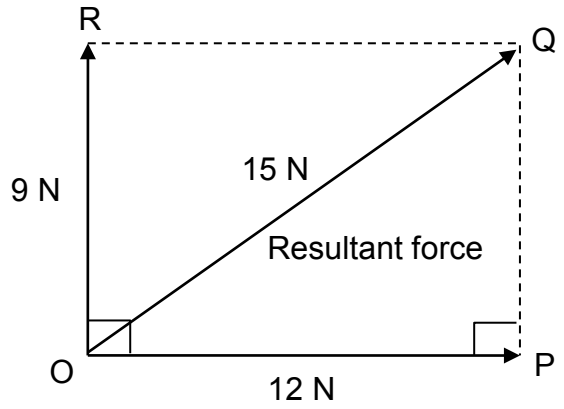
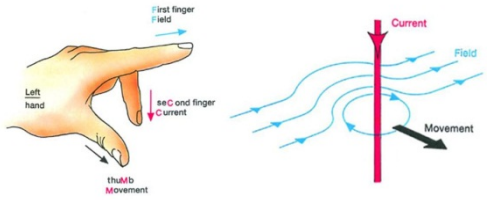
#	Ans	Workings/Remarks
PHYSICS		
1	A	Using Parallelogram of Forces, 
2	C	The acceleration is indicated by the **gradient** of the speed-time graph. From A to B, acceleration is increasing as gradient of the speed-time graph becomes steeper. From B to C, the balloon undergoes uniform acceleration as gradient of the speed-time graph is constant. From C, the gradient starts to **decrease** ⇒ acceleration starts to decrease. At point D, the gradient is zero (or almost zero) ⇒ balloon is moving at uniform speed.
3	B	Average speed is total distance travelled over total time. Total distance travelled = area under graph = ½ × 12 × 3 = 18 m Total time taken = 3 s Average speed = 18 m ÷ 3 s = 6 m/s
4	C	Since $F = R$, net resultant force is zero. When net resultant force is zero, according to Newton's First Law, the object is either at rest or moving with constant velocity. Since the car is moving forward (in motion), it is moving with uniform velocity.
5	B	Inertia is dependent on mass. The larger the mass, the greater its inertia.
6	A	Use moment formula, Clockwise moment from weight = 100N × 0.2m = 20Nm Anticlockwise moment from force = 30N × 0.7m = 21 Nm Resultant moment = 21Nm – 20Nm = 1Nm (anticlockwise)
7	C	Work Done = Force x Distance in the direction of the Force (assuming the distance given is vertical distance) = 1500 N × 2 m = 3000 J
8	D	When heated, the cold water remains at the bottom of the tank so no convection current flows in the tank. Thus, the only way thermal energy can be transferred to the bottom is by conduction. But since water is poor conductor of heat, the rate of heat transfer from the top to the bottom through conduction is extremely slow. Hence the water at the bottom stays cold for some time.

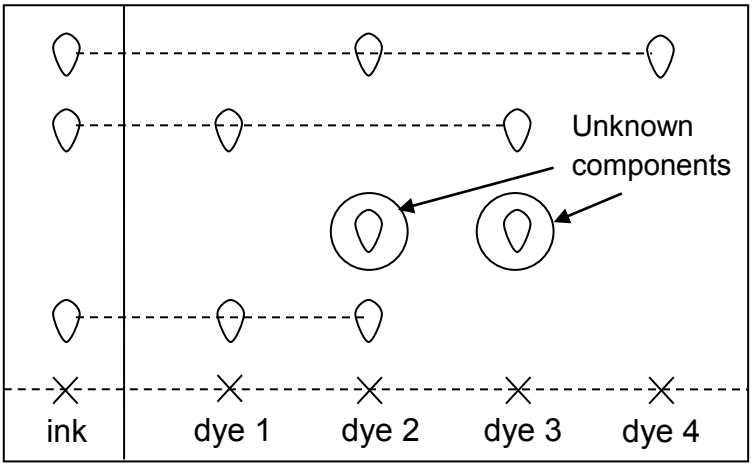
9	C	During solidification, the latent heat of fusion is released from the gold particles as the particles come close together to form solid lattice at a constant temperature.
10	B	Amplitude and wavelength can be measured in metres. Frequency is measured in Hertz (Hz) while speed is measured in m/s.
11	D	The frequency is the number of complete waves produced on 1 second. $\therefore f = 3 \div 2 = 1.5$ Hz Wavelength, λ = 6 cm (distance between two successive crests) $\therefore v = f\lambda = 1.5 \times 6 = 9$ cm/s Alternatively, distance between 2 wavefronts is 1 λ. So using, the equation v = fλ, we can change to $\lambda = \frac{v}{f}$, $6 = \frac{v}{f}$, we can choose an answer that gives us 6.
12	A	Total internal reflection occurs when the angle of incidence in the optically denser medium is greater than the critical angle. Since total internal reflection has already taken place at 45°, the critical angle is less than 45°.
13	A	Since the object is from a distance greater than the focal point of the lens of the human eye, the image formed will be real, inverted and diminished. The image formed is then sent as a signal to the brain which then processes it and flips the image captured on the retina to make it upright.
14	C	Loudness is related to the amplitude of the sound. Thus, a louder note has a greater amplitude with higher peaks.
15	D	By definition, potential difference across the component is the work done by a unit charge through it i.e. $V = \frac{W}{Q}$.
16	A	For resistors connected in parallel, combined resistance *R* given by $\frac{1}{R} = \frac{1}{4} + \frac{1}{2} + \frac{1}{1}$ $R = \frac{4}{7}\Omega$ = 0.57 Ω
17	D	Total resistance of circuit, $R = \left(\frac{1}{\frac{1}{2}+\frac{1}{4}}\right) = \frac{4}{3}\Omega$ $I_1 = \frac{6\text{ V}}{\frac{4}{3}\ \Omega} = 4.5\text{ A}$ Potential difference across 2.0 Ω and 4.0 Ω resistors = 6.0 V $I_2 = \frac{6\text{ V}}{2\ \Omega} = 3.0\text{ A}$ $I_3 = \frac{6\text{ V}}{4\ \Omega} = 1.5\text{ A}$ P.S. Check that $I_1 = I_2 + I_3$.
18	D	From $E = P \times t$, the time the lamp was in operation, $t = \frac{1\text{ kWh}}{0.1\text{ kW}}$ = 10 hours Since the switch controls both heater and lamp, electrical used by heater E = 2 kW × 10 hours = 20 kWh
19	B	A fuse is a safety device to prevent excessive current flow in an electrical circuit. Hence it should have a current rating just slightly higher than the current an electrical appliance will use under normal conditions.
20	C	For the first diagram, we use Maxwell's right hand grip rule to determine the current's

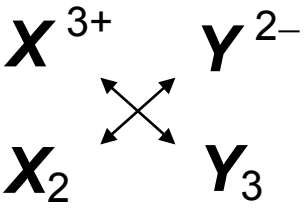
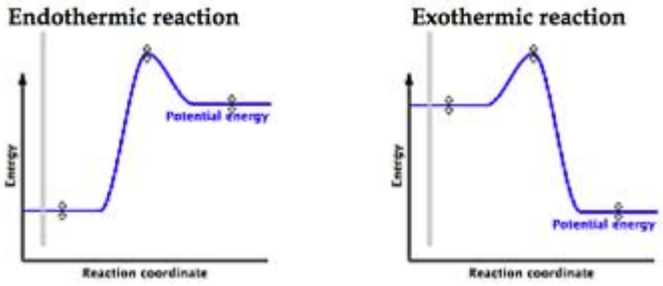
direction. It is into the page.

For the second diagram, we use Fleming's Left Hand Rule to determine the direction of the force on the wire, which is downwards.



CHEMISTRY

21	B	We need to check for the dyes that have *all* their components at the same vertical level as one or more of the ink's components.  As shown in the chromatogram, there's an unknown component each in dyes 2 and 3, hence they are not present in the ink. Dyes 1 and 4, however, have *all* their components matching the reference components in the ink. Hence dyes 1 and 4 are present in the ink.
22	C	A mixture consists of substances added together without chemical bonds being formed ⇒ a mixture of nitrogen and oxygen cannot contain molecules of compound formed from nitrogen and oxygen atoms (Option D is out). Nitrogen and oxygen molecules are diatomic (Options A and D out). Gas molecules are always in constant random motion according to Kinetic Particle Theory (Option B is out).
23	A	Nucleon number is the total no. of protons and neutrons in the nucleus of an atom ⇒ Nucleon number of X = 5 + 4 = 9. Atomic number is the number of protons in the nucleus of an atom ⇒ Proton number of X = 4. Nucleon/Mass number → 9 Atomic/Proton number → 4 X

24	D	We can work backwards to determine the individual charge of each ions.  Charge of X is +3, so it has given away 3 electrons. Charge of Y is –2, so it has received 2 electrons.
25	A	Sharing electrons ⇒ covalent compound ⇒ made up of non-metals. Option A: carbon and chlorine are non-metals, so they will form covalent compounds by sharing electrons. Option B: lithium (metal) and iodine form an ionic compound. Option C: neon is a noble gas and it is unreactive to form bonds with oxygen. Option D: potassium (metal) and bromine form an ionic compound.
26	C	At room temperature and pressure, one mole of any gas occupies the same volume. Since both reactant and product are in gaseous state at room temperature and pressure in the reaction, we can use volume ratio to compare i.e. ratio of SO_2 to H_2S = 1:1 ∴ Volume of SO_2 formed = Volume of H_2S = 48 dm^3.
27	C	Number of moles of HC*l* = 0.1 mol / dm^3 × 0.025 dm^3 = 0.0025 mol From the equation, 1 mole of HC*l* reacts with 1 mole of NaOH ⇒ 0.0025 mole of HC*l* reacts with 0.0025 mole of NaOH ⇒ Concentration of NaOH = 0.0025 mol ÷ 0.02 dm^3 = 0.125 mol/dm^3
28	C	In an endothermic reaction, heat energy is taken in (i.e. absorbed) from the surroundings, causing the temperature of the surroundings to fall. The heat energy lost from the surroundings is transferred to the **reactants**, resulting in a gain in their energy level and temperature. Note: The temperature of the reactants will never fall, even when some of this heat energy is used for bond-breaking. 
29	B	Since sulphuric acid is in excess, magnesium carbonate is the limiting reagent that will determine the amount of product formed. Thus half the mass of magnesium carbonate will produce half the volume of carbon dioxide, along with a slower rate of reaction as indicated by the gentler gradient of graph Z. On the other hand, using a lower temperature (Option D) would only slow the rate of reaction but the final volume of carbon dioxide produce would still be 100 cm^3.
30	D	Potassium Dichromate (VI) is an oxidising agent that is used to detect the presence of a reducing agent by changing from orange to green..

31	A	Alkalis react with acids to form a salt and water only (neutralization). The ionic equation of any neutralization reaction is the formation of water from H^+ ion and OH^- ion i.e. $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$
32	D	Acids react with *reactive* metals or carbonates to produce a gas. Option A: carbon is a non-metal Option B: copper is an unreactive metal Option C: magnesium oxide acts as a base which reacts with acid to form salt and water only (no gas is produced). Option D: sodium carbonate reacts with sulfuric acid to produce a salt, water and carbon dioxide (a gas).
33	D	Group I elements (alkali metals) are soft metals with low densities.
34	C	No reaction with dilute acid $\Rightarrow$ Metal Y is very unreactive. Oxides of metals above zinc cannot be reduced by heating with carbon $\Rightarrow$ Metal Z is highly reactive. Therefore the order of reactivity is Z, X, Y.
35	A	Production of carbon dioxide and its subsequent reduction to carbon monoxide: $C(s) + O_2(g) \rightarrow CO_2(g)$ $CO_2(g) + C(s) \rightarrow CO(g)$ Oxidation state of carbon in formation of carbon dioxide changes from 0 in C to +4 in CO_2. Reduction of haematite by carbon monoxide to iron: $3CO(g) + Fe_2O_3(s) \rightarrow 3CO_2(g) + 2Fe(l)$ Oxidation state of carbon monoxide in extraction of iron changes from +2 in CO to +4 in CO_2.
36	A	Carbon monoxide is produced from *incomplete* combustion of the fossil fuels.
37	B	Organic compounds in the same homologous series have the same functional group. In this case, P and S have the same functional group - the hydroxyl group (–OH).
38	C	Natural gas consists primarily of methane. P.S. Methane, being the smallest alkane molecule in its homologous series with a low boiling point, is collected as natural gas at the top of the fractionating column during the fractional distillation of crude oil.
39	C	Process A involves evaporation where crude oil is heated into a vapour. Process B involves distillation where diesel oil is extracted from the fractionating column. Process C involves **cracking** where diesel oil (which is made up of long-chain alkane molecules) is broken down into smaller alkene molecules to produce ethane, a short-chain alkene. Process D involves polymerization where a large number of ethane molecules are joined together to form the macromolecule poly(ethene).
40	B	When left exposed to air for some time, bacteria from the air will oxidise ethanol into ethanoic acid i.e. alcohol oxidised to form a carboxylic acid. $CH_3CH_2OH(aq) + O_2(g) \xrightarrow{\text{bacteria}} CH_3CO_2H(aq) + H_2O(l)$