S4 Physics Practice Paper: Temperature and Heat Capacity, Latent Heat and Change of State, Conduction Convection and Radiation, Gas Laws, Heat and Work, Heat Experiments and Errors (100 marks)

Level: S4 | Subject: Physics | 60 minutes | 100 marks | 24 questions | question paper

Section A: Temperature and Heat Capacity (17 marks)

Each question is worth 4-5 marks; show working and units.

#	Question	Marks
1	0.50 kg of water is heated from 20 C to 40 C. Given c = 4200 J/(kg K), find the energy needed.	4
2	2.0 kg of a liquid absorbs 168 kJ and its temperature rises by 20 K. Find its specific heat capacity.	4
3	0.20 kg of water at 80 C is mixed with 0.30 kg at 20 C, with no heat loss. Find the final temperature.	4
4	A 2000 W heater warms 1.5 kg of water from 20 C to 100 C. Find the ideal time and the actual time at 70% efficiency.	5

Section B: Latent Heat and Change of State (17 marks)

Each question is worth 4-5 marks; note that temperature is constant during a change of state.

#	Question	Marks
5	0.25 kg of ice at 0 C melts completely. Given the specific latent heat of fusion is 334 kJ/kg, find the energy needed.	4
6	0.10 kg of steam at 100 C condenses to water at 100 C. How much energy is released? (specific latent heat 2260 kJ/kg)	4
7	0.50 kg of ice at -10 C is warmed to water at 20 C. Given ice c = 2100 J/(kg K), Lf = 334 kJ/kg and water c = 4200 J/(kg K), find the total energy.	5
8	1.0 g of water evaporating from skin absorbs 2260 J. If all of it heated 100 g of water, what temperature rise results? (c = 4200 J/(kg K))	4

Section C: Conduction, Convection and Radiation (17 marks)

Each question is worth 4-5 marks; name the heat transfer mechanism.

#	Question	Marks
9	A copper rod 0.50 m long with cross-section 2.0 cm2 has ends 100 K apart. Given k = 400 W/(m K), find the rate of heat conduction.	4
10	A rod conducts 40 W at a fixed temperature difference. If it is replaced by one of double the length, same material and area, what is the new rate?	4
11	An object rises from 300 K to 600 K. If its surface is unchanged, by what factor does the radiated power change?	4

12	A vacuum flask eliminates conduction and convection. Radiation is 30% of the heat loss and silvering cuts it to 3%. Find the percentage reduction and explain the vacuum.	5

Section D: Gas Laws (17 marks)

Each question is worth 4-5 marks; use absolute temperature.

#	Question	Marks
13	2.0 L of gas at 300 K and 1.0 atm is heated to 400 K at constant pressure. Find the new volume.	4
14	Gas sealed in a rigid container is at 100 kPa and 300 K. It is heated to 350 K. Find the new pressure.	4
15	3.0 L of gas at 1.0 atm is compressed isothermally to 1.5 L. Find the new pressure.	4
16	24 dm3 of gas is at 300 K and 100 kPa. Use pV = nRT with R = 8.31 J/(mol K) to find the number of moles.	5

Section E: Heat, Work and Efficiency (16 marks)

Each question is worth 4 marks; show the calculation steps.

#	Question	Marks
17	Water falls 50 m; 10% of the lost potential energy becomes heat. Find the temperature rise (g = 9.81 m/s2, c = 4200 J/(kg K)).	4
18	A 2.0 kg metal block sliding at 5 m/s stops, all kinetic energy becoming heat (c = 500 J/(kg K)). Find the temperature rise.	4
19	A 1000 W heater runs for 10 minutes. Find the energy supplied in kJ.	4
20	Burning 0.10 kg of fuel (45 MJ/kg) heats 5.0 kg of water from 20 C to 60 C. Find the efficiency.	4

Section F: Heat Experiments and Errors (16 marks)

Each question is worth 4 marks; state the source of error.

#	Question	Marks
21	A thermometer reads to within +/-0.5 K and a rise of 20 K is measured. Find the maximum percentage error in the rise.	4
22	The same experiment needs 200 s with good insulation and 240 s with poor insulation. Find the extra energy percentage lost.	4
23	Three results for specific heat capacity are 4180, 4220 and 4500 J/(kg K). Identify the outlier and find the mean of the rest.	4
24	An appliance uses 2.5 kWh. Using 1 kWh = 3.6 MJ, find the energy in MJ.	4