2022

CfE Outcomes

NAME: ____________________

CLASS: ___________________

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DATA SHEET

COMMON PHYSICAL QUANTITIES

Quantity	Symbol	Value	Quantity	Symbol	Value
Speed of light in vacuum	c	$3{\cdot}00 \times 10^{8}\ \mathrm{m\,s^{-1}}$	Planck's constant	h	$6{\cdot}63 \times 10^{-34}\ \mathrm{J\,s}$
Magnitude of the charge on an electron	e	$1{\cdot}60 \times 10^{-19}\ \mathrm{C}$	Mass of electron	m_e	$9{\cdot}11 \times 10^{-31}\ \mathrm{kg}$
Universal Constant of Gravitation	G	$6{\cdot}67 \times 10^{-11}\ \mathrm{m^3\,kg^{-1}\,s^{-2}}$	Mass of neutron	m_n	$1{\cdot}675 \times 10^{-27}\ \mathrm{kg}$
Gravitational acceleration on Earth	g	$9{\cdot}8\ \mathrm{m\,s^{-2}}$	Mass of proton	m_p	$1{\cdot}673 \times 10^{-27}\ \mathrm{kg}$
Hubble's constant	H_0	$2{\cdot}3 \times 10^{-18}\ \mathrm{s^{-1}}$			

REFRACTIVE INDICES

The refractive indices refer to sodium light of wavelength 589 nm and to substances at a temperature of 273 K.

Substance	Refractive index	Substance	Refractive index
Diamond	2·42	Water	1·33
Crown glass	1·50	Air	1·00

SPECTRAL LINES

Element	Wavelength/nm	Colour
Hydrogen	656	Red
	486	Blue-green
	434	Blue-violet
	410	Violet
	397	Ultraviolet
	389	Ultraviolet
Sodium	589	Yellow

Element	Wavelength/nm	Colour
Cadmium	644	Red
	509	Green
	480	Blue

Lasers

Element	Wavelength/nm	Colour
Carbon dioxide	9550 10590	Infrared
Helium-neon	633	Red

PROPERTIES OF SELECTED MATERIALS

Substance	Density/kg $\mathrm{m^{-3}}$	Melting Point/K	Boiling Point/K
Aluminium	$2{\cdot}70 \times 10^{3}$	933	2623
Copper	$8{\cdot}96 \times 10^{3}$	1357	2853
Ice	$9{\cdot}20 \times 10^{2}$	273	. . . .
Sea Water	$1{\cdot}02 \times 10^{3}$	264	377
Water	$1{\cdot}00 \times 10^{3}$	273	373
Air	1·29	. . . .	. . . .
Hydrogen	$9{\cdot}0 \times 10^{-2}$	14	20

The gas densities refer to a temperature of 273 K and a pressure of $1{\cdot}01 \times 10^{5}$ Pa.

RELATIONSHIPS REQUIRED FOR HIGHER PHYSICS

$d = \bar{v}t$

$s = \bar{v}t$

$v = u + at$

$s = ut + \frac{1}{2}at^2$

$v^2 = u^2 + 2as$

$s = \frac{1}{2}(u+v)t$

$W = mg$

$F = ma$

$E_w = Fd$

$E_p = mgh$

$E_k = \frac{1}{2}mv^2$

$P = \frac{E}{t}$

$p = mv$

$Ft = mv - mu$

$F = G\frac{m_1 m_2}{r^2}$

$t' = \frac{t}{\sqrt{1 - \frac{v^2}{c^2}}}$

$l' = l\sqrt{1 - \left(\frac{v}{c}\right)^2}$

$f_o = f_s\left(\frac{v}{v \pm v_s}\right)$

$z = \frac{\lambda_{observed} - \lambda_{rest}}{\lambda_{rest}}$

$z = \frac{v}{c}$

$v = H_0 d$

$W = QV$

$E = mc^2$

$I = \frac{P}{A}$

$I = \frac{k}{d^2}$

$I_1 d_1^2 = I_2 d_2^2$

$E = hf$

$E_k = hf - hf_0$

$v = f\lambda$

$E_2 - E_1 = hf$

$d\sin\theta = m\lambda$

$n = \frac{\sin\theta_1}{\sin\theta_2}$

$\frac{\sin\theta_1}{\sin\theta_2} = \frac{\lambda_1}{\lambda_2} = \frac{v_1}{v_2}$

$\sin\theta_c = \frac{1}{n}$

Path difference= $m\lambda$ or $(m+ ½)\lambda$ where m = 0,1,2 …..

random uncertainty= $\frac{\text{max. value - min. value}}{\text{number of values}}$

$\Delta R = \frac{R_{max} - R_{min}}{n}$

$V_{rms} = \frac{V_{peak}}{\sqrt{2}}$

$I_{rms} = \frac{I_{peak}}{\sqrt{2}}$

$T = \frac{1}{f}$

$V = IR$

$P = IV = I^2R = \frac{V^2}{R}$

$R_T = R_1 + R_2 + ...$

$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + ...$

$V_1 = \left(\frac{R_1}{R_1 + R_2}\right)V_S$

$\frac{V_1}{V_2} = \frac{R_1}{R_2}$

$E = V + Ir$

$C = \frac{Q}{V}$

$Q = It$

$E = \frac{1}{2}QV = \frac{1}{2}CV^2 = \frac{1}{2}\frac{Q^2}{C}$

COURSE OUTCOMES / SUCCESS CRITERIA

UNCERTAINTIES

No	CONTENT	✓ ✗	Traffic Light		
1.	**Uncertainties**				
eq	$\text{random uncertainty} = \dfrac{\text{max. value - min. value}}{\text{number of values}}$ or $\Delta R = \dfrac{R_{max} - R_{min}}{n}$		☺	😐	☹
a)	I can identify that all measurements of physical quantities are liable to uncertainty which I can express in absolute or percentage form.		☺	😐	☹
b)	I can quantify and recognise scale reading, random and systematic uncertainties in a measured quantity.		☺	😐	☹
c)	I can express uncertainties in absolute or percentage form		☺	😐	☹
d)	I know that random uncertainties arise when an experiment is repeated and slight variations occur.		☺	😐	☹
e)	I can explain that scale reading uncertainty is a measure of how well an instrument scale can be read.		☺	😐	☹
f)	I know that scale reading uncertainty is an indication of how precisely a scale can be read.		☺	😐	☹
g)	I can state that random uncertainties can be reduced by taking repeated measurements.		☺	😐	☹
h)	I can explain that systematic uncertainties occur when readings taken are either all too small or all too large.		☺	😐	☹
i)	I can recognise that systematic uncertainties can arise due to measurement techniques or experimental design.		☺	😐	☹
j)	I know the mean of a set of repeated measurements is the best estimate of the ‘true’ value of the quantity being measured.		☺	😐	☹
k)	I know that when systematic uncertainties are present they offset the mean value		☺	😐	☹
l)	I know when mean values are used, the approximate random uncertainty should be calculated.		☺	😐	☹
m)	I can correctly calculate, use and identify uncertainties during data analysis.		☺	😐	☹
n)	I know that when an experiment is being undertaken and more than one physical quantity is measured, the quantity with the largest percentage uncertainty should be identified and this may often be used as a good estimate of the percentage uncertainty in the final numerical result of an experiment.		☺	😐	☹
o)	I can express the numerical result of an experiment in the form final value ±uncertainty.		☺	😐	☹

UNITS PREFIXES AND SCIENTIFIC NOTATION

No	CONTENT	✓ ✗	Traffic Light		
2.	**Units, prefixes and scientific notation**				
a)	I know the units for all of the physical quantities used in this unit.		☺	😐	☹
b)	I can use the prefixes: pico (p), nano (n), micro (μ), milli (m), kilo (k), mega (M), giga (G) and tera (T).		☺	😐	☹
c)	I can give an appropriate number of significant figures when carrying out calculations. (This means that the final answer can have no more significant figures than the value with least number of significant figures used in the calculation).		☺	😐	☹
d)	I can use scientific notation when large and small numbers are used in calculations.		☺	😐	☹

OUR DYNAMIC UNIVERSE (START:_________END: _________)

No	CONTENT	✓ ✗	Traffic Light		
3.	**Equations of Motion**				
eq	$d = \bar{v}t,\ s = \overline{vt};\quad s = \frac{1}{2}(u+v)t;$ $v = u + at \qquad s = ut + \frac{1}{2}at^2 \qquad v^2 = u^2 + 2as$		☺	😐	☹
a)	I can use the equations of motion to find distance, displacement, speed, velocity, and acceleration for objects with constant acceleration in a straight line.		☺	😐	☹
b)	I can interpret and draw motion-time graphs for motion with constant acceleration in a straight line, including graphs for bouncing objects and objects thrown vertically upwards.		☺	😐	☹
c)	I know the interrelationship of displacement-time, velocity-time and acceleration- time graphs.		☺	😐	☹
d)	I can calculate distance, displacement, speed, velocity, and acceleration from appropriate graphs (graphs restricted to constant acceleration in one dimension, inclusive of change of direction).		☺	😐	☹
e)	***I can give a description of an experiment to measure the acceleration of an object down a slope***		☺	😐	☹

4.	**Forces, energy and power**				
eq	$W = mg \qquad F = ma \qquad Ew \text{ or } W = Fd \qquad Ep = mgh$ $Ek = \frac{1}{2} mv^2 \qquad E = Pt$		☺	😐	☹

No	CONTENT	✓ ✗	Traffic Light		
a)	I can use vector addition and appropriate relationships to solve problems involving balanced and unbalanced forces, mass, acceleration and gravitational field strength.		☺	😐	☹
b)	I know the effects of friction on a moving object (static and dynamic friction are not required)		☺	😐	☹
c)	I can identify and explain the effects of friction on moving objects. I do not need to use reference to static and dynamic friction.		☺	😐	☹
d)	I can identify and explain, in terms of forces an object moving with terminal velocity		☺	😐	☹
e)	I can interpret and produce velocity-time graphs for a falling object when air resistance is taken into account.		☺	😐	☹
f)	I can analyse motion using Newton's first and second laws.		☺	😐	☹
g)	I can use free body diagrams and appropriate relationships to solve problems involving friction and tension.		☺	😐	☹
h)	I can resolve a vector into two perpendicular components.		☺	😐	☹
i)	I can resolve the weight of an object on a slope into a component acting parallel (down the slope) and a component acting normal to the slope.		☺	😐	☹
j)	I can use the principle of conservation of energy and appropriate relationships to solve problems involving work done, potential energy, kinetic energy and power.		☺	😐	☹

5.	**Collisions and explosions**				
eq	$p = mv$ $\quad Ft = mv - mu$ $\quad E_k = \frac{1}{2}mv^2$		☺	😐	☹
a)	I can use the principle of conservation of momentum and an appropriate relationship to solve problems involving the momentum, mass and velocity of objects interacting in one dimension.		☺	😐	☹
b)	I can explain the role in kinetic energy in determining whether a collision is described as elastic and inelastic collisions or in explosions.		☺	😐	☹
c)	I can use appropriate relationships to solve problems involving the total kinetic energy of systems of interacting objects.		☺	😐	☹
d)	I can use Newton's third law to explain the motion of objects involved in interactions.		☺	😐	☹
e)	I can draw and interpret force-time graphs involving interacting objects.		☺	😐	☹
f)	I know that the impulse of a force is equal to the area under a force-time graph and is equal to the change in momentum of an object involved in the interaction.		☺	😐	☹
g)	I can use data from a force-time graph to solve problems involving the impulse of a force, the average force and its duration.		☺	😐	☹
h)	I can use appropriate relationships to solve problems involving mass, change in velocity, average force and duration of the force for an object involved in an interaction.		☺	😐	☹

No	CONTENT	✓ ✗	Traffic Light		
6.	**Gravitation**				
eq	$\boldsymbol{d = \bar{v}t,\ s = \bar{v}t\ ;\quad s = \frac{1}{2}(u+v)t;}$ $v = u + at \qquad s = ut + \frac{1}{2}at^2 \qquad v^2 = u^2 + 2as \qquad F = \frac{Gm_1m_2}{r^2}$		☺	😐	☹
a)	I can use the equation $F = \frac{Gm_1m_2}{r^2}$		☺	😐	☹
b)	***I can give a description of an experiment*** **to measure the acceleration of a falling object.**		☺	😐	☹
c)	I know that the horizontal motion and the vertical motion of a projectile are independent of each other.		☺	😐	☹
d)	I know that satellites are in free fall around a planet/star.		☺	😐	☹
e)	I can resolve the initial velocity of a projectile into horizontal and vertical components and their use in calculations.		☺	😐	☹
f)	I can use resolution of vectors, vector addition, and appropriate relationships to solve problems involving projectiles.		☺	😐	☹
g)	I can use Newton's Law of Universal Gravitation to solve problems involving force, masses and their separation.		☺	😐	☹

No	CONTENT	✓ ✗	Traffic Light		
7.	**Special relativity**				
eq	$t' = \frac{t}{\sqrt{1 - \frac{v^2}{c^2}}} \qquad l' = l\sqrt{1 - \frac{v^2}{c^2}}$		☺	😐	☹
a)	I know that the speed of light in a vacuum is the same for all observers.		☺	😐	☹
b)	I know that measurements of space, time and distance for a moving observer are changed relative to those for a stationary observer, giving rise to time dilation and length contraction.		☺	😐	☹
c)	I can use appropriate relationships to solve problems involving time dilation, length contraction and speed.		☺	😐	☹

No	CONTENT	✓ ✗	Traffic Light		
8.	**The expanding Universe**				
eq	$f_o = f_s\left(\frac{v}{v \pm v_s}\right) \qquad f_{observed} = f_{source}\frac{v}{[v + v_{source}]} \qquad v = H_o d \qquad z = \frac{v}{c}$ $z = \frac{\lambda_{observed} - \lambda_{rest}}{\lambda_{rest}}$		☺	😐	☹
a)	I know that the Doppler effect causes shifts in wavelengths of sound and light.		☺	😐	☹
b)	I can use appropriate relationship to solve problems involving the observed frequency, source frequency, source speed and wave speed.		☺	😐	☹
c)	I know that the light from objects moving away from us is shifted to longer wavelengths (redshift).		☺	😐	☹

No	CONTENT	✓ ✗	Traffic Light		
d)	I know that the redshift of a galaxy is the change in wavelength divided by the emitted wavelength. For slowly moving galaxies, redshift is the ratio of the recessional velocity of the galaxy to the velocity of light.		☺	😐	☹
e)	I can use appropriate relationships to solve problems involving redshift, observed wavelength, emitted wavelength, and recessional velocity		☺	😐	☹
f)	I can use appropriate relationship to solve problems involving the Hubble constant, the recessional velocity of a galaxy and its distance from us.		☺	😐	☹
g)	I know that Hubble's law allows us to estimate the age of the Universe.		☺	😐	☹
h)	I know that measurements of the velocities of galaxies and their distance from us lead to the theory of the expanding Universe.		☺	😐	☹
i)	I know that the mass of a galaxy can be estimated by the orbital speed of stars within it.		☺	😐	☹
j)	I know that evidence supporting the existence of dark matter comes from estimations of the mass of galaxies.		☺	😐	☹
k)	I know that evidence supporting the existence of dark energy comes from the accelerating rate of expansion of the Universe.		☺	😐	☹
l)	I know that the temperature of stellar objects is related to the distribution of emitted radiation over a wide range of wavelengths.		☺	😐	☹
m)	I know that the peak wavelength of this distribution is shorter for hotter objects than for cooler objects.		☺	😐	☹
n)	I know that hotter objects emit more radiation per unit surface area per unit time than cooler objects.		☺	😐	☹
o)	I know of evidence supporting the big bang theory and subsequent expansion of the Universe: cosmic microwave background radiation, the abundance of the elements hydrogen and helium, the darkness of the sky (Olbers' paradox) and the large number of galaxies showing redshift rather than blueshift.		☺	😐	☹

PARTICLES AND WAVES (START:_________END: _________)

No	CONTENT	✓✗	Traffic Light		
9.	**Forces on charged particles**				
eq	$W = QV$ $\quad$ $E_k = \frac{1}{2}mv^2$		☺	😐	☹
a)	I know that charged particles experience a force in an electric field.		☺	😐	☹
b)	I know that electric fields exist around charged particles and between charged parallel plates.		☺	😐	☹
c)	I can sketch electric field patterns for single-point charges, systems of two-point charges and between two charged parallel plates (ignore end effects).		☺	😐	☹

No	CONTENT	✓×	Traffic Light		
d)	I can determine the direction of movement of charged particles in an electric field.		☺	😐	☹
e)	I can define voltage (potential difference) as the work done moving unit charge between two points		☺	😐	☹
f)	I can solve problems involving the charge, mass, speed, and energy of a charged particle in an electric field and the potential difference through which it moves.		☺	😐	☹
g)	I know that a moving charge produces a magnetic field.		☺	😐	☹
h)	I can determine the direction of the force on a charged particle moving in a magnetic field for negative and positive charges using the slap rule or other method.		☺	😐	☹
i)	I know the basic operation of particle accelerators in terms of acceleration by electric fields, deflection by magnetic fields and high-energy collisions of charged particles to produce other particles.		☺	😐	☹

10.	**Standard Model**				
a)	I know that the Standard Model is a model of fundamental particles and interactions.		☺	😐	☹
b)	I can describe the Standard Model in terms of types of particles and groups		☺	😐	☹
c)	I can use orders of magnitude and am aware of the range of orders of magnitude of length from the very small (sub-nuclear) to the very large (distance to furthest known celestial objects).		☺	😐	☹
d)	I know that evidence for the existence of quarks comes from high-energy collisions between electrons and nucleons, carried out in particle accelerators.		☺	😐	☹
e)	I know that in the Standard Model, every particle has an antiparticle.		☺	😐	☹
f)	I know that the production of energy in the annihilation of particles is evidence for the existence of antimatter		☺	😐	☹
g)	I know that beta decay was the first evidence for the neutrino.		☺	😐	☹
h)	I know the equation for β- decay above (β+ decay not required) ${}_{0}^{1}n \rightarrow {}_{1}^{1}p + {}_{-1}^{0}e + \overline{\nu_e}$		☺	😐	☹
i)	I know that fermions, the matter particles, consist of quarks (six types: up, down, strange, charm, top, bottom) and leptons (electron, muon and tau, together with their neutrinos).		☺	😐	☹
j)	I know that hadrons are composite particles made of quarks.		☺	😐	☹
k)	I know that baryons are made of three quarks.		☺	😐	☹
l)	I know that mesons are made of quark-antiquark pairs.		☺	😐	☹
m)	I know that the force-mediating particles are bosons: photons (electromagnetic force), W- and Z-bosons (weak force), and gluons (strong force).		☺	😐	☹

No	CONTENT	✓×	Traffic Light		
11.	**Nuclear reactions**				
eq	$E = mc^2$		☺	😐	☹
a)	I can use nuclear equations to describe radioactive decay, fission (spontaneous and induced), with reference to mass and energy equivalence.		☺	😐	☹
b)	I can use nuclear equations to describe fusion reactions, with reference to mass and energy equivalence.		☺	😐	☹
c)	Use of an appropriate relationship to solve problems involving the mass loss and the energy released by a nuclear reaction. $E = mc^2$		☺	😐	☹
d)	I know that nuclear fusion reactors require charged particles at a very high temperature (plasma) which have to be contained by magnetic fields.		☺	😐	☹

12.	**Inverse square law**				
eq	$I = \frac{P}{A}$ $I = \frac{k}{d^2}$ $I_1 d_1^2 = I_2 d_2^2$		☺	😐	☹
a)	I know that irradiance is the power per unit area incident on a surface.		☺	😐	☹
b)	I can use the equation $I = \frac{P}{A}$ to solve problems involving irradiance, the power of radiation incident on a surface and the area of the surface.		☺	😐	☹
c)	I know that irradiance is inversely proportional to the square of the distance from a point source.		☺	😐	☹
d)	***I can describe an experiment to verify the inverse square law for a point source of light***		☺	😐	☹
e)	I can use $I = \frac{k}{d^2}$ and $I_1 d_1^2 = I_2 d_2^2$ to solve problems involving irradiance and distance from a point source of light.		☺	😐	☹

13.	**Wave Particle Duality**				
eq	$E = hf$ $E = \frac{hc}{\lambda}$ $E_k = hf - hf_0$ $E_k = \frac{1}{2}mv^2$ and $v = f\lambda$		☺	😐	☹
a)	I know that the photoelectric effect is evidence for the particle model of light.		☺	😐	☹
b)	I know that photons of sufficient energy can eject electrons from the surface of materials (photoemission).		☺	😐	☹
c)	I can use $E = hf$ and $E = \frac{hc}{\lambda}$ to solve problems involving the frequency and energy of a photon.		☺	😐	☹
d)	I know that the threshold frequency, f_0 is the minimum frequency of a photon required for photoemission.		☺	😐	☹
e)	I know that the work function, W or hf_0 of a material is the minimum energy of a photon required to cause photoemission.		☺	😐	☹

No	CONTENT	✓✗	Traffic Light		
f)	I can use $E_k = hf - hf_0$ $E_k = \frac{1}{2}mv^2$ *and* $v = f\lambda$ to solve problems involving the mass, maximum kinetic energy and speed of photoelectrons, the threshold frequency of the material, and the frequency and wavelength of the photons.		☺	😐	☹

14.	**Interference**				
eq	$path\ difference = m\lambda\ or\ \left(m+\frac{1}{2}\right)\lambda$ where *m* =0,1,2. $d\ sin\theta = m\lambda$		☺	😐	☹
a)	I know that interference is evidence for the wave model of light.		☺	😐	☹
b)	I know that coherent waves have a constant phase relationship.		☺	😐	☹
c)	I can describe of the conditions for constructive and destructive interference in terms of the phase difference between two waves.		☺	😐	☹
d)	I know that maxima are produced when the path difference between waves is a whole number of wavelengths		☺	😐	☹
e)	I know that minima are produced when the path difference between waves is an odd number of half-wavelengths respectively.		☺	😐	☹
f)	I can use $path\ difference = m\lambda\ or\ \left(m+\frac{1}{2}\right)\lambda$ where *m* =0,1,2… to solve problems involving the path difference between waves, wavelength and order number.		☺	😐	☹
g)	I can use $d\ sin\theta = m\lambda$ to solve problems involving grating spacing, wavelength, order number and angle to the maximum.		☺	😐	☹

15.	**Spectra**				
eq	$E_2 - E_1 = hf$ and $E = hf$		☺	😐	☹
a)	I have knowledge of the Bohr model of the atom.		☺	😐	☹
b)	I can explain the Bohr model of the atom using the terms *ground state, energy levels, ionisation and zero potential energy*.		☺	😐	☹
c)	I know the mechanism of production of line emission spectra, continuous emission spectra and absorption spectra in terms of electron energy level transitions.		☺	😐	☹
d)	I can use $E_2 - E_1 = hf$ and $E = hf$ to solve problems involving energy levels and the frequency of the radiation emitted/absorbed.		☺	😐	☹
e)	I know that the absorption lines (Fraunhofer lines) in the spectrum of sunlight provide evidence for the composition of the Sun's outer atmosphere.		☺	😐	☹

16.	**Refraction**				
eq	$n = \frac{\sin\theta_1}{\sin\theta_2} = \frac{\lambda_1}{\lambda_2} = \frac{v_1}{v_2}$ and $v = f\lambda$ and $\sin\theta_c = \frac{1}{n}$		☺	😐	☹

No	CONTENT	✓✗	Traffic Light		
a)	I can define absolute refractive index of a medium as the ratio of the speed of light in a vacuum to the speed of light in the medium.		☺	😐	☹
b)	I can use $n = \frac{\sin\theta_1}{\sin\theta_2}$ to solve problems involving absolute refractive index, the angle of incidence and the angle of refraction.		☺	😐	☹
c)	***I can describe an experiment to determine the refractive index of a medium.***		☺	😐	☹
d)	I can use $\frac{\sin\theta_1}{\sin\theta_2} = \frac{\lambda_1}{\lambda_2} = \frac{v_1}{v_2}$ and $v = f\lambda$ to solve problems involving the angles of incidence and refraction, the wavelength of light in each medium, the speed of light in each medium, and the frequency, including situations where light is travelling from a more dense to a less dense medium.		☺	😐	☹
e)	I know that the refractive index of a medium increases as the frequency of incident radiation increases.		☺	😐	☹
f)	I can define critical angle as the angle of incidence which produces an angle of refraction of 90°.		☺	😐	☹
g)	I know that total internal reflection occurs when the angle of incidence is greater than the critical angle.		☺	😐	☹
h)	I can use $\sin\theta_c = \frac{1}{n}$ to solve problems involving critical angle and absolute refractive index.		☺	😐	☹

ELECTRICITY (START:________END: ________

No	CONTENT	✓✗	Traffic Light		
17.	**Monitoring and Measuring A.C.**				
eq	$T = \frac{1}{f}$ $V_{rms} = \frac{V_{peak}}{\sqrt{2}}$ $I_{rms} = \frac{I_{peak}}{\sqrt{2}}$		☺	😐	☹
a)	I know that an A.C. is a current which changes direction and instantaneous value with time.		☺	😐	☹
b)	I can use $V_{rms} = \frac{V_{peak}}{\sqrt{2}}$ $I_{rms} = \frac{I_{peak}}{\sqrt{2}}$ to solve problems involving peak and r.m.s. values.		☺	😐	☹
c)	I can determine the frequency, peak voltage and r.m.s. values from graphical data.		☺	😐	☹
d)	I can use $T = \frac{1}{f}$ to determine the frequency.		☺	😐	☹

No	CONTENT	✓ ✗	Traffic Light		
18.	**Current, potential difference, power and resistance**				
eq	$V = IR$ $\quad P = IV = I^2R = \frac{V^2}{R}$ $\quad R_T = R_1 + R_2 + \ldots$		☺	😐	☹
Eq	$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$ $\quad V_2 = \left(\frac{R_2}{R_1 + R_2}\right)V_S$ $\quad \frac{V_1}{V_2} = \frac{R_1}{R_2}$		☺	😐	☹
a)	I can use relationships involving potential difference, current, resistance and power to analyse circuits even those that may involve several steps in the calculations.		☺	😐	☹
b)	I can correctly use calculations involving potential dividers circuits.		☺	😐	☹
19.	**Electrical sources and internal resistance**				
eq	$E = V + Ir$ $\quad V = IR$		☺	😐	☹
a)	I can correctly use and explain the terms electromotive force (E.M.F), internal resistance, lost volts, terminal potential difference (t.p.d) ideal supplies, short circuits and open circuits.		☺	😐	☹
b)	I can use $E = V + Ir$ and $V = IR$ to solve problems involving EMF, lost volts, t.p.d., current, external resistance, and internal resistance.		☺	😐	☹
c)	***I can describe of an experiment to measure the EMF and internal resistance of a cell.***		☺	😐	☹
d)	I can determine electromotive force, internal resistance and short circuit current using graphical analysis.		☺	😐	☹

20.	**Capacitors**				
eq	$C = \frac{Q}{V}$ $\quad Q = It$ $\quad E = \frac{1}{2}QV = \frac{1}{2}CV^2 = \frac{1}{2}\frac{Q^2}{C}$		☺	😐	☹
a)	I know that a capacitor of 1 farad will store 1 coulomb of charge when the potential difference across it is 1 volt.		☺	😐	☹
b)	I can use the equation C=Q/V to solve problems involving capacitance, charge and potential difference.		☺	😐	☹
c)	I can use the equation $Q = It$ to determine the charge stored on a capacitor for a constant charging current.		☺	😐	☹
d)	I know the total energy stored in a charged capacitor is equal to the area under a charge-potential difference graph.		☺	😐	☹
e)	I can use $E = \frac{1}{2}QV = \frac{1}{2}CV^2 = \frac{1}{2}\frac{Q^2}{C}$ to solve problems involving energy, charge, capacitance, and potential difference.		☺	😐	☹
f)	I know the variation of **current** with time for both charging and discharging cycles of a capacitor in an RC circuit (charging and discharging curves).		☺	😐	☹

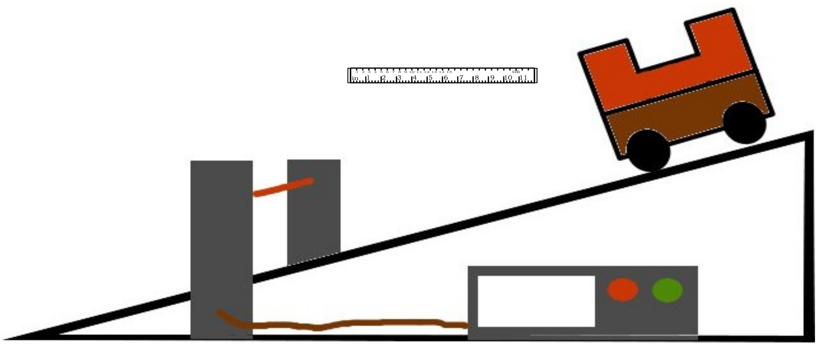
No	CONTENT	✓ ✗	Traffic Light		
g)	I know the variation of **potential difference** with time for both charging and discharging cycles of a capacitor in an RC circuit (charging and discharging curves).		☺	😐	☹
h)	I know the effect of resistance and capacitance on charging and discharging curves in an RC circuit.		☺	😐	☹
i)	***I can describe experiments to investigate the variation of current in a capacitor and voltage across a capacitor with time, for the charging and discharging of capacitors***		☺	😐	☹
21.	**Semiconductors and p-n junctions**				
a)	I know and can explain the terms conduction band and valence band.		☺	😐	☹
b)	I know that solids can be categorised into conductors, semiconductors or insulators by their band structure and their ability to conduct electricity. Every solid has its own characteristic energy band structure. For a solid to be conductive, both free electrons and accessible empty states must be available.		☺	😐	☹
c)	I can explain qualitatively the electrical properties of conductors, insulators and semiconductors using the electron population of the conduction and valence bands and the energy difference between the conduction and valence bands. (Reference to Fermi levels is not required.)		☺	😐	☹
d)	I know that the electrons in atoms are contained in energy levels. When the atoms come together to form solids, the electrons then become contained in energy bands separated by gaps.		☺	😐	☹
e)	I know that for metals we have the situation where one or more bands are partially filled.		☺	😐	☹
f)	I know that some metals have free electrons and partially filled valence bands, therefore they are highly conductive.		☺	😐	☹
g)	I know that some metals have overlapping valence and conduction bands. Each band is partially filled and therefore they are conductive.		☺	😐	☹
h)	I know that in an insulator, the highest occupied band (called the valence band) is full. The first unfilled band above the valence band is the conduction band. For an insulator, the gap between the valence band and the conduction band is large and at room temperature there is not enough energy available to move electrons from the valence band into the conduction band where they would be able to contribute to conduction. There is no electrical conduction in an insulator.		☺	😐	☹

No	CONTENT	✓ ×	Traffic Light		
i)	I know that in a semiconductor, the gap between the valence band and conduction band is smaller and at room temperature there is sufficient energy available to move some electrons from the valence band into the conduction band allowing some conduction to take place. An increase in temperature increases the conductivity of a semiconductor.		☺	😐	☹
j)	I know that, during manufacture, semiconductors may be doped with specific impurities to increase their conductivity, resulting in two types of semiconductor: p-type and n-type.		☺	😐	☹
k)	I know that, when a semiconductor contains the two types of doping (p-type and n- type) in adjacent layers, a p-n junction is formed. There is an electric field in the p-n junction. The electrical properties of this p-n junction are used in a number of devices.		☺	😐	☹
l)	I know and can explain the terms forward bias and reverse bias. Forward bias reduces the electric field; reverse bias increases the electric field in the p-n junction.		☺	😐	☹
m)	I know that LEDs are forward biased p-n junction diodes that emit photons. The forward bias potential difference across the junction causes electrons to move from the conduction band of the n-type semiconductor towards the conduction band of the p- type semiconductor. Photons are emitted when electrons 'fall' from the conduction band into the valence band either side of the junction		☺	😐	☹
n)	I know that solar cells are p-n junctions designed so that a potential difference is produced when photons are absorbed. (This is known as the photovoltaic effect.) The absorption of photons provides energy to 'raise' electrons from the valence band of the semiconductor to the conduction band. The p-n junction causes the electrons in the conduction band to move towards the n-type semiconductor and a potential difference is produced across the solar cell.		☺	😐	☹

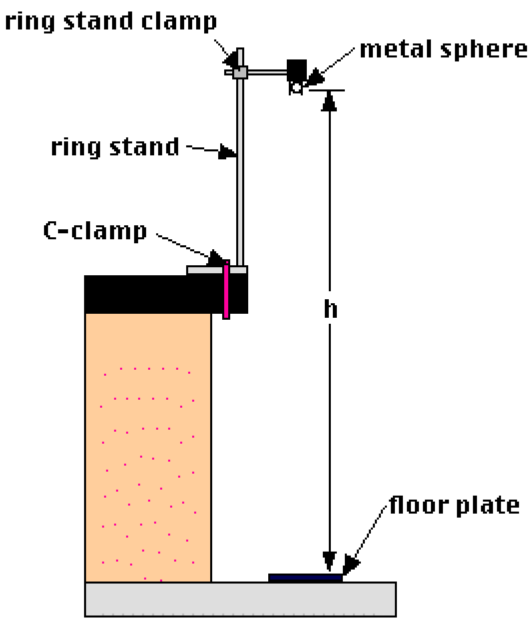
PRESCRIBED PRACTICAL EXPERIMENTS

One example of a method has been exemplified for each practical. Many more alternatives are available and just as good.

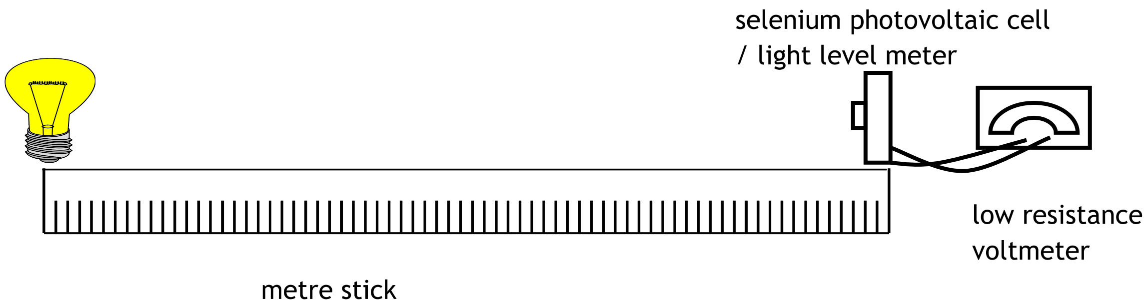
1e	An experiment to measure the acceleration of an object down a slope



4b	An experiment to measure the acceleration of a falling object.



11e	*I can describe an experiment to verify the inverse square law for a point source of light*



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<tr><td>15c</td><td>I can describe an experiment to determine the refractive index of a medium.</td></tr>
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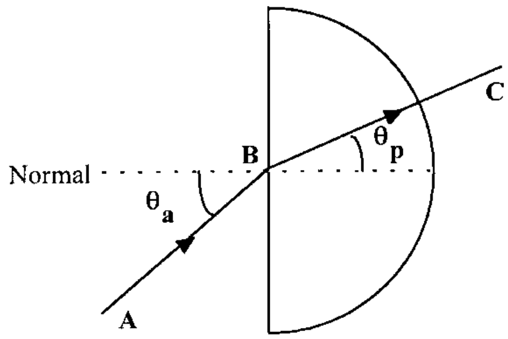

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<tr><td>19c</td><td>I can describe of an experiment to measure the EMF and internal resistance of a cell.</td></tr>
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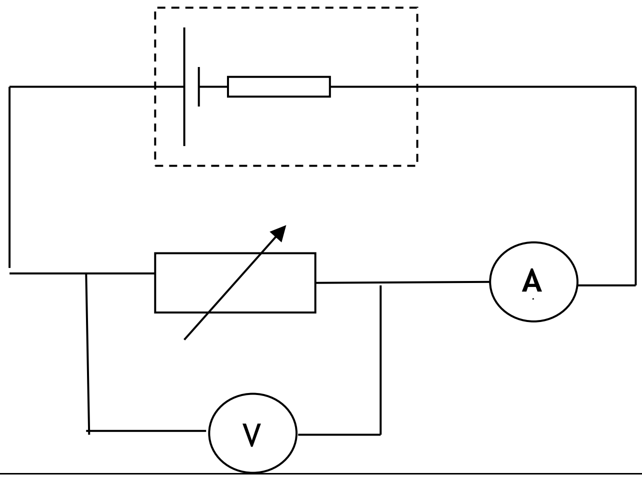

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<tr><td>20i</td><td>I can describe experiments to investigate the variation of current in a capacitor and voltage across a capacitor with time, for the charging and discharging of capacitors</td></tr>
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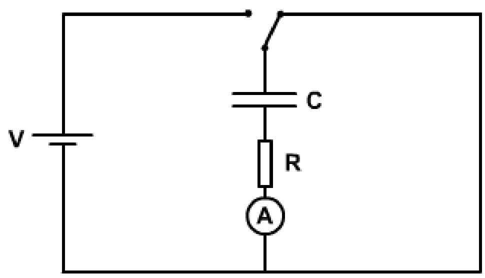

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EXAM DATE: Wednesday 16th May 2023