45 Very Hard Calculation Questions based on all the GCSE Physics Equations

1. A 1200 kg car speeds up from 15 m/s to 31 m/s. The engine transfers 720000 J of energy during this time. Calculate the efficiency of the energy transfer to kinetic energy.
2. A 70 kg skier descends a slope with a vertical drop of 45 m. At the bottom, the skier is travelling at 24 m/s. Calculate how much energy has been transferred to the surroundings.
3. A 0.30 kg ball is dropped from a height of 20 m and rebounds upwards at 12 m/s. Calculate the energy transferred to the surroundings during the bounce and fall.
4. A spring launcher fires a 0.050 kg ball at 18 m/s. The spring constant is 900 N/m. Calculate the compression of the spring, assuming 80% efficiency.
5. A 2.0 kg kettle of water is heated from 18°C to 100°C and then 0.15 kg of water boils away. Calculate the total energy transferred. Use c = 4200 J/kg°C and L = 2260000 J/kg.
6. A 3.0 kW heater is 85% efficient. It heats 1.5 kg of water from 20°C to 95°C. Calculate the time taken.
7. A 12 V battery powers a motor for 8 minutes. The current is 6 A. The motor is 70% efficient. Calculate the useful energy transferred by the motor.
8. A phone charger transfers 54000 C of charge at 5 V. If only 65% of the energy is stored in the phone battery, calculate the useful energy stored.
9. A 230 V appliance transfers 1.38 MJ of energy in 10 minutes. Calculate the current drawn by the appliance.
10. A heater has a resistance of 18 Ω and is connected to a 230 V supply. Calculate the energy transferred in 5 minutes.
11. A 2.4 kW oven is used for 1 hour 20 minutes. Electricity costs 32 p per kWh. Calculate the cost of using the oven.

12. A steel block has dimensions 25 cm × 12 cm × 8 cm and a density of 7850 kg/m³. Calculate its mass.
13. A 0.50 kg aluminium block cools from 180°C to 25°C. Calculate the energy transferred to the surroundings. Use c = 900 J/kg°C.
14. A gas in a sealed syringe has a volume of 80 cm³ at a pressure of 100000 Pa. The plunger compresses it to 25 cm³. Calculate the final pressure.
15. A submarine window has an area of 0.75 m² and is 300 m below the surface. Calculate the force on the window due to the water pressure. Use ρ = 1030 kg/m³.
16. A hydraulic lift uses a pressure of 250000 Pa to lift a car of mass 1200 kg. Calculate the minimum area of the lifting piston.
17. A 950 kg car brakes from 28 m/s to rest over 56 m. Calculate the average braking force.
18. A 0.060 kg tennis ball travelling at 45 m/s is hit back at 35 m/s in the opposite direction. The contact time is 0.008 s. Calculate the average force on the ball.
19. A 1500 kg car accelerates from 12 m/s to 30 m/s over 9 s. Calculate the resultant force and the distance travelled during the acceleration.
20. A rollercoaster of mass 600 kg starts from rest at the top of a 40 m hill. It loses 48000 J to the surroundings. Calculate its speed at the bottom.
21. A lift of mass 800 kg rises 12 m in 15 s. The motor is 75% efficient. Calculate the input power needed.
22. A crane lifts a 500 kg load by 20 m. The motor has an input power of 5 kW and is 80% efficient. Calculate the time taken.
23. A spring stores 45 J of elastic potential energy when compressed by 0.15 m. Calculate the force needed at this compression.
24. A spring with k = 600 N/m is compressed by 0.20 m and launches a 0.10 kg ball vertically upwards. Calculate the maximum height reached, assuming no energy is wasted.

25. A transformer changes 230 V to 12 V. The secondary current is 5 A. Calculate the primary current, assuming 100% efficiency.
26. A transformer has 120 turns on the secondary coil and produces 18 V. The primary coil is connected to 240 V. Calculate the number of turns on the primary coil.
27. A transformer is 90% efficient. It takes in 240 V at 0.50 A and gives an output voltage of 12 V. Calculate the output current.
28. A wire of length 0.40 m carries a current of 8 A in a magnetic field. The force on the wire is 1.6 N. Calculate the magnetic flux density.
29. A loudspeaker wire experiences a force of 0.24 N in a 0.50 T magnetic field. The wire length in the field is 0.12 m. Calculate the current.
30. A wave travels 1500 m in 5 s. Its wavelength is 12 m. Calculate its frequency.
31. A radio wave has frequency 100 MHz and travels at 300000000 m/s. Calculate its wavelength.
32. A ripple tank wave has a period of 0.20 s and wavelength of 0.15 m. Calculate its wave speed.
33. A microscope makes a 0.20 mm object appear 16 mm tall. Calculate the magnification.
34. A cyclist travels 4.5 km in 12 minutes, then rests for 3 minutes, then travels another 3.0 km in 8 minutes. Calculate the average speed for the whole journey.
35. A car accelerates from 5 m/s to 25 m/s over 100 m. Calculate the acceleration and the time taken.
36. A rocket sled accelerates from rest to 90 m/s over 450 m. Calculate its acceleration and the time taken.
37. A 0.20 kg cricket ball is bowled at 36 m/s. It is hit back at 42 m/s in the opposite direction. Calculate the change in momentum.

38. A 60 kg skateboarder travelling at 6 m/s jumps onto a stationary 3 kg skateboard. Calculate their shared velocity after the jump.
39. A pressure sensor under a chair leg reads 200000 Pa. The area of the chair leg touching the floor is 0.0008 m^2. Calculate the force on that chair leg.
40. A diver is at a depth where the pressure due to water is 490000 Pa. Calculate the depth. Use $\rho = 1000$ kg/m^3.
41. A 500 W motor lifts a 25 kg mass. If the motor is 60% efficient, calculate the maximum speed the mass can be lifted vertically.
42. A car of mass 1000 kg travels at 20 m/s. Its brakes apply an average force of 5000 N. Calculate the stopping distance.
43. A spring stretches by 0.25 m when 150 J of energy is stored. Calculate the spring constant and the force at this extension.
44. A 0.75 kg metal block is heated using a 60 W heater for 8 minutes. Its temperature rises by 32°C. Calculate the specific heat capacity of the metal.
45. A 0.40 kg piece of wax needs 80000 J to melt. Calculate its specific latent heat.