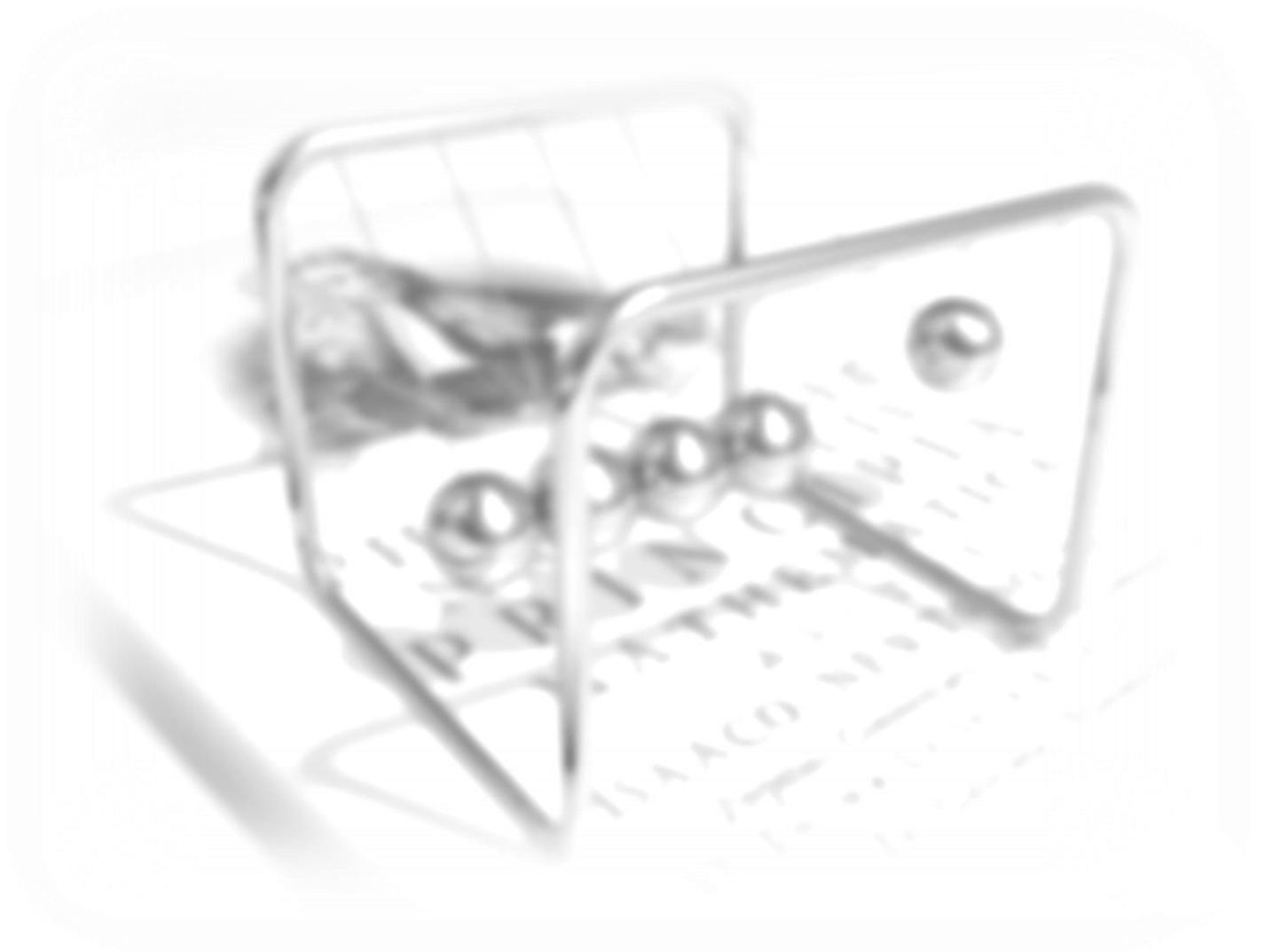


Name:

COMBINED SCIENCE
Topics 1, 2 & 3
LEARNING OUTCOMES



Maintain a record of your progress
Use the booklet to guide revision

Topic 1

1.1	Recall and use the SI unit for physical quantities, as listed in Appendix 5	  
1.2	Recall and use multiples and sub-multiples of units, including giga (G), mega (M), kilo (k), centi (c), milli (m), micro (μ) and nano (n)	  
1.3	Be able to convert between different units, including hours to seconds	  
1.4	Use significant figures and standard form where appropriate	  

Topic 2

2.1	Explain that a scalar quantity has magnitude (size) but no specific direction	  
2.2	Explain that a vector quantity has both magnitude (size) and a specific direction	  
2.3	Explain the difference between vector and scalar quantities	  
2.4	Recall vector and scalar quantities, including: a displacement/distance b velocity/speed c acceleration d force e weight/mass f momentum g energy	  
2.5	Recall that velocity is speed in a stated direction	  
2.6	Recall and use the equations: a (average) speed (metre per second, m/s) = distance (metre, m) \div time (s) b distance travelled (metre, m) = average speed (metre per second, m/s) \times time (s)	  
2.7	Analyse distance/time graphs including determination of speed from the gradient	  
2.8	Recall and use the equation: acceleration (metre per second squared, m/s ²) = change in velocity (metre per second, m/s) \div time taken (second, s) $() t v u a - =$	  
2.9	Use the equation: (final velocity) ² – (initial velocity) ² = 2 \times acceleration \times distance	  
2.10	Analyse velocity/time graphs to: a compare acceleration from gradients qualitatively b calculate the acceleration from the gradient (for uniform acceleration only) c determine the distance travelled using the area between the graph line and the time axis (for uniform acceleration only)	  
2.11	Describe a range of laboratory methods for determining the speeds of objects such as the use of light gates	  
2.12	Recall some typical speeds encountered in everyday experience for wind and sound, and for walking, running, cycling and other transportation systems	  
2.13	Recall that the acceleration, g, in free fall is 10 m/s ² and be able to estimate the magnitudes of everyday accelerations	  
2.14	Recall Newton's first law and use it in the following situations: a where the resultant force on a body is zero, i.e. the body is moving at a constant velocity or is at rest b where the resultant force is not zero, i.e. the speed and/or direction of the body change(s)	  

2.15	Recall and use Newton's second law as: force (newton, N) = mass (kilogram, kg) × acceleration (metre per second squared, m/s^2) $F = m \times a$	  
2.16	Define weight, recall and use the equation: weight (newton, N) = mass (kilogram, kg) × gravitational field strength (newton per kilogram, N/kg) $W = m \times g$	  
2.17	Describe how weight is measured	  
2.18	Describe the relationship between the weight of a body and the gravitational field strength	  
2.19	Core Practical: Investigate the relationship between force, mass and acceleration by varying the masses added to trolleys	  
2.20	Explain that an object moving in a circular orbit at constant speed has a changing velocity (qualitative only)	  
2.21	Explain that for motion in a circle there must be a resultant force known as a centripetal force that acts towards the centre of the circle	  
2.22	Explain that inertial mass is a measure of how difficult it is to change the velocity of an object (including from rest) and know that it is defined as the ratio of force over acceleration	  
2.23	Recall and apply Newton's third law both to equilibrium situations and to collision interactions and relate it to the conservation of momentum in collisions	  
2.24	Define momentum, recall and use the equation: momentum (kilogram metre per second, $kg\ m/s$) = mass (kilogram, kg) × velocity (metre per second, m/s) $p = m \times v$	  
2.25	Describe examples of momentum in collisions	  
2.26	Use Newton's second law as: force (newton, N) = change in momentum (kilogram metre per second, $kg\ m/s$) ÷ time (second, s) $F = \frac{\Delta p}{\Delta t}$	  
2.27	Explain methods of measuring human reaction times and recall typical results	  
2.28	Recall that the stopping distance of a vehicle is made up of the sum of the thinking distance and the braking distance	  
2.29	Explain that the stopping distance of a vehicle is affected by a range of factors including: a the mass of the vehicle b the speed of the vehicle c the driver's reaction time d the state of the vehicle's brakes e the state of the road f the amount of friction between the tyre and the road surface	  
2.30	Describe the factors affecting a driver's reaction time including drugs and distractions	  
2.31	Explain the dangers caused by large decelerations and estimate the forces involved in typical situations on a public road	  

Topic 3

3.1	Recall and use the equation to calculate the change in gravitational PE when an object is raised above the ground: change in gravitational potential energy (joule, J) = mass (kilogram, kg) × gravitational field strength (newton per kilogram, N/kg) × change in vertical height (metre, m) $\Delta GPE = m \times g \times \Delta h$	  
3.2	Recall and use the equation to calculate the amounts of energy associated with a moving object: kinetic energy (joule, J) = $\frac{1}{2} \times \text{mass (kilogram, kg)} \times (\text{speed})^2$ ((metre/second) ² , (m/s) ²) $\frac{1}{2} KE = m \times v^2$	  
3.3	Draw and interpret diagrams to represent energy transfers	  
3.4	Explain what is meant by conservation of energy	  
3.5	Analyse the changes involved in the way energy is stored when a system changes, including: a an object projected upwards or up a slope b a moving object hitting an obstacle c an object being accelerated by a constant force d a vehicle slowing down e bringing water to a boil in an electric kettle	  
3.6	Explain that where there are energy transfers in a closed system there is no net change to the total energy in that system	  
3.7	Explain that mechanical processes become wasteful when they cause a rise in temperature so dissipating energy in heating the surroundings	  
3.8	Explain, using examples, how in all system changes energy is dissipated so that it is stored in less useful ways	  
3.9	Explain ways of reducing unwanted energy transfer including through lubrication, thermal insulation	  
3.10	Describe the effects of the thickness and thermal conductivity of the walls of a building on its rate of cooling qualitatively	  
3.11	Recall and use the equation: $\text{efficiency} = \frac{\text{useful energy transferred by the device}}{\text{total energy supplied to the device}}$	  
3.12	Explain how efficiency can be increased	  
3.13	Describe the main energy sources available for use on Earth (including fossil fuels, nuclear fuel, bio-fuel, wind, hydroelectricity, the tides and the Sun), and compare the ways in which both renewable and non-renewable sources are used	  
3.14	Explain patterns and trends in the use of energy resources	  

Active Learn	Topic 2 Exercise 1	
Active Learn	Topic 2 Exercise 2	
Active Learn	Topic 3 Exercise 1	
Active Learn	Topic 3 Exercise 2	
Question paper (Basic)	Topic 2	
Question paper (Extended)	Topic 2	
Question paper (Basic)	Topic 3	
Question paper (Extended)	Topic 3	
Topic test	Topic 2	
Topic test	Topic 3	

Notes:

You must know, and be able to use, these equations:

Distance = speed x time
 $X = v \times t$
 (m/s) = (m) / (s)

Force = mass x acceleration
 $F = m a$
 (newton, N) =
 (kilogram, kg) x (metres per second², m/s²)

Momentum = mass x velocity
 $p = m \times v$
 kilogram meter per second (m/s) = kilogram (kg) / metre per second (m/s)

ΔG.P.E. = mass x gravitational field strength x Δvertical height
 $\Delta GPE = m \times g \times \Delta h$
 (joule, J) = (kilogram, kg) x (newton per kilogram, N/kg) x (metre, m)

Kinetic energy = ½ x mass x velocity²
 $KE = \frac{1}{2} m \times v^2$
 (joule, J) = (kilogram, kg) x ((metre per second)², (m/s)²)

Efficiency = (useful energy transferred by the device) / (total energy supplied to device)

velocity change
Acceleration = time taken
 $a = (v-u) / t$
 (m/s²) = (m) / (s²)

Weight = mass x gravitational field strength
 $W = m g$
 (newton, N) = (kilogram, kg) x (newtons per kilogram, N/kg)

You must be able to use, these equations but they will be given to you

(final velocity)² – (initial velocity)² = 2 x acceleration x distance
 $v^2 - u^2 = 2 \times a \times x$
 (m/s)² = (m/s²) x (m)

change in momentum
Force = time
 $F = (mv - mu) / t$ 
 (newton, N) = (kilogram meters per second, kg) / (metres per second², m/s²)