S4 Physics Practice Paper | sound and echoes, refraction and lenses, resistor networks, specific heat capacity, pressure and buoyancy, energy efficiency

Senior Secondary Physics

S4 Physics practice paper with answers: sound, refraction, lenses, resistor networks, specific heat, pressure, buoyancy and energy efficiency.

Question 1 Sound waves and echoes

The speed of sound in air is 340 m/s. A tuning fork vibrates at 500 Hz.

#	Question
1	(a) Find the period of the sound wave in milliseconds and its wavelength in metres.
2	(b) How many complete vibrations does the fork make in 3 seconds?
3	(c) A person shouts in front of a cliff and hears the echo 0.8 s later. Find the distance to the cliff.
4	(d) Two identical machines each produce 70 dB. Find the combined sound level and explain why it is not 140 dB.

Question 2 Refraction and lenses

A ray of light enters glass of refractive index 1.5 from air at an angle of incidence of 30 degrees.

#	Question
5	(a) Find the angle of refraction.
6	(b) Find the critical angle at the glass to air boundary.
7	(c) A convex lens of focal length 10 cm has an object 30 cm away. Find the image distance, the magnification and describe the image.
8	(d) If the object is moved to 15 cm from the lens, find the image distance and magnification.

Question 3 Resistor networks and electrical energy

A 12 V supply is connected to a 4 ohm resistor in series with a parallel pair of 6 ohm and 3 ohm resistors.

#	Question
9	(a) Find the equivalent resistance of the parallel part.
10	(b) Find the total resistance and the total current.
11	(c) Find the voltage across the parallel part and the current in the 6 ohm resistor.
12	(d) Find the charge passing through the circuit in 5 minutes and the energy dissipated in the 4 ohm resistor.

Question 4 Specific heat capacity and mixtures

A heater raises 2 kg of water from 20 to 45 degrees Celsius in 300 s. The specific heat capacity of water is 4200 J per kg per K.

#	Question
13	(a) Find the energy gained by the water in joules and in kilojoules.
14	(b) Assuming no heat loss, find the power of the heater.
15	(c) Mix 0.5 kg of water at 80 degrees with 1.5 kg of water at 20 degrees. Find the final temperature.
16	(d) Two rods of the same material and cross sectional area have lengths in the ratio 1 : 2. With the same temperature difference, find the ratio of their rates of heat conduction.

Question 5 Pressure and buoyancy

A box of mass 30 kg rests on level ground. Its base area is 0.15 square metres and a side face measures 0.30 square metres. Take g as 10 N per kg.

#	Question
17	(a) Find the pressure the box exerts on the ground.
18	(b) If the box is turned to rest on its side, find the pressure.
19	(c) Find the pressure due to water at a depth of 1.5 m, ignoring atmospheric pressure.
20	(d) Find the upthrust on a 0.002 cubic metre object fully immersed in water, and the volume of water displaced by a floating object weighing 12 N.

Question 6 Efficiency and cost of electricity

An electric motor has an input power of 500 W and a useful output power of 350 W.

#	Question
21	(a) Find the efficiency of the motor.
22	(b) If it runs for 30 minutes, find the energy supplied in joules and in kilowatt hours.
23	(c) At $1.2 per kilowatt hour, find the cost of that run.
24	(d) State the power lost and where it goes, and explain why total energy is conserved.