GCSE Topic 1 Physics Mark Scheme AQA

Q1. Unit of energy [1 mark]

- Answer: joule (J). (1 mark)

Q2. Falling ball [2 marks]

(a) Decreasing energy store: gravitational potential energy (1 mark)
 (b) Increasing energy store: kinetic energy (1 mark)

Q3. Gravitational potential energy [3 marks]

(a) Equation: Ep = m × g × h (1 mark)
 (b) Substitution and calculation: Ep = 5.0 × 9.8 × 2.0 = 98 J → increase = 98 J (2 marks: 1 for substitution, 1 for answer)

Q4. Braking cyclist — kinetic energy change [3 marks]

- Point 1: The cyclist's kinetic energy decreases as brakes do work (1 mark)

- Point 2: Most kinetic energy is converted into thermal energy in the brakes (and tyres/air) (1 mark)

- Point 3: Thermal energy is transferred to the surroundings (brake discs and air), causing a temperature rise/heat loss (1 mark)

(Any equivalent description that mentions: KE → work by friction → heat to brakes/air earns full marks.)

Q5. Hooke's law and calculation [3 marks]

(a) Hooke's law: F = k × x (1 mark)
(b) Calculation: F = 200 × 0.05 = 10 N → force = 10 N (2 marks: 1 for substitution, 1 for answer)

Q6. Heating water (specific heat capacity) [4 marks]

(a) Equation: E = m × c × ΔT (1 mark)
(b) Calculation: m = 0.5 kg, c = 4200 J/kg°C, ΔT = 20 °C

- E = 0.5 × 4200 × 20 = 42,000 J → 42 000 J (3 marks: 1 for substitution, 1 for correct multiplication, 1 for final answer)

Q7. Efficiency calculation [2 marks]

- Efficiency = (useful energy output / total energy input) × 100%

- Substitution: (150 / 300) × 100% = 50% (2 marks: 1 for formula/substitution, 1 for final %)

Q8. Sankey diagrams [2 marks]

(a) A Sankey diagram represents energy flows in a system — showing input energy and how it splits into useful output and wasted energy, with arrow widths proportional to energy amounts. (1 mark)
(b) Example of wasted energy in a household: heat loss through walls/windows, wasted heat from old boilers, sound from appliances, heat from electric motors. (1 mark)

Q9. Reduce heat loss from a house [2 marks]

Give any two appropriate measures (1 mark each), e.g.:

- Loft insulation / cavity wall insulation

- Double glazing

- Draught excluders / draught-proofing

- Thick curtains / wall insulation

Q10. Energy resources [3 marks]

(a) Example renewable: solar (1 mark)
 (b) Example non-renewable: coal (or oil, natural gas, uranium) (1 mark)
 (c) One advantage of renewable sources: they do not run out / produce less CO2 when generating electricity (1 mark)

Q11. Power / energy transferred [4 marks]

(a) Equation: P = E / t (1 mark)
 (b) Calculation: P = 1200 W, t = 10 minutes = 600 s

- E = P × t = 1200 × 600 = 720,000 J = 720 kJ (3 marks: 1 for converting time, 1 for substitution, 1 for final answer in kJ)

Q12. Make cars more energy efficient [1 mark]

Accept one reasonable answer, e.g.:

- Improve aerodynamics / reduce weight / use hybrid or electric technology / use low-rolling-resistance tyres / regenerative braking. (1 mark)

Q13. Specific latent heat (fusion) [3 marks]

(a) Definition: Specific latent heat of fusion is the energy required to change 1 kg of a substance from solid to liquid without a change in temperature. (2 marks: 1 for energy per kg, 1 for "solid to liquid" and "no temp change")
 (b) Everyday example: melting ice (in drinks), melting snow, ice packs melting. (1 mark)

Q14. Electrical energy usage (kWh) [3 marks]

- 60 W for 3 hours: convert to kW: 60 W = 0.060 kW (1 mark)

- Energy = power × time = 0.060 kW × 3 h = 0.18 kWh (2 marks: 1 for substitution, 1 for answer)

(If student gives J: 0.18 kWh = 0.18 × 3,600,000 J = 648,000 J — accept if correct and shown.)

Q15. Comparing fuels experiment [6]

- Apparatus: calorimeter (metal can), thermometer, spirit burners with different fuels, balance, stopwatch, insulation (1)

- Measure mass of fuel before & after burning (1)

- Measure initial and final water temp (1)

- Keep water mass & conditions the same (fair test) (1)

- Calculate energy: $Q = mc\Delta T$ per gram of fuel (1)

- Safety: goggles, heatproof mat, ventilated area (1)

(Any equivalent sensible experimental plan covering apparatus, measurements, fair test, calculation and safety receives full marks.)

Q16. Falling stone [3]

(a) Gravitational potential energy decreases (1)
(b) Energy stores that increase (any 2):

- Kinetic energy (1)

- Thermal energy of water (1)

- Sound energy (1)

Q17. Lifting box [4]

(a) Ep = m × g × h (1)
 (b) Substitution: 12 × 9.8 × 1.5 (1)
 = 176.4 (1)
 Answer with unit: 176 J (1)

Q18. Arrow and bow [4]

(a) Elastic potential energy decreases (1)
 (b) Energy transfer explanation:

- Elastic potential → kinetic energy (1)

- Work done by string on arrow (1)

- Arrow gains kinetic energy, moves forward (1)

Q19. Motorbike fuel [4]

- Kinetic energy is constant (1)

- Energy is still transferred to overcome resistive forces (friction, air resistance) (1)

- Energy transferred as thermal energy to surroundings (1)

- Fuel provides the energy to replace these losses (1)

Q20. Falling object [6]

(a) Ep = m × g × h = 2.0 × 9.8 × 10 = 196 J (2)
 (b) Ek = ½ × 2.0 × 12² = 144 J (2)
 (c) KE < GPE because some energy lost to air resistance / heating / sound (2)

Q21. Heating water [5]

(a) E = m × c × ΔT (1)
 = 0.75 × 4200 × (100 − 20) (1)
 = 252,000 J (1)
 (b) More energy supplied because:

- Heat lost to surroundings (1)

- Kettle itself also heats up (1)

Q22. Efficiency [4]

(a) Efficiency = (useful power ÷ total power) × 100 (1)
 (b) (8 ÷ 40) × 100 = 20% (2)
 (c) More efficient bulb wastes less energy / cheaper to run / lasts longer (1)

Q23. Insulated container [4]

(a) Any two: insulation, lid, reduce surface area, thick walls (1 each)
 (b) Shiny surfaces reflect infrared radiation (1) → reduce heat loss (1)

Q24. Fossil fuels vs wind [5]

Credit any 5 valid points, e.g.:

- Fossil fuels: release CO_2 → global warming (1), release SO_2 → acid rain (1), finite resource (1)

- Wind: renewable (1), no greenhouse gases (1), but unreliable / depends on weather (1), visual/noise pollution (1)

Q25. Nuclear fuel [4]

(a) High energy per kg (1)
 (b) Produces radioactive waste (1)
 (c) Opposition: accidents/radiation risk (1), long-term waste storage problem (1)

Q26. Motor [4]

(a) Power = E ÷ t = 480 ÷ 30 = 16 W (2)
 (b) Useful power less because some energy lost as heat / sound (2)

Q27. Energy cost [5]

(a) E = P × t (1)
 (b) 2.0 × 2 = 4.0 kWh (2)
 (c) 4.0 × 0.25 = £1.00 (2)

Q28. Hammer on nail [4]

(a) GPE → KE (1)
 KE → work done on nail (1)
 Work → increases nail's thermal/elastic energy (1)
 (b) Some energy lost as heat, sound, vibration (1)

Q29. Insulation variables [3]

(a) Independent: type of insulation (1)
 (b) Dependent: temperature change / heat loss (1)
 (c) Control: same starting temp, same container, same volume of water (1)

Q30. Specific latent heat [5]

(a) Energy to change 1 kg from liquid → gas without temperature change (2)
 (b) Temperature constant because:

- Energy used to break intermolecular bonds (1)

- Not to increase KE (1)

- Energy supplied used for phase change (1)

Q31. Weights in gym [3]

- Work done lifting weights (1)

- Energy transferred to muscles and surroundings as heat (1)

- Body loses chemical energy → tiredness (1)

Q32. Wind power [4]

(a) Advantage: renewable / no emissions (1)
(b) Disadvantage: unreliable / noisy / visual pollution (1)
(c) Can't meet demand because wind not constant / low energy density / storage issues (2)

Q33. Kettle [4]

(a) $E = P \times t = 1500 \times 180 = 270,000$ J (3)
(b) Wasted energy: heat lost to air, kettle body (1)

Q34. Scooter [2]

(a) Renewable: solar, wind, hydro, tidal (1)
(b) Disadvantage: unreliable / weather-dependent / expensive (1)

Q35. Surface area & cooling [5]

- Fill containers with same volume of hot water (1)

- Use containers with different surface areas (1)

- Measure initial and final temperatures (1)

- Same time intervals / same room conditions (1)

- Fair test: same material, insulation, water mass (1)

Q36. Power station [4]

(a) Chemical energy in coal (1)
 (b) Coal burned → heat energy (1)
Heats water → steam produced (1)
Steam turns turbine, drives generator (1)

Q37. Tidal vs wind [1]

Tides are predictable / always occur twice daily (1)

Q38. Washing machine [2]

(a) Wasted: heat, sound, vibrations (1)
 (b) Reduce with insulation / quieter motors / more efficient design (1)

Q39. Electric heater [4]

(a) P = E ÷ t = 3000 ÷ 20 = 150 W (2)
 (b) Not 100% efficient because some energy lost as sound/light/heat to surroundings (2)

Q40. Pumped storage [5]

Advantages:

- Stores surplus energy (1)

- Quick response to demand (1)

- Renewable / no CO_2 (1)

Disadvantages:

- Needs suitable geography (valleys, reservoirs) (1)

- Expensive to build (1)

- Can impact local habitats (1)

Q41. Specific heat capacity practical [6]

Credit up to 6 points:

- Apparatus: block of aluminium with heater and thermometer (1)

- Connect heater to power supply + joulemeter / ammeter & voltmeter with stopwatch (1)

- Measure mass of block (1)

- Record temperature change over time (1)

- Calculate energy supplied using E = V × I × t (or joulemeter reading) (1)

- Reduce heat loss: insulation, lagging block, place lid on (1)

Q42. Motor lifting load [6]

(a) Work done = m × g × h = 50 × 9.8 × 6 = 2940 J (2)
(b) Power = W ÷ t = 2940 ÷ 12 = 245 W (2)
(c) Useful power less because:

- Energy lost as heat due to friction (1)

- Or as sound (1)

Q43. Efficiency [5]

(a) Two equations:

- Efficiency = useful output ÷ total input (1)

- Efficiency = useful power ÷ total power (1)
  (b) Efficiency = 1200 ÷ 2000 = 0.6 (1)
  = 60% (1)
  Correct unit / both forms given (1)

Q44. Thermal conductivity experiment [5]

Credit up to 5 points:

- Use rods of different metals, same dimensions (1)

- Heat one end of each rod with a Bunsen burner (1)

- Measure time for wax/marker to melt/fall at the other end (1)

- Compare times → faster melting = higher conductivity (1)

- Control variables: same heat input, same rod length, same starting temp (1)

Q45. Nuclear power station [5]

(a) Nuclear energy store (1)
(b) Transfers:

- Nuclear → thermal (in reactor core) (1)

- Thermal → kinetic of steam (1)

- Kinetic of turbine → kinetic of generator (1)

- Generator transfers → electrical (1)

Q46. Solar panel [4]

(a) Energy = 100 × 5 ÷ 1000 = 0.5 kWh (2)
 (b) Limitation (any 2 for 2 marks):

- Depends on sunlight (1)

- Ineffective at night / poor in cloudy weather (1)

Q47. Cogeneration (CHP) [4]

- Uses waste heat for heating, not just electricity (1)

- More efficient overall (1)

- Reduces fuel use (1)

- Lower CO_2 emissions than conventional stations (1)

Q48. Tidal barrages [5]

Advantages:

- Renewable (1)

- Predictable / reliable (1)

- No greenhouse gases (1)
   Disadvantages:

- High construction cost (1)

- Environmental impact: affect habitats / fish migration (1)

Q49. Biofuels [4]

(a) Renewable / reduce fossil fuel use (1)
 (b) Large land use / deforestation / food vs fuel conflict (1)
 (c) Carbon neutral because:

- CO_2 released when burned = CO_2 absorbed by plants during growth (1)

- Net zero carbon (1)

Q50. Kettle efficiency [4]

(a) Efficiency = (330 ÷ 450) × 100 = 73% (2)
 (b) Improve efficiency (any 2):

- Insulate kettle (1)

- Use lid / smaller volume of water (1)

Q51. Crane lifting [4]

(a) Work = m × g × h = 2000 × 9.8 × 8 = 156,800 J (2)
 (b) Power = W ÷ t = 156,800 ÷ 40 = 3920 W (2)

Q52. Insulation thickness investigation [6]

Credit up to 6 points:

- Apparatus: containers, hot water, insulation of different thicknesses, thermometer, stopwatch (1)

- Measure initial temperature (1)

- Measure temperature drop over set time (1)

- Repeat with different thicknesses (1)

- Independent variable: thickness of insulation (1)

- Control variables: same water mass, same starting temp, same container type (1)

Q53. Electricity cost [2]

Cost = 12 × 0.30 = £3.60 (2)

Q54. Batteries vs pumped storage [5]

- Batteries: portable (1), useful for small-scale storage (1), but limited lifespan / expensive / hazardous waste (1)

- Pumped storage: large-scale (1), rapid response to demand (1), but requires suitable landscape and large reservoirs (1)

Q55. Switching to renewables [6]

Social:

- New jobs in renewable sector (1)

- Possible local opposition to wind farms / visual impact (1)

Economic:

- High initial investment (1)

- Lower running costs in long term (1)

Environmental:

- Reduces CO_2 emissions (1)

- Protects against climate change (1)