involving solids/liquids/gases	1 1	AO1 4.3.2.1
02.3	the particles in a gas are in random motion		1	AO1 4.3.2.1
03.1	20 °C		1	AO2
03.2	70 °C		1	AO2
03.3	energy transferred = power × time	allow E = P × t	1	AO1 4.3.2.3
03.4	energy = 1000 × 2 × 60 = 120 000 J energy transferred = mass × specific latent heat of vaporisation 120 000 = mass × 365 000 mass = $\frac{120000}{365000}$ = 0.33 kg	allow E = mL	1 1 1 1 1	AO2 4.3.2.3
03.5	an overestimate (the energy transferred to vaporise the water is lower because) some energy is transferred to the thermal energy store of the surroundings		1 1	AO2 4.3.2.3
03.6	a line that starts at 20 °C steeper than the original line becomes horizontal at 70 °C at about 2 minutes		1 1 1	AO2

Question	Answers	Extra information	Mark	AO / Specification reference
04.1	energy = power × time	allow E = P × t	1	AO1
04.2	2 kW = 2000 W 2 minutes = 120 seconds energy = 2000 × 120 = 240 000 J		1 1 1 1	AO1 AO2 4.1.1.4 4.3.2.3
04.3	change in mass = 1.276 - 1.180 = 0.096 kg energy transferred = specific latent heat × change in mass 240 000 J = specific latent heat of vaporisation × 0.096 kg specific latent heat of vaporisation = $\frac{240000}{0.096}$ = 2 500 000 J/kg = 2500 kJ/kg	allow 2500 with no substitution for two marks allow E = mL	1 1 1 1 1	AO1 AO2
04.4	the energy transferred was heating the material of the kettle/air around it as well as vaporising the water a lower mass of water vaporised than should have been the case so the value calculated was bigger than the textbook value		1 1 1	AO2 4.3.2.3
05.1	the gas has been compressed/is exerting a big pressure on the inside of the container		1	AO1 4.3.3.2
05.2	the student has done work on the gas (so has transferred energy) so has increased the internal energy of the system (which produces an increase in temperature)		1 1	AO1/2 4.3.3.3

Question	Answers	Extra information	Mark	AO / Specification reference
05.3	when the student does work, the particles move more quickly/energy is transferred to the particles the average speed/kinetic energy of the particles increases, so the temperature increases		1 1	AO1 4.3.3.3
06.1	(when the student is in the shower) water evaporates to make water vapour the water vapour condenses when it comes in contact with the colder mirror and energy is transferred to the mirror		1 1 1	AO1 AO2 4.3.1.2
06.2	for converting all kJ to J, cm to m the mass of water that condenses = $\frac{\text{energy}}{\text{specific latent heat of vaporisation}}$ $= \frac{730000}{2265000}$ = 0.322 kg mass = density × volume volume of water = $\frac{0.322}{1\times10^{-8}}$ = 0.000 322 volume = area x thickness thickness of water = $\frac{0.000322}{0.6\times0.6}$ = 8.95×10^{-4} m		1 1 1 1 1 1	AO1 AO2 4.3.1.1 4.3.2.3

Question	Answers	Extra information	Mark	AO / Specification reference
07.1	the particles in a solid are arranges in a regular pattern/array the particles in a gas are moving in all/random direction the particles in a solid are vibrating about a fixed position the particles in a gas are moving quickly		1 1 1 1	AO2
07.2	the particles collide with the walls of the container each particle exerts a force on the wall pressure is force per unit area the total force of all the collisions of the particles per unit area is the pressure		1 1 1 1	AO3
07.3	pressure on y-axis, temperature on x-axis straight line with positive gradient that intercepts y-axis above zero (does not need to be extrapolated)		1 1 1	AO1 AO2 4.1.2.1
08.1	the steam is at a high temperature (and in the gas state) steam transfers latent heat energy to the milk (steam cools/changes to a liquid state and the temperature of the milk rises)		1 1	AO1 AO2 4.3.2.2 4.3.2.3
08.2	convert 242 g to 0.242 kg, and 3.93 kJ/kg °C to 3930 J/kg °C temperature difference = 70 - 20 = 50°C energy required = mass × specific heat capacity × change in temperature = 0.242 × 3930 × 50 = 47 553 J (≈ 48 000 J so about 48 kJ)	allow $E = m\,c\,\Delta\theta$ allow 47533 with no substitution for three marks	1 1 1	AO1 AO2 4.3.2.2

Question	Answers	Extra information	Mark	AO / Specification reference
08.3	convert 2260 kJ/kg to 2260 000 J/kg energy = mass × specific latent heat of vaporisation 47 553 = mass × 2 260 000 mass = $\frac{47553}{2260000}$ = 0.02 kg	allow E= mL	1 1 1 1	AO2 4.3.2.3
08.4	Assume that all the energy transferred to the milk to heat it comes from the change of state of the steam.		1	AO2 4.3.2.3
09.1	B D the temperature isn't changing/doesn't change even though the substance is being heated		1 1 1 1	AO1 4.3.1.2
09.2	solid it changes state twice/goes from solid to liquid, then liquid to gas		1 1	AO1 4.3.1.2
09.3	A		1	AO1 4.3.1.2
09.4	C E		1 1	AO1 4.3.1.2
10.1	volume = $(5)^3$ = 125 cm^3		1 1	AO2 4.3.1.1

OXFORD Revise

Question	Answers	Extra information	Mark	AO / Specification reference
10.2	density = $\frac{\text{mass}}{\text{volume}}$ 1.5 = $\frac{\text{mass}}{125}$ mass = 1.5 x 125cm^3 = 187.5g		1 1 1 1	AO1 AO 4.3.1.1
10.3	sublimation		1	AO1 4.3.1.2
10.4	if the process is reversed, the material recovers its original properties		1	A01 4.3.1.2
10.5	the internal energy of the gas is bigger than the internal energy of the solid the particles have more kinetic energy/are moving faster		1 1	AO2 4.3.1.2
11.1	one mark for correct symbol one mark for correct label		2	AO1 4.2.1.1
11.2	(when they put the test tube into iced water) the temperature of the water decreases the resistance of the thermistor increases the potential difference across the thermistor increases V_{out} decreases because the total potential difference across the thermistor and the resistor = 12 V at all times		1 1 1 1 1	AO1 AO2 4.2.1.4

Question	Answers	Extra information	Mark	AO / Specification reference
11.3	find the potential difference across the resistor by measuring V_{out} find potential difference across thermistor by subtracting V_{out} from 12 V use $\frac{\text{potential difference across the resistor}}{\text{potential difference across the thermistor}} = \frac{\text{resistance of resistor}}{\text{resistance of thermistor}}$ to find the resistance of the thermistor use a graph/table of the resistance of the thermistor at different temperatures to work out the temperature of the water.		1 1 1 1	AO1 AO2 4.2.2
11.4	sensible suggestions e.g., the human body continually generates thermal energy, but the water in the test tube does not		1	AO3
12	**Level 3:** Well organised answer with descriptions of reasons for calculations. Equations for power, efficiency and gravitational potential energy used		5-6	AO1/1 AO2/1 4.1.1.4 4.1.1.2
	Level 2: Some relevant calculations, but descriptions lacking detail or missing, or parts of calculations/conversions incorrect.		3-4	
	Level 1: Some relevant calculations completed, but unit conversions may be missing, and no explanation of method.		1-2	
	No relevant comment.		0	

Question	Answers	Extra information	Mark	AO / Specification reference
	Indicative content: • calculate energy needed to be transferred to bulb: ○ energy = power × time = 0.24 × 60 = 14.4 J • energy transferred to motor must be greater than this because the generator is only 90% efficiency ○ efficiency = $\frac{\text{energy out}}{\text{energy in}}$ x 100 ○ 90 = $\frac{14.4}{\text{energy in}}$ x 100 ○ energy in = $\frac{14.4}{90}$ x 100 ○ = 16 J • this energy is transferred by the falling mass. ○ gravitational potential energy = mass × gravity × height ○ 16 = 0.3 × 9.8 × height ○ height = 5.4 m			
13.1	voltmeter		1	AO2 4.2.1.3
13.2	potential difference = current × resistance	allow V = IR	1	AO1
13.3	potential difference = 15 × 10 = 1.5 V	allow 1.5 with no substitution for two marks	1 1	AO1 4.2.1.3

Question	Answers	Extra information	Mark	AO / Specification reference
13.4	charge = current × time	allow Q = It	1	AO1
13.5	charge = 0.15 × 60 = 9 C/coulombs	allow nine with no substitution for two marks	1 1 1	AO1 AO2 4.2.1.2
13.6	it would increase the potential difference has increased (but the clock resistance is the same)		1 1	AO1 AO2 4.2.1.3
14.1	before the air is pumped out the pressure of the air in the marshmallow pockets = the pressure of the air outside the marshmallow the particles of the air (inside and outside the marshmallow) collide with the (surface/material of the) marshmallow, producing a force, force = pressure × area initially the forces are the same when the teacher pumps the air out, the force/pressure exerted by the particles of the air on the outside is smaller than the force exerted by the particles inside, (so the marshmallow expands)		1 1 1 1 1	AO2 AO3 4.3.3.1 4.3.3.2

Question	Answers	Extra information	Mark	AO / Specification reference
14.2	initially: pressure × volume = $101 \times 10^3 \times 8 \times 10^{-6}$ = 0.808 (Pa m^3) = final pressure × final volume final pressure = $\frac{0.808}{2.7 \times 10^{-5}}$ = 2.99×10^4 Pa = 29.9 kPa. change in pressure = 101 - 29.9 = 71.1 kPa (71 100 Pa)		1 1 1 1 1 1	AO1 4.3.3.2