Combined Physics Recall Questions

Topic 2 – Motion and forces

1. Define the term: scalar quantity
2. Define the term: vector quantity
3. Explain the difference between vector and scalar quantities
4. List some vector and scalar quantities
5. Define the term velocity
6. State the equation for acceleration
7. Describe three ways of measuring speed in a classroom.
8. State the general speeds of wind and sound, and for walking, running, cycling, driving and flying
9. State the acceleration due to gravity.
10. State Newton's First law
11. State Newton's second law. Include the general equation.
12. Define weight and include the equation.
13. Describe how weight is measured
14. Describe how changing mass changes acceleration.
15. Describe how to measure human reaction times.
16. State some typical reaction times in humans.
17. State the equation for stopping distance.
18. Describe some factors that affect stopping distance.
19. Describe some factors that affect human reaction time.

Topic 2 – Motion and forces

1. A quantity with only magnitude
2. A quantity with magnitude and direction
3. Vector quantities have direction, scalar does not.
4. Vector: forces, velocity, displacement. Scalar: mass, distance, speed, temperature
5. The speed of an object in a given direction
6. a = (v – u) /t
7. Stopwatch and meter ruler, light gates, video
8. State the general speeds of 5 – 20 m/s, 330m/s, and for 1.4m/s, 3m/s, 6m/s, 13 – 30m/s and 250m/s
9. $10m/s^2$
10. Objects at rest stay at rest, objects in motion stay in motion unless a force acts on them
11. The acceleration of an object is proportional to its mass. F = m x a
12. Weight is the force acting on an object due to gravity. W = m x g
13. Newton meter
14. Increase mass, acceleration decreases proportionally. V.V
15. Place hand on edge of table, drop ruler, measure distance before catch / online reaction time tool
16. 0.2 – 0.6s
17. Stopping distance = thinking distance + braking distance
18. Road condition, brake condition, mass of vehicle
19. Stimulants, depressants, tiredness, distractions (phones radio etc.)

Topic 3 – Conservation of energy

1. State the equation for gravitational potential energy.
2. State the equation for kinetic energy.
3. Describe the law of conservation of energy.
4. Describe the meaning of a closed system.
5. Describe what is meant by wasted energy.
6. Describe what happens to wasted energy.
7. Define the term dissipated.
8. Describe the effect of lubrication on energy dissipation.
9. Describe the effect of insulation on dissipation.
10. State the equation for efficiency
11. Describe how to increase efficiency (lubrication and insulation)
12. Define non-renewable energy
13. Define renewable energy
14. Describe 4 non-renewable energy sources
15. Describe 8 renewable energies.

Topic 3 – Conservation of energy

20. GPE = m x g x h
21. KE = 0.5 x m x v^2
22. Energy is not created, not destroyed, only turned from one form to another
23. A collection of objects that can transfer energy between them, but no extra energy is added and none removed.
24. Energy that is transferred in un-useful ways.
25. Dissipated into the environment
26. Lost to the surroundings
27. Reduces transfer of energy due to friction
28. Reduced transfer of energy due to heating
29. Efficiency = useful energy / total energy
30. Reduce un-useful energy transfers through lubrication and insulation
31. Energy resources that will run out
32. Energy resources that are replaced as fast as they are used.
33. Nuclear, coal, natural gas, crude oil
34. Hydro-electric, wind, solar, tidal, wave, biofuels

Topic 4 – Waves

1. Waves transfer _____________ and _____________ without transferring ____________
2. Define the term wavelength
3. Define the term frequency
4. Define the term amplitude
5. Define the term period
6. Define the term wave velocity
7. Describe longitudinal waves
8. Describe transverse waves
9. State whether these are longitudinal or transverse: sound, EM, P waves, S waves and water waves.
10. State the equation for wave speed when you have frequency and wavelength
11. State the equation for wave speed when you have distance and time
12. Define the term refraction
13. Describe what happens to the wave speed of different wavelengths when travelling through glass.
14. Describe how to measure angles of light rays
15. Define the term normal line
16. Define the term angle of refraction
17. Define the term angle of incidence.

Topic 4 – Waves

35. Waves transfer information and energy without transferring matter
36. The distance between two points in a wave
37. The number of waves per second
38. Either, the distance that particles move from resting or the relative field strength of the EM wave
39. 1 / frequency – the amount of time taken for one complete wave to form.
40. The speed of a wave in a given direction
41. Oscillations are parallel to the direction of energy travel
42. Oscillations are perpendicular to the direction of travel
43. State whether these are longitudinal or transverse: L, T, L, T and T.
44. $v = f \times \lambda$
45. $v = x / t$
46. A ray of light bending after crossing a medium of differing density
47. Decreases
48. Use a ray box, measure form the normal to the ray
49. A 90^0 angle from the medium border
50. The angle from the normal to the refracted ray
51. The angle from the normal to the incidence ray

Topic 5 – Light and the electromagnetic spectrum

1. State whether EM waves are longitudinal or transverse
2. State the order of the EM spectrum from high wavelength to low wavelength.
3. State the order of the visible light spectrum from high to low frequency
4. State the type of EM wave that can be detected by eyes.
5. Describe some uses of the EM spectrum.
6. Describe how frequency can affect energy transfer
7. Define the term spectrum.
8. Describe the harmful effects of the three highest frequency EM waves.

Topic 5 – Light and the electromagnetic spectrum

52. Transverse
53. Radio, Micro, Infrared, visible light. Ultraviolet, X-rays, Gamma rays
54. Violet, Indigo, Blue, Green, Yellow, Orange, Red
55. Visible light
56. R-communication, M-communication / cooking, I-heating, V-photography, UV – forgery. X and G - medical
57. Increasing frequency increases energy transfer
58. A continuous scale between two extreme points.
59. Can cause mutations and cancer

Topic 6 – Radioactivity

1. Describe the structure of the atom fully, including all masses, charges and locations.
2. State the size of the nucleus in standard form.
3. Define the term isotope including the term atomic number and nucleon number.
4. State the relative masses and relative electric charges of protons, neutrons, electrons and positrons
5. Describe the result of the absorption or emission of EM radiation.
6. Define the term emission.
7. Describe how positive ions are formed
8. Describe the location of all nuclear radiation source
9. Describe the term ionisation
10. Define the term background radiation
11. Describe the origins of background radiation.
12. Describe how to use photographic film to detect radiation
13. Describe how to use a Geiger- Müller tube for measuring radioactivity
14. Describe the structure of alpha, beta minus, positron and gamma radiation.
15. Describe alpha, beta and gamma properties including penetration and ionisation capabilities.
16. Describe how and why the atomic model has changed over time: plum pudding, Rutherford and Bohr
17. Describe the process of β^- decay
18. Describe the process of β^+ decay
19. Describe the effects on the atomic (proton) number and mass (nucleon) number of radioactive decays
20. State the unit of nuclear activity
21. Describe the term half life
22. Describe the dangers of ionising radiation

Topic 6 – Radioactivity

60. Proton–mass 1, charge +1, nucleus Neutron–mass 1, charge none, nucleus Electron–mass 0, charge -1, shells
61. 1×10^{-10} m
62. Same number of protons different number of neutrons.
63. Proton-mass 1, charge +1 Neutron-mass 1 charge none Electron-mass 1/1835, charge -1
64. Electrons jump shells when EM is absorbed. Atoms release EM when atoms fall down shells
65. Release of energy or matter from a nucleus
66. Loss of electrons
67. The nucleus
68. The gain or loss of electrons from a neutral nucleus
69. The constant low level radiation present in the environment
70. Cosmic rays from space, radon gas from the ground, building materials, medical
71. Photographic film reacts to radiation, showing dark areas where nuclear radioactive decay is strongest
72. Place sample a set distance from the Geiger-Muller tube and determine count rate for set amount of time.
73. Alpha– 2 protons, 2 neutrons Beta Negative – high powered electron, Positron – positron, Gamma – EM wave
74. A low pen. , high ionisation, B-medium pen., medium ionisation, γ high pen. low ionisation
75. PP – cloud of -ve charge, +ve charges in the cloud R-fired α at gold foil, saw nucleus B-electrons in shells
76. Neutron decays into proton and emits high power electrons
77. Proton decays into neutron and emits positron
78. α – proton decrease by two, mass decrease by 4. β- proton +1 β+- proton -1
79. Bequerel (Bq)
80. The time taken for the activity to decrease by half
81. Can cause cancer / mutation of DNA

Topic 8 – Energy – forces doing work

1. Describe some changes involved in the way energy is stored when systems change

2. Define the term closed system
3. State the different ways that the energy of a system can be changed
4. Define the term work done
5. State the equation for calculating work done when you have force and distance moved.
6. State the equation to calculate the change in gravitational PE when an object is raised above the ground.
7. State the equation to calculate the amounts of energy associated with a moving object:
8. Define the term dissipation
9. Define the term power
10. State the equation for calculating power when you have the energy transferred and the time taken.
11. Define the term Watt.
12. State the equation for efficiency.

Topic 8 – Energy – forces doing work

82. Any reference to stores and transfers
83. A group of objects that do work with no energy coming in and no energy coming out.
84. Forces (mechanically), heating, electrical transfer
85. When a force moves and object
86. W = F x d
87. GPE = m x g x h
88. KE = 0.5 x m x v^2
89. Energy lost to the surroundings
90. The amount of energy transferred in a unit of time.
91. P = E / t
92. Joule per second
93. Efficiency = useful energy transferred / total energy transferred

Topic 9 – Forces and their effects

1. Define the term contact force
2. Define the term non-contact force.
3. Describe some contact forces
4. Describe some non-contact force.
5. State Newton’s First Law
6. Describe how to reduce unwanted energy transfers in mechanical systems.
7. Describe how to reduce unwanted energy transfers in heated systems.

Topic 9 – Forces and their effects

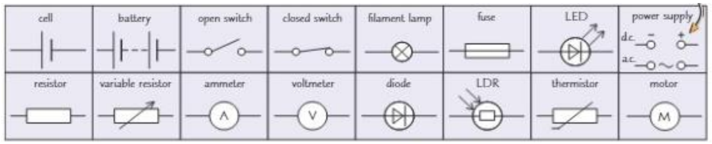
94. A force that acts when objects touch
95. A force that acts when objects do not touch
96. Friction – 2 surfaces moving opposite, Contact – resting between 2 surfaces, resistance…
97. Weight – force of gravity, Magnetism–between opposite magnetic poles, Electrostatic–opposite electric fields
98. Objects at rest stay at rest and objects in motion stay in motion unless a force acts against it.
99. Lubrication – reduces friction. Insulation – reduces heating
100. Insulation – reduces heating

Topic 10 – Electricity and circuits

1. Describe the structure of the atom, limited to the position, mass and charge of protons, neutrons and electrons
2. Draw the symbols that represent cells, including batteries, switches, voltmeters, ammeters, resistors, variable resistors, lamps, motors, diodes, thermistors, LDRs and LEDs
3. Describe the differences between series and parallel circuits
4. Describe how to connect a voltmeter over a filament lamp.
5. Define the term potential difference, include the units, the unit symbol and the equation symbol.
6. Define the term charge, include the units, the unit symbol and the equation symbol.
7. State the equation to find the energy transferred when you have the charge and the voltage.
8. Describe how to connect and ammeter to a circuit.
9. Define the term current include the units, the unit symbol and the equation symbol.
10. State the equation for charge when you have current and time.
11. Describe what conservation of current in a parallel circuit means.
12. Describe the use of a variable resistor for increasing or decreasing current.
13. State the equation for voltage when you have current and resistance.
14. Describe how connecting resistors in series affect resistance
15. Describe how connecting resistors in parallel affects resistance
16. Describe the effect of increasing resistance on current in circuits.
17. Describe the effect of increasing the current in an ohmic resistor
18. Describe the effect of increasing the current in a filament lamp
19. Describe the effect of increasing current in a diode.
20. Describe the effect of changing temperature on a thermistor
21. Describe the effect of changing light levels on a light dependent resistor.
22. Define and describe the term resistance, including reference to subatomic particles.
23. Describe the energy transfers in a resistor when there is an electric current.
24. Describe the term dissipation
25. Describe the cause of dissipation in electrical circuits
26. Describe the effect of using low resistance wires on energy transfers
27. Describe advantages and disadvantages of the heating effect of electric current.
28. State the equation to calculate energy when you have voltage, current and time.
29. Define the term power include the units, the unit symbol and the equation symbol.
30. Describe the link between voltage, current and power.
31. State the equation to calculate power when you have voltage and current
32. State the equation to calculate power when you have resistance and current.
33. Describe the difference between direct and alternating voltage, include directionality and sources
34. Describe fully the UK electrical domestic supply.
35. Describe the function, and properties of the wires in UK domestic plugs.
36. Describe the function of an earth wire and of fuses or circuit breakers in ensuring safety

Topic 10 – Electricity and circuits

101. Proton–mass 1, charge +1, nucleus Neutron–mass 1, charge none, nucleus Electron–mass 0, charge -1, shells
102.



103. Series: $V_T=V_1+V_2$, $I_T=I_1=I_2$, $R_T=R_1+R_2$ Parallel: $V_T=V_1=V_2$, $IT=I_1+I_2$, $1/R_T=1/R_1+1/R_2$
104. In parallel
105. Joule per Coulomb, EQN SYM: V, UNITS: Volt, UN SYM: V
106. The electrical charge passed in a unit of time, EQN SYM: Q, UNITS: Coulomb, UN SYM: C
107. E = Q x V
108. In series
109. The flow of charge, EQN SYM: I, UNITS: Amp, UN SYM: A
110. Q = I x t
111. The current splits at a branch and returns at the next junction
112. A rheostat increases and decreases the resistance, which changes the current
113. V = I x R
114. Increases the resistance
115. Decreases the resistance
116. Increasing resistance decreases current
117. The resistance remains constant, current increases proportionally
118. The resistance increase rapidly, the current increases until a maximum, non-proportional
119. In one direction there is no increase, in the opposite direction, the current increases exponentially
120. Increasing temperature decreases resistance
121. Increasing light levels, decreases resistance
122. Electrons collide with +ve ions, causing the +ve ions to oscillate, KE is decreased, current decreases
123. KE in electrons -> Transferred via electrical work-> KE in +ve ions and Thermal store
124. Energy transferred to the environment
125. Thermal store of wires increases and is transferred to the environment
126. Decreases the thermal store of the wires, decreases energy dissipation, increases efficiency
127. ADV: cooking, toasting, heating. DIS: decreased efficiency,
128. E = V x I x t
129. Joule per second, EQN SYM: P, UNITS: Watt, UN SYM: W
130. Increase current, increase power / increase voltage, increase power / V-V
131. P = I x V
132. P = I^2 x R
133. AC – changes direction very quickly, mains, 230V DC – one direction only, batteries and DC converters
134. 50Hz frequency, 230V, alternating current
135. Brown: live wire 230V. Green and White: earth wire safety. Blue: neutral wire 0V, return to the power plant
136. EW: safety in case of live wire connection with case. Fuse: melts in case of high current / overflow.

Topic 12 – Magnetism and the motor effect

1. ___________ magnetic poles ___________ and ___________ magnetic poles repel.

2. Describe the uses of permanent and temporary magnetic materials including cobalt, steel, iron and nickel
3. Describe the difference between permanent and induced magnets
4. Describe the shape and direction of the magnetic field around bar magnets.
5. Describe the use of plotting compasses to show the shape and direction of the field of a magnet
6. Describe evidence that the core of the earth must be magnetic
7. Describe the effect of a current flowing through a long straight conductor.
8. Describe how to change the strength of this field.
9. Describe the magnetic field of a solenoid, including reference to field lines.

Topic 12 – Magnetism and the motor effect

137. Opposite magnetic poles attract and like magnetic poles repel.
138. C: high temperature magnets. S: permanent magnets. I: temporary magnets. N: hard metal case for magnets
139. P: always magnetic. T: only induced in the magnetic field of a magnet.
140. From North – South, concentration at the poles, concentrated field lines near magnet.
141. Compass placed near magnet, pencil spot at magnet ribbon, move compass and repeat.
142. Magnets always point north, anywhere on Earth.
143. Induces a weak magnetic field.
144. Increase the voltage and current.
145. Concentrated in the centre, field lines cancel out outside the solenoid.

Topic 13 – Electromagnetic induction

1. Describe the factors that affect the size and direction of an induced potential difference.
2. Describe the effect of an alternating current in one circuit on another in a transformer.
3. Describe the uses of transformers
4. Describe the need for step up transformers
5. Describe the advantages of using high voltage power lines
6. Describe the need for step down transformers
7. Describe the assumptions made when using the power equation for transformers.

Topic 13 – Electromagnetic induction

146. Strength of magnet, size of wire, direction of current.
147. Induces a current in the coil through the generator effect
148. Step-up voltage for transmission and step-down voltage for domestic use.
149. Increase voltage, decrease current, decrease resistance, increase efficiency
150. Reduces power loss, less resistance, less heat energy dissipated (because $P=I^2 \times R$)
151. Decreases the voltage, for safe use in homes
152. The transformer is 100% efficient.

Topic 14 – Particle model

1. Describe the differences between solids, liquids and gasses using kinetic theory.
2. State the equation for density when you have volume and mass
3. Describe how to find the density of an irregular object
4. Describe how to find the density of a regular object
5. Describe how to find the density of a liquid.
6. Describe the reasons for differences in density between the different states of matter.
7. Describe what is meant by the conservation of mass
8. Describe 6 state changes that matter can undertake.
9. Describe the effect of heating a system, referencing temperature and change of state.
10. Define the term specific heat capacity
11. Define the term specific latent heat.
12. Describe the differences between specific hat capacity and specific latent heat.
13. Describe the effect of thermal insulation on energy transfers in systems.
14. Describe an experiment to investigate the specific latent heat of water.
15. Describe an experiment to investigate the specific latent heat of water.
16. Describe the cause of gas pressure
17. Describe the effect of changing the temperature on gas pressure.
18. Describe what is meant by absolute zero
19. Describe how to convert from degrees Celsius to degrees kelvin

Topic 14 – Particle model

153. S: vibrate around a fixed point, little KE L: able to flow, more KE G: fills container, most KE
154. p = m / v
155. Find mass with balance, find volume with overflow can and measuring cylinder, p=m/v
156. Find mass with balance, measure volume with callipers, p=m/v
157. Find mass of empty measuring cylinder, add liquid, find mass, measure volume, p=m/v
158. Greater volume in liquids and gasses, decreases density for a fixed mass.
159. Mass is not created or destroyed in chemical reactions
160. Freezing, melting, condensing, evaporation, sublimating, deposition
161. Temperature increases, until the change of state – energy being used to change state, then increases again.
162. Energy required to increase the temperature of 1Kg of a substance by $1^{o}C$
163. Energy required to change the state of 1Kg of a substance
164. SHC: amount of energy needed to increase temperature SLH: amount of energy needed to change state
165. Reduces dissipation by heating and radiation
166. Measure: mass of water (balance), initial and final temperature (thermometer), energy transferred to heater from joulemeter.
167. Find temperature of ice in boiling tube, place in water bath, measure time interval with stopwatch, find final temperature.
168. Collisions of gas particles on the container, exerting a force
169. Increase the temperature, increases kinetic energy of the particles, increasing the number of collisions.
170. $-273^{0}C$ or 0K – the temperature at which particles have no kinetic energy
171. $^{o}C = K - 273$

Topic 15 – Forces and matter

1. Describe the difference between elastic and inelastic distortion
2. State the equation for linear elastic distortion when you have the spring constant and the force
3. State the equation to calculate the energy in stretching a spring when you have the spring constant and the extension.
4. Describe the difference between linear and non-linear relationships between force and extension
5. Describe an experiment to discover the spring constant of a given spring.

Topic 15 – Forces and matter

172. Elastic: atoms realign after stretching. Inelastic: atoms do not realign after stretching
173. $F = \chi \times K$
174. $E = 0.5 \times k \times \chi^2$
175. During the elastic extension of spring, the relationship is linear proportional until limit of proportionality.
176. Hang spring and ruler, apply mass to spring, measure extension, repeat, graph.

Symbol Equations	Word Equations	Unit Equations	Symbols		Name and Unit	
$x = av\ x\ t$	$distance = average\ speed\ x\ time$	$(m) = \left(\frac{m}{s}\right) x\ (s)$	x	Δh	Distance (m) Meters	Height (m) Meters
$a = \frac{(v-u)}{t}$	$acceleration = \frac{change\ in\ velocity}{time\ taken}$	$(\frac{m}{s^2}) = \frac{(\frac{m}{s})}{(s)}$	av	P	Speed (m/s) Meters / second	Power (W) Watts
$F = m\ x\ a$	$force = mass\ x\ acceleration$	$(N) = (Kg)\ x\ (\frac{m}{s^2})$	t	E	Time (s) Seconds	Energy (J) Joules
$W = m\ x\ g$	$weight = mass\ x\ gravitational\ field\ strength$	$(N) = (Kg)\ x\ (\frac{N}{Kg})$	a	Q	Acceleration (m/s^2) Meters per second squared	Charge (C) Coulombs
$\mathbf{p = m\ x\ v}$	$\mathbf{momentum = mass\ x\ velocity}$	$\mathbf{\left(Kg.\frac{m}{s}\right) = (Kg) x\ (\frac{m}{s})}$	v	V	End velocity (m/s) Meters per second	Voltage (V) Volt
$v = f\ x\ \lambda$	$wave\ speed = frequency\ x\ wavelength$	$\left(\frac{m}{s}\right) = (Hz)\ x\ (m)$	u	I	Start velocity (m/s) Meters per second	Current (A) Amps
$v = \frac{x}{t}$	$wave\ speed = \frac{distance}{time}$	$(\frac{m}{s}) = \frac{(m)}{(s)}$	F	R	Force (N) Newtons	Resistance (Ω) Ohms
$E = F\ x\ d$	$work\ done = force\ x\ distance\ moved$	$(J) = (N)\ x\ (m)$	m	P	Mass (Kg) Kilograms	Power (W) Watts
$\Delta GPE = m\ x\ g\ x\ \Delta h$	$\Delta GPE = mass\ x\ gravitational\ fieldx\ vertical\ height$	$(J) = (Kg)\ x\ \left(\frac{N}{Kg}\right) x\ (m)$	W	k	Power (W) Watts	Constant No Unit
$KE = \frac{1}{2} x\ m\ x\ v^2$	$\Delta Kinetic\ Energy = \frac{1}{2}\ x\ mass\ x\ (speed)^2$	$(J) = \frac{1}{2}\ x\ (Kg)\ x\ (\frac{m}{s})$	g	X	Gravity (N/Kg) Newtons per kilo	Extension (m) Meters
$\rho = \frac{m}{V}$	$density = \frac{mass}{volume}$	$(\frac{kg}{L}) = \frac{(Kg)}{(L)}$	p	G-	Momentum ($Kg.ms^{-1}$) Kilogram meters/ sec	Giga- 10^9
$P = \frac{E}{t}$	$power = \frac{work\ done}{time\ taken}$	$(W) = \frac{(J)}{(s)}$	f	M-	Frequency (Hz) Hertz	Mega- 10^6
$P = \frac{E}{t}$	$power = \frac{energy\ transferred}{time\ taken}$	$(W) = \frac{(J)}{(s)}$	λ	K-	Wavelength (m) Meters	Kilo- 10^3
$E = Q\ x\ V$	$energy\ transferred = charge\ moved\ x\ voltage$	$(J) = (C)\ x\ (V)$	ρ	c-	Density (Kg/m^3) Kilogram / meter cubed	Centi- 10^2
$Q = I\ x\ t$	$charge = current\ x\ time$	$(C) = (A)\ x\ (s)$	V	m-	Volume (m^3 Meters cubed	Milli- 10^{-3}
$V = I\ x\ R$	$voltage = current\ x\ resistance$	$(V) = (A)\ x\ (\Omega)$	E	µ-	Work Done (J) Joules	Micro- 10^{-6}
$P = I\ x\ V$	$electrical\ power = current\ x\ voltage$	$(W) = (A)\ x\ (V)$	F	n-	Force (N) Newtons	Nano- 10^{-9}
$P = I^2\ x\ R$	$electrical\ power = (current)^2\ x\ resistance$	$(W) = (A)\ x\ (\Omega)$	d	p-	Distance (m) Meters	Pico- 10^{-12}
$F = k\ x\ \times$	$force\ on\ a\ spring = spring\ constant\ x\ extension$	$(F) = (k)\ x\ (m)$	ΔGPE		Energy (J) Joules	

Paper 1

1. Weight – assume g=9.8N/kg on Earth:
    a. Calculate the weight of a 45kg girl
    b. A box weighs 49N. What is its mass?
    c. A 85kg astronaut in orbit weighs only 23mN. What is the gravitational field strength?
2. Work done:
    a. Calculate the work done when a box is pushed 20m against 7.0N of friction.
    b. What is the force if 24J is needed to move 6.0m?
    c. It takes 30MJ to fire a sounding rocket that weighs 750N. How high does the rocket go?
3. Distance and speed:
    a. Calculate the distance a car will travel in 30s when moving at 12m/s.
    b. How long will it take a pupil to walk to a lesson 70m away at 1.5m/s?
    c. What is the speed (*in m/s*) of a car that travels 30km in 45 minutes?
4. Acceleration and speed:
    a. Calculate the acceleration of a sprinter who takes 0.70s to reach their maximum speed of 11m/s.
    b. A penny dropped accelerates at 9.8m/s. How fast will it travel when it hits the bottom 3.6s later?
    c. How many seconds will it take a car to accelerate from 45km/hr to 90km/hr at 1.5m/s^2?
5. Force and acceleration:
    a. Calculate the force necessary to accelerate a 10kg mass by 17m/s^2.
    b. What acceleration will a car of mass 1100kg experience if a force of 550N acts on it?
    c. An aircraft's engines provide a thrust of 240kN. What is its mass if it accelerates by 8.0m/s^2?
6. Momentum:
    a. Calculate the momentum of a bullet of mass 0.010kg travelling at 400m/s.
    b. A bike and rider have a combined momentum of 1000kgm/s. If their velocity is 12m/s, what is their combined mass?
    c. What is the velocity of a 58g tennis ball with a momentum of 2.4kgm/s?
7. Kinetic energy:
    a. Calculate the kinetic energy of a bullet of mass 0.010kg travelling at 400m/s.
    b. A car has a kinetic energy of 50 000J when travelling at 10m/s. What is the mass of the car?
    c. A bowler's arm does 90J of work when throwing an 80g rounders ball. What is the speed of the ball?
8. Gravitational potential energy – assume g=9.8N/kg on Earth:
    a. Calculate the gravitational potential energy gained when a 700kg light aircraft takes off to an altitude of 500m.
    b. What height can a 40kg rock reach if it gains 2 800J of gravitational potential energy?
    c. What is the mass of a bird that loses 50J of gravitational potential energy when it dives from a 20m cliff?
    d. A robot on the surface of Mars has a mass of 190kg. It gains 620kJ of gravitational potential energy when it climbs 0.85km up a hill. What is the strength of gravity on Mars?

Paper 2

1. Force and extension of a spring:
   a. Calculate the force needed to extend a spring with a spring constant of 20N/m by 0.020m.
   b. If a spring stretches by 0.020m when 26N is attached, what is the spring constant?
   c. A car's suspension has *four* springs, *each* with a spring constant of 1.2×10^5N/m. By how much will the car sink when an 900N passenger gets into the car?
2. Power and energy:
   a. Calculate the power of a torch when the battery's chemical energy store empties by 45J in 30s.
   b. A rower develops a power of 600W. How long will the 1 900 000J of chemical energy in a Mars bar allow them to row?
   c. A mobile phone has an average power of 0.50W. How much chemical energy must be stored in the battery if it can power the phone for an entire day?
3. Power and work:
   a. Calculate the power of a machine that does 700J of work in 35s.
   b. How long does it take a machine rated at 250W to do 75J of work?
   c. A car develops a power of 20kW when driving along a motorway. If it is driven for 2 hours, how much work does the car do against air resistance?
4. Efficiency and energy:
   a. Calculate the efficiency of a device that usefully shifts 20J of energy when supplied with 50J.
   b. A microwave oven has an efficiency of 60%. How much does the internal energy store of a bowl of baked beans increased when 80 000J of energy is supplied to the oven?
   c. A wind farm has an efficiency of 0.17. If it supplies 120TJ of energy to the National Grid, how much energy was in the wind's kinetic store?
5. Efficiency and power:
   a. Calculate the efficiency of a 60W lightbulb that emits 2.0W of visible light.
   b. A washing machine has an efficiency of 20%. If the power supplied is 1 200W, how much power is usefully shifted?
   c. Steam trains have very low efficiencies – around 5.0%. If it needed 50MW to pull the carriages, what power must have been supplied?
6. Charge flow:
   a. Calculate the charge carried by a current of 2.0A in 6.0s.
   b. How long will it take a current of 10A to transfer 200C of charge?
   c. What current flows from a mobile phone's battery if it transfers 300C per hour?
7. "Ohm's Law"
   a. Calculate the potential difference across a 3.0Ω resistor with 4.0A flowing through.
   b. What is the resistance of a 230V lamp with 0.25A flowing in it?
   c. A 4.7kΩ resistor is connected to a 1.5V cell. How much current flows?
8. Electrical power and p.d.:
   a. Calculate the power of a 230V lamp with 0.25A flowing in it.
   b. What p.d. is needed across a 0.040W LED to cause a current of 0.020A?
   c. A 3kW kettle is connected to the mains. How much current will flow?
9. Electrical power and resistance:
   a. Calculate the power of a 16Ω resistor with 4.0A flowing through it.
   b. What is the resistance of a 1200W heater when 3A flows?
   c. How much current flows through a 2.0mW LED with a resistance of 0.50Ω?
10. (Electrical) energy transferred and power:
    a. Calculate the energy transferred by a 6.0W light bulb in 60s.
    b. How long will a 50W heater take to deliver 200J of energy?
    c. What is the power of a shower that delivers 3.7MJ of energy in 7.0 minutes?
11. Electrical energy transferred and charge:
    a. Calculate the energy transferred by 4.0C in 6.0s.
    b. How much charge must flow through 8.0V to do 4.0J of work?
    c. A spark transfers 0.20μC of charge doing 0.040J of work – what was the p.d.?
12. Density:
    a. Calculate the density of a piece of metal, mass 3000kg and volume $0.70m^3$.
    b. What is the volume of 65kg of air with a density of $1.1kg/m^3$?
    c. What is the mass of $3.0cm^3$ of salt water if it has a density of 1 $100kg/m^3$?

Answers

1. Weight:
   a. 440N
   b. 5.0kg
   c. 2.7×10^{-4} (0.00027) N/kg
2. Work done:
   a. 140J
   b. 4.0N
   c. 40 000m
3. Force and extension of a spring:
   a. 0.40N
   b. 1 300N/m
   c. 0.0019m
4. Moment of a force:
   a. 12Nm
   b. 5.0N
   c. 5.0m
5. Pressure:
   a. 2 800Pa
   b. $0.20m^2$
   c. 200N
6. Distance and speed:
   a. 360m
   b. 47s
   c. 11m/s
7. Acceleration and speed:
   a. $16m/s^2$
   b. 35m/s
   c. 8.3s
8. Force and acceleration:
   a. 170N
   b. $2.0m/s^2$
   c. 30 000kg
9. Momentum:
   a. 4kgm/s
   b. 83kg
   c. 41m/s
10. Kinetic energy:
    a. 800J
    b. 1000kg
    c. 47m/s
11. Gravitational potential energy:
    a. 3 400 000J
    b. 7.1m
    c. 0.25kg
    d. 3.8N/kg
12. Power and energy:
    a. 1.5W
    b. 3 200s
    c. 43 000J
13. Power and work:
    a. 20W
    b. 0.30s
    c. 1.44×10^{8} (140 000 000) J
14. Efficiency and energy:
    a. 40% (=0.4)
    b. 48 000J
    c. 700TJ
15. Efficiency and power:
    a. 3.3% (=0.033)
    b. 240W
    c. 1 000MW (=1GW)
16. Wave speed equation:
    a. 2.5m/s
    b. 1.3m
    c. 5.5×10^{14}Hz
17. Charge flow:
    a. 12C
    b. 20s
    c. 0.083A
18. "Ohm's Law"
    a. 12V
    b. 920Ω
    c. 3.2×10^{-4} (0.00032) A
19. Electrical power and p.d.:
    a. 58W
    b. 2.0V
    c. 13A
20. Electrical power and resistance:
    a. 260W
    b. 130Ω
    c. 0.063A
21. (Electrical) energy transferred and power:
    a. 360J
    b. 4.0s
    c. 8 800W
22. Electrical energy transferred and charge:
    a. 24J
    b. 0.50C
    c. 200 000V
23. Density:
    a. $4\ 300kg/m^3$
    b. $59m^3$
    c. 3.3×10^{-3} (0.0033) kg