S4 Physics Practice Paper: Heat and Specific Heat Capacity, Gas Laws, Forces and Motion, Work Energy and Power, Waves and Sound, Basic Electricity

S4 | Physics | Time: 60 minutes | Total: 100 marks | 24 questions

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Part A: Heat and Specific Heat Capacity (16 marks)

Show your working and state the units.

1. 0.5 kg of water is heated from 20 °C to 80 °C. Given the specific heat capacity of water is 4200 J kg^{-1} K^{-1}, find the energy absorbed. [4]

2. 0.2 kg of ice at 0 °C melts completely into water. Given the specific latent heat of fusion of ice is 3.34 × 10^{5} J kg^{-1}, find the energy required. [4]

3. Explain why a sea breeze (wind blowing from sea to land) usually occurs on a hot sunny day. [4]

4. A thermometer reads 98 °C in boiling water although the true boiling point is 100 °C. Give one possible reason and state how the error can be reduced. [4]

Part B: Gas Laws (16 marks)

Assume ideal gas behaviour and give units in your answers.

5. A fixed mass of gas occupies 2.0 L at 300 K and 1.0 × 10^{5} Pa. It is heated to 400 K at constant pressure. Find the new volume. [4]

6. A gas occupies 6.0 L at 1.0 atm. Its pressure is increased to 3.0 atm at constant temperature. Find the volume. [4]

7. Convert 27 °C to absolute temperature, and find the absolute temperature of 327 °C. [4]

8. Use the kinetic theory of gases to explain why compressing a gas at constant temperature raises its pressure. [4]

Part C: Forces and Motion (18 marks)

Take g = 9.81 m s^{-2}.

9. A car travelling at 20 m s^{-1} decelerates uniformly at 4 m s^{-2} to rest. Find the braking time and the stopping distance. [5]

10. On a velocity–time graph, what do the gradient and the area under the line represent? [4]

11. A body of mass 10 kg is acted on by a resultant force of 30 N. Find its acceleration. [4]

12. A 60 kg person stands on a scale inside a lift accelerating upwards at 2 m s^{-2}. Find the scale reading in N. [5]

Part D: Work, Energy and Power (16 marks)

Take g = 9.81 m s^{-2} and give power in W.

13. A 20 kg box is lifted vertically through 3 m at constant speed. Find the work done. [4]

14. A 2000 W kettle heats 1 kg of water from 20 °C to 100 °C. The specific heat capacity of water is 4200 J kg^{-1} K^{-1}. Assuming no heat loss, find the time required. [5]

15. A ball of mass 2 kg moves at 6 m s^{-1}. Find its kinetic energy. [4]

16. A machine takes in 500 J of energy and delivers 350 J of useful output. Find its efficiency. [3]

Part E: Waves and Sound (17 marks)

Take the speed of sound in air as 340 m s^{-1}.

17. A wave has a frequency of 50 Hz and a wavelength of 4 m. Find its speed. [4]

18. A person sees lightning and hears the thunder 3 s later. Estimate the distance to the lightning. [4]

19. A person shouts towards a cliff and hears the echo 1.5 s later. Find the distance to the cliff. [5]

20. Explain why sound cannot travel through a vacuum. [4]

Part F: Basic Electricity (17 marks)

Assume the battery and connecting wires have negligible resistance.

21. Two 6 Ω resistors are connected in parallel. Find the equivalent resistance. [4]

22. A 12 V battery is connected across a 4 Ω resistor. Find the current and the power dissipated. [5]

23. A 2000 W air conditioner runs 3 hours a day. If electricity costs $1.2 per kWh, find the daily cost. [4]

24. A current of 3 A flows through a 5 Ω resistor. Find the potential difference across it. [4]
