Assessment

Assessed with a 1 hour 15 minute, 60 mark paper where all questions are answered.

Useful Data

Gravitational constant, *G*	6.67×10^{-11} N m^{2} kg^{-2}
Avogadro constant, N_A	6.02×10^{23} mol^{-1}
Molar gas constant, *R*	8.31 J mol^{-1} K^{-1}
Boltzmann constant, *k*	1.38×10^{-23} J K^{-1}

Module 1: Newton's laws and momentum

You should be able to...	**Unaware of this section**	**I am aware of this, but need to do more work**	**I understand this area well**
4.1.1 Newton's laws of motion			
... state and use each of Newton's three laws of Motion.			
... define *linear momentum* as the product of mass and velocity and appreciate the vector nature of momentum.			
... define *net force on a body* as equal to rate of change of its momentum.			
... select and apply the equation: $F = \Delta p / \Delta t$ to solve problems.			
... explain that *F* = *ma* is a special case of Newton's second law when mass *m* remains constant.			
... define *impulse of a force.*			
... recall that the area under a force against time graph is equal to impulse.			
... recall and use the equation impulse = change in momentum.			
4.1.2 Collisions			
... state the principle of conservation of momentum.			
... apply the principle of conservation of momentum to solve problems when bodies interact in one dimension.			
... define a *perfectly elastic collision* and an *inelastic collision.*			
... explain that whilst the momentum of a system is always conserved in the interaction between bodies, some change in kinetic energy usually occurs.			

Module 2: Circular motion and oscillations

You should be able to...	Unaware of this section	I am aware of this, but need to do more work	I understand this area well
4.2.1 Circular motion			
... define the *radian*.			
... convert angles from degrees into radians and vice versa.			
... explain that a force perpendicular to the velocity of an object will make the object describe a circular path.			
... explain what is meant by centripetal acceleration and centripetal force.			
... select and apply the equations for speed: $v = 2\pi r / T$ and centripetal acceleration $a = v^2 / r$			
... select and apply the equation for centripetal force: $F = ma = mv^2 / r$			
4.2.2 Gravitational fields			
... describe how a mass creates a gravitational field in the space around it.			
... define *gravitational field strength* as force per unit mass.			
... use gravitational field lines to represent a gravitational field.			
... state Newton's law of gravitation.			
... select and use the equation: $F = - GMm / r^2$ for the force between two point or spherical objects.			
... select and apply the equation: $g = - GM / r^2$ for the gravitational field strength of a point mass.			
... select and use the equation: $g = - GM / r^2$ to determine the mass of the Earth or another similar object.			
... explain that close to the Earth's surface the gravitational field strength is uniform and approximately equal to the acceleration of free fall.			
... analyse circular orbits in an inverse square law field by relating the gravitational force to the centripetal acceleration it causes.			

... define and use the *period* of an object describing a circle.			
... derive the equation: $T^2 = (4\pi^2/GM)r^3$ from first principles.			
... select and apply the equation: $T^2 = (4\pi^2/GM)r^3$ for planets and satellites (natural and artificial).			
... select and apply Kepler's third law $T^2 \alpha r^3$ to solve problems.			
... define *geostationary orbit* of a satellite and state the uses of such satellites.			
4.2.3 Simple harmonic oscillations			
... describe simple examples of free oscillations.			
... define and use the terms *displacement*, amplitude, *period*, *frequency*, *angular frequency* and *phase difference*.			
... select and use the equation: *period = 1/frequency*			
... define *simple harmonic motion*.			
... select and apply the equation $a = -(2\pi f)^2x$ as the defining equation of simple harmonic motion.			
... select and use $x = A\cos(2\pi ft)$ or $x = A\sin(2\pi ft)$ as solutions to the equation $a = -(2\pi f)^2x$			
... select and apply the equation $vmax = (2\pi f)A$ for the maximum speed of a simple harmonic oscillator.			
... explain that the period of an object with simple harmonic motion is independent of its amplitude.			
... describe, with graphical illustrations, the changes in displacement, velocity and acceleration during simple harmonic motion.			
... describe and explain the interchange between kinetic and potential energy during simple harmonic motion.			
... describe the effects of damping on an oscillatory system.			
... describe practical examples of forced oscillations and resonance.			
... describe graphically how the amplitude of a forced oscillation changes with frequency near to the natural frequency of the system			
... describe examples where resonance is useful and other examples where resonance should be avoided			

Module 3: Thermal physics

You should be able to...	Unaware of this section	I am aware of this, but need to do more work	I understand this area well
4.3.1 Solid, Liquid and Gas			
...describe solids, liquids and gases in terms of the spacing, ordering and motion of atoms or molecules.			
...describe a simple kinetic model for solids, liquids and gases.			
...describe an experiment that demonstrates Brownian motion and discuss the evidence for the movement of molecules provided by such an experiment.			
...define the term *pressure* and use the kinetic model to explain the pressure exerted by gases.			
...define *internal energy* as the sum of the random distribution of kinetic and potential energies associated with the molecules of a system.			
...explain that the rise in temperature of a body leads to an increase in its internal energy.			
...explain that a change of state for a substance leads to changes in its internal energy but not its temperature.			
...describe using a simple kinetic model for matter the terms melting, boiling and evaporation.			
4.3.2 Temperature			
...explain that thermal energy is transferred from a region of higher temperature to a region of lower temperature.			
...explain that regions of equal temperature are in thermal equilibrium.			
...describe how there is an absolute scale of temperature that does not depend on the property of any particular substance (i.e. the thermodynamic scale and the concept of absolute zero).			
...convert temperatures measured in kelvin to degrees Celsius (or vice versa): $T\ (K) = \theta\ (°C) + 273.15$			
...state that absolute zero is the temperature at which a substance has minimum internal energy.			
4.3.3 Thermal properties of materials			
...define and apply the concept of specific heat capacity.			
...select and apply the equation $E = mc\Delta\theta$			
...describe an electrical experiment to determine the specific heat capacity of a solid or a liquid.			
...describe what is meant by the terms latent heat of fusion and latent heat of vaporisation.			
4.3.4 Ideal Gases			
...state Boyle's law.			
...select and apply pV/T = constant			

...state the basic assumptions of the kinetic theory of gases.			
...state that one mole of any substance contains 6.02×10^{23} particles and that 6.02×10^{23} mol^{-1} is the Avogadro constant N_A			
...select and solve problems using the ideal gas equation expressed as $pV = NkT$ and $pV = nRT$, where N is the number of atoms and n is the number of moles.			
...explain that the mean translational kinetic energy of an atom of an ideal gas is directly proportional to the temperature of the gas in Kelvin.			
...select and apply the equation $E = 3kT/2$ for the mean translational kinetic energy of atoms.			