The GCSE Physics of the Nintendo Switch

1. Chemical energy store.
2. Light from the screen, sound from the speakers and movement from the vibration motors are useful energy transfers.
3. Thermal energy store.
4. Some electrical energy is transferred to thermal energy because the components and wires have resistance.
5. Energy transferred = power × time.
6. 5 minutes = 300 s
   Energy = 8 × 300 = 2400 J.
7. 20 minutes = 1200 s
   Energy = 18 × 1200 = 21 600 J.
8. A demanding game uses a higher power, so the battery's energy is used up more quickly.
9. Time = energy ÷ power
   Time = 60 000 ÷ 12 = 5000 s.
10. 5000 s = about 83 minutes.
11. The UK mains supply is about 230 V and uses alternating current.
12. The charger reduces the potential difference so the Switch can charge safely without damaging the battery or circuits.
13. Power = potential difference × current
    Power = 5 × 1.6 = 8 W.
14. Potential difference = current × resistance
    Potential difference = 0.25 × 12 = 3 V.
15. Resistance = potential difference ÷ current
    Resistance = 3 ÷ 0.5 = 6 Ω.
16. Copper is used because it is a good electrical conductor and has low resistance.
17. Plastic is used because it is an electrical insulator, light and strong.
18. A larger current transfers more energy each second. This can make components overheat and become damaged.
19. Visible light.

20. Radio waves.
21. They can travel through air and carry information without needing wires.
22. Sunlight reflects off the screen into your eyes. This causes glare and makes the image harder to see.
23. Refraction.
24. Sound is a longitudinal wave.
25. The frequency has increased.
26. The amplitude has increased.
27. Wave speed = frequency × wavelength
Wave speed = 800 × 0.425 = 340 m/s.
28. Sound needs particles to vibrate. A vacuum has no particles, so sound cannot travel through it.
29. The radio waves carry changing signals that transfer information between the console and controllers.
30. A current flows through a coil inside a magnetic field. The coil experiences a force. When the current changes, the force changes. This makes the speaker cone vibrate and produce sound waves.
31. The wire experiences a force.
32. Increase the current or use a stronger magnetic field.
33. The vibration motor does not turn electricity directly into sound. It transfers electrical energy into kinetic energy, causing movement.
34. The current may have increased.
35. A current in a magnetic field experiences a force, so the coil or wire moves.
36. Work done = force × distance
Work done = 2.5 × 0.006 = 0.015 J.
37. Elastic potential energy store.
38. Weight = mass × gravitational field strength
Weight = 0.40 × 10 = 4 N.
39. Gravitational potential energy = mass × g × height
GPE = 0.40 × 10 × 1.3 = 5.2 J.
40. Gravitational potential energy is transferred to kinetic energy as the Switch falls.

41. Momentum = mass × velocity
Momentum = 0.40 × 3.5 = 1.4 kg m/s.
42. A larger momentum means a larger force, or a longer time, is needed to stop it.
43. The case increases the stopping time. The same change in momentum happens over a longer time, so the force is smaller.
44. A wide base makes the Switch less likely to topple because the line of action of its weight is more likely to stay inside the base.
45. The centre of mass is the point where the object's mass seems to act.
46. A tall, narrow stand has a smaller base and a higher centre of mass, so it topples more easily.
47. Pressure = force ÷ area
Pressure = 1.8 ÷ 0.0003 = 6000 Pa.
48. It may be transparent, strong, smooth, hard or scratch-resistant.
49. Friction transfers electrons from one insulating material to another. One object becomes negatively charged and the other becomes positively charged.
50. A sudden discharge of static electricity can send a large current through tiny circuits and damage them.
51. Conductors allow current to flow where it is needed. Insulators stop current flowing where it should not and help protect the user.
52. Plastic does not stop all energy transfers. It reduces electrical conduction, but heat and radiation can still be transferred.
53. A larger current means more energy is transferred each second. Because the circuits have resistance, more energy is transferred to the thermal energy store.
54. In conduction, particles in the hot part vibrate more and pass energy to neighbouring particles.
55. Metals are good thermal conductors because they contain free electrons that transfer energy quickly.
56. Convection.
57. It emits more infrared radiation.
58. Ventilation holes let warm air escape. If they are blocked, thermal energy is removed less effectively, so the temperature rises.
59. Acceleration is the change in velocity per second.

60. Acceleration = change in velocity ÷ time
Acceleration = 4 ÷ 0.8 = 5 m/s².
61. Buttons, joystick, touchscreen or motion sensor.
62. Screen, speaker or vibration motor.
63. Digital signals are less affected by noise and are easier for circuits to process.
64. The Switch is not 100% efficient because some energy is wasted as thermal energy.
65. The energy does not disappear. It is transferred to light, sound, movement and thermal energy in the surroundings.
66. Example: a speaker uses electromagnetism because a coil in a magnetic field experiences a force. It also uses waves because the vibrating cone produces sound waves.
67. A Nintendo Switch uses electrical circuits to transfer energy from the battery to the screen, processor, speakers and vibration motors. The screen emits visible light, the speakers produce sound waves and Wi-Fi or Bluetooth uses radio waves. Forces are involved when buttons are pressed and when the vibration motors move. Some energy is wasted as thermal energy, so the Switch is not 100% efficient.