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Memorandum for Physics 2019

1	C	11	C	21	C	31	A	41	B	51	C	61	D	71	B	81	C	91	C
2	A	12	D	22	C	32	D	42	D	52	C	62	D	72		82	B	92	C
3	C	13	C	23	D	33	C	43	A	53		63	D	73	B	83	C	93	A
4	A	14	C	24	A	34	D	44	A	54	C	64	B	74	B	84	A	94	A
5	B	15	D	25	A	35	C	45	A	55	D	65	B	75	D	85	C	95	B
6	C	16	C	26	C	36	A	46	C	56	A	66	A	76	A	86	B	96	D
7	C	17	B	27	D	37	D	47	A	57	A	67	B	77	D	87	A	97	D
8	C	18	B	28	C	38	B	48	B	58	A	68	C	78	D	88	C	98	D
9	A	19	C	29	D	39	A	49	C	59	B	69	D	79	B	89	C	99	C
10	B	20	D	30	D	40	D	50	B	60	C	70	D	80	C	90	B	100	A

SOLUTIONS:

1 Book work

2 When comparing densities there is no unit – dimensionless.

3 W = Mg, so Mg/M = g

4 Points 1 wavelength apart, should be at the same place 1 wave further along – EH.

5 Copy the wave, superimpose it on the original and shift it slightly to the right, Y direction. Drop a perpendicular from the original E, and where it cuts the new wave shows E has moved down.

6 Using the Doppler equation $f_L = \dfrac{c+v}{c-v_L} f_S$ then since v = 0 and c = 340 m.s^{-1}

We get $f_L = \dfrac{c}{c-v_L} f_S = \dfrac{340}{340-30} 420 = 461\text{Hz}$

7 Bookwork

8 Magnification = $M = \dfrac{\text{Focal Legnth Objective}}{\text{Focal length Eye lens}} = \dfrac{60}{1.5} = 40$

9 Bookwork

10 If a bright fringe forns then there is constructive interference and the path difference = $n\lambda$. A dark fringe means there is destructive interference and the path difference is $n\lambda/2$

11 100 cos 30 = 100 x 0.866 = 86.6 N

12 Taking moments about P remembering that the plank weighs W that acts at 2.5 m

Clockwise 3W + 2.5W

Anticlockwise 5T These are equal so 5T = 5.5W so $T = \frac{5.5W}{5} = 1.1W = \frac{11W}{10}$

You get the same answer if you use fractions.

13 As everything is frictionless. (M = m) will move down and M will move up.

So (M = m)g – T = (M + m)a
T – Mg = Ma

This then gives Mg + mg – Mg = Ma + ma + Ma or mg = 2Ma ma.

This simplifies to m(g – a) = 2Ma. So $m = \frac{2Ma}{g - a}$

14 Resolving vertically: T_2sin50 = 600 T_2 = 600/0.766 = 783 N
Resolving horizontally T_2cos 50 = T_1 so T_1 = 783 x 0.64 = 503 N.

15 Weight component F down slope equal mgsin30. The Pcos30 = F = mgsin30.

So P = mg Tan 30 = 200 = 115. 5N

16 Distance fallen in 6s – distance fallen in 4s. Using $s = ut + ½ gt^2$ we get, since u = 0

We get that the distance fallen is $½ g(6^2 – 4^2)$ = 5(36 – 16) = 100 m.

17 There are two ways to do this:

1 Force down slope = Mgsin30 this means that the acceleration a down the slope is

Mgsin30 = Ma so a = 5 $m.s^{-2}$ Then using $v^2 = u^2 + 2as$ we get

$v^2 = 2gs$ as u = 0 so v^2 = 2 x 5 x 8 = 80 then v = 8.94 $m.s^{-1}$

2 Energy: Block falls down 4m (8 sin 30) so PE = mgh, KE = ½ mv^2
PE = KE so v = $\sqrt{(2gh)} = \sqrt{80}$ = 8.94 $m.s^{-1}$

18 Locomotive exerts force F N. For the first case F = 60a
Fot the second case F = 30a'. The since F is the same we have 60a = 30a'
This means that a' = 2a = 3 $m.s^{-2}$

19 Impulse can be thought of as rate of change of momentum (or $\Delta P/\Delta t$)

ΔP = 0.051 x 80 4.08 Ns Δt =0.006 s I = 4.08/0.006 = 680 N

20 Momentum P = mv, so $P^2 = m^2v^2$ so dividing this by 2m gives $P^2/2m = E$

So $P^2 = 2mE$ and $P = \sqrt{(2mE)}$

21 When the truck and the traffic officer meet they will have covered the same distance in the same time

So truck speed = 30 $m.s^{-1}$ $D_S = 30t$. Traffic Officer $D_T = ½at^2$ since u = 0
So $D_S = D_T$, ie $30t = ½at^2$ or 30 = 2t so t = 15 s.

22 The sliding friction between the 5 kg mass and the top of the 10 kg mass is f N

Now f = μR and since R= mg = 5 x 10 = 50 N we get that tension in the string is T = f = μmg

So T = 0.2 x 5 x 10 = 10N

23 Since distance is always greater than or equal to displacement so will speed be
ie speed $\geq$ velocity

24 Time of fall is given by $\sqrt{\frac{2h}{g}}$ .Time taken by the sound to return = $\frac{h}{c}$

So total time is $T = \sqrt{\frac{2h}{g}} + \frac{h}{c} = h\left[\sqrt{\frac{2}{gh}} + \frac{1}{c}\right]$

25 Resistance to motion is F= kv. And power P = Fv = av^2. His maximum power is 600 W,

So $av^2 = 600$ ie $v^2 = 150$ so $v = \sqrt{150} = 12.25$ $m.s^{-1}$

26 His mass is 60 kg, so his weight is 600 N. His increase in PE = 5 x 600 = 3 000 J
Power = WD/t, so his power is 3 000/4 =750 kW

27 $E_1 = \frac{1}{2}mv^2 = \frac{p_1^2}{2m}$ so $p_1 = \sqrt{2m_1E_1}$

$$E_2 = \frac{1}{2}mv^2 = \frac{p_2^2}{2m} \text{ Þ } p_2 = \sqrt{2m_2E_2}$$

$$\frac{p_1}{p_2} = \frac{\sqrt{2m_1E_1}}{\sqrt{2m_2E_2}} = \sqrt{\frac{m_1}{m_2}} = \sqrt{\frac{m}{4m}} = \frac{1}{2}$$

28 From $v^2 = u^2 + 2as$ we have that $s \propto V^2$ which means the $E_K \propto H$, hence linear.

29 Using the conservation of energy, then as there is no air resistance.

Total energy of stone $E_T = E_K + E_P = ½mu^2 + mgH$.
On reaching the water the potential energy is converted to kinetic energy: $mgH = ½mv^2$

So $E_T = ½\, m(u^2 + v^2) = ½\, mV^2$ where V is the speed of the stone as it strikes the water.

Therefore $V = \sqrt{(u^2 + v^2)}$. Here u is fixed (given) and v is the speed gained by falling H metres, so V is not dependent on the angle thrown.

Note: remember that $v^2 = 2gH$ – so the speed v due to its loss of E_P is independent of the angle at which it is thrown – depends just on the height – ie E_P

Another way to answer this poses a challenge as the question has two unknown quantities: the angle at which it is thrown and the speed that the stones strikes the water.

The only alternative here is to go by trial and error! Try for example throwing the ball straight up, straight down and horizontally. Firstly straight up and straight down are the same. (***Why? Discuss!***) Then use the vertical and horizontal components for the horizontal throw. The horizontal component is constant, and the equations of motion can be used to find the final vertical velocity and thus the final speed can be found and shows that it's independent of the angle.

30 When in contact the charge is distributed between the two conductors, ie 3μC on each.

From Coulomb's Law: $F = \frac{kQq}{d^2}$ the magnitude of the original force

$F_0 = \frac{k \times 12 \times 6}{d^2} = \frac{72k}{d^2}$ and after contact the magnitude of the new force

$F_N = \frac{k \times 3 \times 3}{d^2} = \frac{9k}{d^2}$ So the new force is 1/8th of the original.

31 Five capacitors in parallel gives an equivalent $5 \times 2\,\mu F = 10\,\mu F$ capacitor. Further, two capacitors in series give a capacity of $1\mu F$. When the two combinations are connected in series, they give a resultant capacitance of :

$$\frac{1}{C} = \frac{1}{10} + \frac{10}{10} = \frac{11}{10} \therefore C = \frac{10}{11}\mu F \ .$$

32 Some reasoning would lead to the conclusion that C must be located to the left of A so that the repulsion interaction with B is balanced by the attractive interaction with A. Thus, the distance from A to C can be called x and the distance from B to C can be called 0.6 + x (where x is the absolute value of the coordinate position (in meters).Expressions for F_{AC} and F_{BC} can be written

$F_{AC} = kQ_AQ_C / (d_{AC})^2$ and $F_{BC} = kQ_B Q_C / (d_{BC})^2$

and set equal to each other since objects at equilibrium have balanced forces. Thus

$kQ_AQ_C / (d_{AC})^2 = kQ_B Q_C / (d_{BC})^2$

The equation can be simplified by canceling k and Q_C. Thus,

$Q_A / (d_{AC})^2 = Q_B / (d_{BC})^2$

Substitute x and 0.6 + x into this equation to get $Q_A / x^2 = Q_B / (0.6 + x)^2$ Then solve for x by taking the square root of each side and substituting the Q values into the equation which then gives – 2.67 m

33 None of the bulbs in the RH circuit will light up as they are all "shorted" out, so any answer containg a bulb from the RH diagram is invalid!

34 A current of 1 ampere is equal to a flow of 1 C per second,; so 2A = 2C/s. 3 minutes = 180 s, so the charge through the conductor is 360 C

35 For N resistors in parallel the effective resistance r_i will be $r_i = \frac{r}{N}$ The equation for then circuit is: $E = i\left(R + r_i\right)$ so $i = \frac{E}{\left(R + \frac{r}{N}\right)}$

36 Bookwork

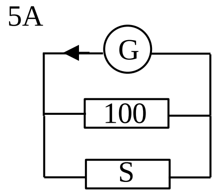
37 With S open, the circuit consists of a cell, a resistor and a high resistance voltmeter. It is assumed the internal resistance = 0. Effectively the 1Ω resistor can be neglected since its value is very much less that that of the voltmeter. So in effect the voltmeter is measuring the PD across the terminals of the cell, ie 4V (maybe 3.99999999V)

38 With S closed, the current will flow through the two resistors and the voltmeter will measure the PD across the 3Ω resistor. Since the current is 1A, PD = 3 V.

39 The Galvanometer, G, can carry a maximum current of $I_G = \frac{V}{R} = \frac{5\times10^{-2}}{100} = 5\times10^{-4}\,A$.

So the resistance of the shunt will such that the ratio of the resistors in parallel will be such that the shunt S will carry the bulk of the current:

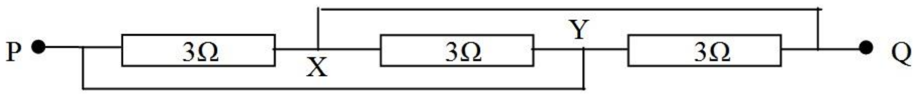
$$\frac{S}{100} = \frac{5\times10^{-4}}{5} \text{ so } S = \frac{5\times10^{-4}\times100}{5} = 0.01\Omega$$

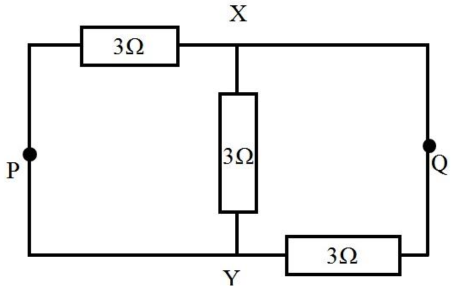


40 The RMS current = to the equivalent DC current. Energy generated Q = I^2R, so for 3A, Q = 9R. So for twice the energy, 2Q = i^2R, ie 18R = i^2R.
So i^2 = 18 and i = √18 = √(2 x 9) = 3√2.

41 As there is no internal resistance, and the other resistors are in parallel, the reading on the voltmeter remains constant. However when S is closed a current now also flows through the second resistor, so the reading on A will increase.

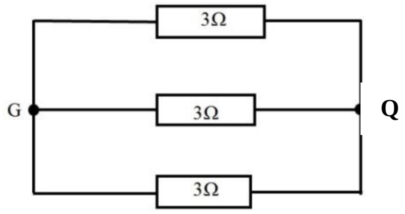
42 Look at the same problem with a few extra labels:





Looking at the upper wire, the RHS has X connected to Q, which means that Q and X are the same point! The same applies to the lower wire, Y and P are the same point. So we could redraw the diagram as follows:

Which is another way of asking the same question, but it becomes easier to see the obvious. By simply sliding Y to P and X to Q you get:



So the equivalent circuit is simply three, 3Ω resistors in parallel, so the equivalent resistance is 1Ω.

43 Power = VI = $\frac{V^2}{R}$ so $R_{50} = \frac{V^2}{50}$ = 800Ω and similarly R_{200} = 200Ω. So in series the total resistance = 1 000Ω and the current in the circuit would be I = $\frac{200}{1000} = \frac{1}{5}$ A .
Now Power P = I^2R, so P_{50} = 1/25 x 800 = 32 W, and P200 = 1/25 x 200 = 8 W.
So ratio = 1:4

44 PD, in volts, is equal to the work per unit charge,
so: $Vq = Energy = \frac{1}{2} mu^2$

to get: $u^2 = \frac{2Vq}{m} = \frac{2 \times 20 \times 9 \times 10^{-6}}{6 \times 10^{-12}} = 60 \times 10^6 \Rightarrow u = 7746 m.s^{-1}$

45 Therefore the weight is = 5.23 x 10^{-19} x 10 N = 5.23 x 10^{-18} N
Electrostatic force on the electron = e x E = 5.23 x 10^{-18} N so E = 31.2 V.m $^{-1}$

46 The volt can be defined as the work done per unit charge, or $V = W/q$. It should also be remembered that work and energy are the same so $V = E/q$. Now $q = e$ (electron charge) and $E = ½ mu^2$.

So: $V.e = E = \frac{1}{2}mu^2 \quad so \quad \frac{e}{m} = \frac{u^2}{2V}$

47 An alpha decay means a mass loss 4 and a charge loss of 2
A beta decay means an increase in atomic number of 1
So 2 α losses means mass loss of 8 and charge loss of 4
Three β losses means anatomic number increase of 3
So total mass loss = 8 ie 230 and total charge loss = 1 ie 91.

48 The stopping potential is given by: $V_S = hf - W$ where: V_S = stopping potential,

h = Plancks constant 6.6×10^{-34} Js W = work function of the metal = 1.6×10^{-19} J

So $V_S = 6.6 \times 10^{-34} \times 10^{15} - 1.6 \times 10^{-19}$ volts = 5 volts.

49 de Broglie wavelength $= \lambda = \frac{h}{P}$ As both the alpha particle and the proton have been accelerated through the same PD, the alpha particle picks up twice the energy, (q = 2)

So $E_\alpha = 2E_P$ and $m_\alpha = 4m_P$

So for the alpha particle P = √and for the proton we have $P_P^2 = 2m_pE$

Now $E = \frac{P^2}{2m}$ so $P_P = \sqrt{(2mE)}$ and $P\alpha = 2\sqrt{(2 \times 2mE)} = 2\sqrt{2}P_P$

$$\lambda_\alpha = \frac{1}{2\sqrt{2}}\lambda_P$$

50 Frequency of blue light is ~ 7.5×10^{14} Hz
Frequency of UV ranges from ~7.5×10^{14} Hz – 5×10^{15} Hz

Using $f = \frac{E}{h}$ and also that 3eV = $3 \times 1.6 \times 10^{-19}$ J it is then easy to work out the numbers below.

Now 3eV corresponds to a frequency of ~7.3×10^{14} Hz, this is blue light as given.
From 3eV to 10eV = 7eV this corresponds to a frequency of 1.7×10^{15} Hz is within the UV range.

51 **C**

The halogens are the group 7/17 elements.
F, Cℓ and Br are all in group 7/17.

52 **C**

235 is the mass number of U and 92 is the atomic number. The atomic number is equal to the number of protons in the nucleus as in a neutral atom also equal to the number of electrons. Therefore in $^{235}_{92}U$ are 92 protons and 92 electrons. The sum of the number of neutrons and the number of protons is equal to the mass number. Therefore the number of neutrons in $^{235}_{92}U$ is 235 – 92 = 143

53 **No correct answer.**

Distractor A is the electron configuration of an alkalimetal atom and NOT an ion.
Alkali metals are the group 1 metals. They all have one valence electron in a s orbital.
When an ion is formed, they lose this one valance electron to form a positive ion. A correct answer could be $1s^22s^22p^6$.

54 **C**

An element with three valence electrons is in group 3 and can form three bonds. An element with six valence electrons is in group 6/16 and can form two bonds. Therefore the formula is A_2B_3. Group 3 elements are metals and those in group 6/16 are non-metals. A bond between a metal and a non-metal is ionic.

55 **D**
The electron configuration of Ca^{2+} (18 electrons) as well as that of $C\ell^-$ (18 electrons) is $1s^2 2s^2 2p^6 3s^2 3p^6$.

56. **A**
Ca^{2+} - brick red flame
Na^+ – yellow flame
Zn^{2+} – colourless and sometimes bluish-green flame
K^+ – lilac flame

57 **A**
Iodine is non-polar and the intermolecular forces between molecules are London forces which is the weakest type of intermolecular force. Due to these weak forces iodine sublimes i.e. it changes directly from the solid to the gaseous phase.

58 **A**
An endothermic reaction takes in energy when taking place and is recognised by a positive value for the heat of reaction (ΔH). Otherwise heat needs to be written on the reactant side of the equation.

59 **B**
When you mix wheat flour into an aqueous solution, glutenins and gliadins (proteins) are able to come together and form intermolecular disulfide bonds, crosslinking the molecules. Disulfide bonds are formed when sulphur atoms of two thiol groups interact. Formation of large gluten molecules causes batter to thicken.

60 **C**
A solution is a homogenous single phase mixture of two or more compounds of which the composition can be changed.

61 **D**
$2PH_3 + \underline{4}O_2 \rightarrow P_2O_5 + \underline{3}H_2O$

62 **D**
Elements in the same group of the periodic table have similar chemical properties due to the same number of valence electrons. These outer electrons determine chemical properties.

63 **D**
The atomic mass reported on a periodic table is the average of the weight of all the naturally occurring isotopes. Being an average it would be most unlikely to be a whole number. The atomic mass of hydrogen is an average of the atomic amasses of the different isotopes found in nature

64 **B**
Hydrogen gas is diatomic with a molar mass of 2 $g \cdot mol^{-1}$. Oxygen is also diatomic and 1 mole will be 32 g. For gases only at STP, 22,4 dm^3 will also be one mole.

65 **B**

$n(CH_4) = \frac{48}{16} = 3$ mole

n(H atoms) = 4 x 3 mole = 12 mole

Number of H atoms $= nN_A$

$= 12(6{,}02 \times 10^{23})$

$= 7{,}22 \times 10^{24}$

66 **A**

A trigonal planar geometry is a molecular geometry with one atom at the center and three atoms at the corners of an equilateral triangle.

67 **B**

Chlorine is more electronegative than iodine. Therefore Cℓ will attract bonding electrons stronger in the C- Cℓ bond than I in the C – I bond. The C- Cℓ bond is more polar than the C – I bond resulting in stronger attraction and thus a higher energy needed to break the bond. The bond length of the C – I bond is greater than that of the C- Cℓ bond which also causes the latter to be stronger, but the primary factor is the difference in electronegativity allowing the bond between C and Cℓ to be shorter and stronger.

68 **C**

Avogadro's law states that one mole of ay gas occupies the same volume at the same temperature and pressure.

69 **D**

$$\frac{p_1V_1}{T_1} = \frac{p_2V_2}{T_2}$$

$$= \frac{3p_1V_1}{3T_1}$$

Thus if the pressure increases by a factor 3, the temperature must also increase by a factor 3 for a constant volume. The ration of V:T is thus 1 : 3.

70 **D**

Real gases have ideal behaviour at high temperatures and low pressures.

71 **B**

Decompression sickness (DCS, also called the bends or caisson disease) is the result of inadequate decompression following exposure to increased pressure. During a dive, the body tissues absorb nitrogen from the breathing gas in proportion to the surrounding pressure. As long as the diver remains at pressure, the gas presents no problem. If the pressure is reduced too quickly, however, the nitrogen comes out of solution and forms bubbles in the tissues and bloodstream. Bubbles forming in or near joints are the presumed cause of the joint pain of a classical "bend." When high levels of bubbles occur, complex reactions can take place in the body, usually in the spinal cord or brain. Numbness, paralysis and disorders of higher cerebral function may result.

72 **None of the answers are correct.**

The empirical formula is the simplest integral ratio of moles for the atoms. There are four different kinds of atoms, C, H, Cl and O.

$n(C) = \frac{37.84}{12} = 3.15$

$n(H) = \frac{2.12}{1} = 2.12$

$n(Cl) = \frac{55.84}{35.5} = 1.57$

$n(O) = \frac{4.2}{16} = 0.26$

As none of the moles is an integer, we have to divide all values by the smallest value among them. Here the smallest value is 0.26.

$C : H : Cl : O = \frac{3.15}{0.26} : \frac{2.12}{0.26} : \frac{1.57}{0.26} : \frac{0.26}{0.26}$

$= 12.1 : 8.1 : 6.0 : 1$

$= 12 : 8 : 6 : 1$

The empirical formula contains 12 C, 8 H, 6 Cl and 1 O. Thus, the empirical formula is: $C_{12}H_8Cl_6O$.

73 **B**

Molecular formula = (empirical formula)$_n$ where n is a whole number:

$$n = \frac{\text{Molecular mass of vitamin C}}{\text{empirical mass}}$$

$$= \frac{176}{88} = 2$$

Molecular formula: $(C_3H_4O_3)_2 = C_6H_8O_6$

74 **B**

Theoretical yield:

$n(C_6H_6) = \frac{15.6}{78} = 0.2$ mol

$n(C_6H_5NO_2) = 0.2$ mol

$m(C_6H_5NO_2) = nM = 0{,}2 \times 123$

$= 24.6$ g

$\%\ \text{yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100$

$\%\ \text{yield} = \frac{15.6}{24.6} \times 100 = 63.41\%$

75 **D**

H_2S loses electrons and is oxidised:

$H_2S \rightarrow S + 2H^+ + 2e^-$

MnO_4^- is reduced:

$MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$

76 **A**

The oxidation number of C changes from +2 in CO to +4 in CO_2. The oxidation number of Fe changes from +3 in Fe_2O_3 to 0 in Fe.

CO is oxidised and acts as reducing agent. Fe_2O_3 is reduced and is the oxidising agent.

77 **D**

IUPAC is the acronym for International Union of Pure and Applied Chemistry.

78 **D**

Polyethylene is primarily used in packaging (plastic bags, containers including bottles, etc.). Foam cups are made from polystyrene and plastic cups from polypropylene.
Polyvinyl chloride (PVC) is used in a variety of applications in the building and construction, health care, electronics, automobile and other sectors, in products ranging from piping and siding, blood bags and tubing, to wire and cable insulation, windshield system components and more. Polystyrene (PS) is used for producing disposable plastic cutlery, foam cups, CD cases, license plate frames and many other objects where a rigid, economical plastic is desired.

79 **B**

The first part of the name of an ester comes from the alcohol (butan-1-ol) and the last part comes from the acid (propanoic acid). Thus the name is butyl propanoate.
The formula is: $CH_3CH_2COOCH_2CH_2CH_2CH_3$

80 **C**

The functional group of the aldehydes is -CHO.

81 **C**

HCℓ is removed from the haloalkane to form an alkene. The reaction is called dehydrohalogenation and takes place in the presence of a concentrated strong base.

82 **B**

During the addition of HCℓ to an alkene, the H atom adds mainly to the C atom of the double bond already having the greater number of H atoms. Therefore the major product will be $CH_3CHCℓCH_3$.

83 **C**

A Kc < 1 indicates that the forward reaction will not take place to a great extent and not much products will be formed.

84 **A**

A decrease in volume of the vessel results in an increase in pressure. The reaction that forms the smaller number of moles of gas will be favoured.

In (i), the forward reaction will be favoured at higher pressure (2 moles of gas will react to form 1 mole of gas).Reactions (ii) and (iii) will not be affected by a change in pressure. In (ii) there are 4 moles of gas reactants as well as 4 moles of gas products. In (iii) there are 2 moles of gas reactants as well as 2 moles of gas products.

85 **C**

	$CaCO_3$	CaO	CO_2
Initial (mol)	$\frac{2,5}{100}$ = 0,025	0	0
Change	8 x 10^{-3}		8 x 10^{-3}
Equi	$\frac{1,7}{100}$ = 0,017		
Equi c			$\frac{8\times10^{-3}}{0,25}$ = 0,032

$K_c = [CO_2] = 0,032$

86 **B**

Phenolphthalein is a weak acid commonly used acid-base indicator.

87 **A**

Na reacts with water to form NaOH which is a base and turns litmus blue. Basic solutions have a soapy feeling.

88 **C**

K_2CO_3 is the salt of a weak acid and a strong base. The solution will thus be a base and have a pH greater than 7.

K^+ does not undergo hydrolysis. CO_3^{2-} will udergo hydrolysis:

$CO_3^{2-} + 2H_2O \rightarrow H_2CO_3 + 2OH^-$

Due to the formation of OH^-, the solution will be basic with a pH greater than 7.

89 **C**

$CH_3COOH(aq)$ is a weak acid and NaOH(aq) is a strong base.

At neutralisation, the solution will be basic due to hydrolysis of $CH_3COO^-(aq)$ according tothefollowing equation

$CH_3COO^-(aq) + H_2O(\ell) \rightleftharpoons CH_3COOH(aq) + OH^-(aq)$

$Na^+(aq)$ will not undergo hydrolysis.

90 **B**

Addition of $HC\ell$ increases the H_3O^+ concentration which will favour the reverse reaction. The equilibrium position will shift to the left causing the colour to become less blue.

91 **C**

pH = $-\log[H_3O^+]$

$2 = -\log[H_3O^+]$

$[H_3O^+] = 100\ mol\cdot dm^{-3}$

92 **C**

$$\frac{c_aV_a}{c_bV_b} = \frac{n_a}{n_b}$$

$$\frac{(0{,}21)(35)}{c_b(20)} = \frac{1}{2}$$

$\therefore c_b = 0.735\ mol\cdot\ell^{-1}$

93 **A**

Cu^{2+} ions are reduced at the cathode to form Cu. Zn is oxidized at the anode to form Zn^{2+}.

94 **A**

The cathode of any electrochemical cell is the electrode where reduction takes place. In a galvanic cell it is the positive electrode because electrons move from the negative anode to the positive cathode in the external circuit.

Electroplating takes place in an electrolytic cell. Positive ions moves to the negative electrode, the cathode, where they gain electrons to form a metal which is deposited onto the cathode. Electroplating thus takes place at the cathode of a electrolytic cell.

The anode is the positive electrode in an electrolytic cell. Oxidation takes place at the anode. Reduction takes place at the cathode which is the negative electrode in an electrolytic cell.

95 **B**

Ammonia is formed during the reaction H_2 and N_2 in the Haber process.

95 **D**

The Ostwald process is the industrial preparation of nitric acid, HNO_3.

96 **D**

Aspirin, with the chemical name acetylsalicylic acid, is medication extensively used around the world as an anti-inflammatory and anti-pyretic. The chemical formula is $C_9H_8O_4$.

98 **D**

Both ruby ad sapphire consists of Al_2O_3.
Sapphire is a precious gemstone, a variety of the mineral corundum, consisting of aluminium oxide with trace amounts of elements such as iron, titanium, chromium, copper or magnesium. It is typically blue, but natural sapphires also occur in yellow, purple, orange, and green colour. The only colour corundum stone that the term sapphire is not used for is red, which is called a ruby.

A ruby is a pink to blood-red coloured gemstone, a variety of the mineral corundum (aluminium oxide). Other varieties of gem-quality corundum are called sapphires. The word *ruby* comes from *ruber*, Latin for red. The colour of a ruby is due to the element chromium.

99 **C**

At King’s College London, Rosalind Franklin obtained images of DNA using X-ray crystallography, an idea first broached by Maurice Wilkins. Franklin’s images allowed James Watson and Francis Crick to create their famous double- helix model.

100 **A**

Frances H. Arnold from the California Institute of Technology, Pasadena, USA was awarded half of the Nobel Prize for Chemistry in 2018 for “*the directed evolution of enzymes”*.The other half was jointly awarded to George P. Smith, University of Missouri, Columbia, USA and to Sir Gregory P. Winter, MRC Laboratory of Molecular Biology, Cambridge, UK *“for the phage display of peptides and antibodies”*

These Nobel Laureates in Chemistry have taken control of evolution and used it for purposes that bring the greatest benefit to humankind. Enzymes produced through directed evolution are used to manufacture everything from biofuels to pharmaceuticals. Antibodies evolved using a method called phage display can combat autoimmune diseases and in some cases cure metastatic cancer.