CAMBRIDGE INTERNATIONAL EXAMINATIONS

International General Certificate of Secondary Education

MARK SCHEME for the October/November 2013 series

0652 PHYSICAL SCIENCE

0652/31 Paper 3 (Extended Theory), maximum raw mark 80

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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1	**(a)**	**(i)**	87, 67, 39, 3 – all correct ±1 cm ; 12, 32, 60, 96 – all correct (ecf) ;	[1] [1]	**[2]**
		(ii)	All points plotted correctly to within ½ square including (0,0), but allow if line goes thro (0,0) ; clear smooth curve (accept best fit straight line if distances = 12, 20, 48 etc.) ;	[1] [1]	**[2]**
	(b)		Choice of any two correct points e.g. (10,0) and (175,0.80) ; Use of gradient (176 –10) / (0.80 – 0) or use of $a = (v – u) / t$; 210 cm / s^2 or 2.1 m / s^2 (accept 206 and ignore sig. figs) ; (Answer mark can only be scored if answer lies between 200 and 210)	[1] [1] [1]	**[3]**
					[Total 7]
2	**(a)**		F^- , Na^+ , P (3 correct symbols 1, 3 correct charges 1) ;	[2]	
	(b)		Fe_2O_3 ; (accept $Fe^{3+}{}_2\,O^{2+}{}_3$)	[1]	
					[Total 3]
3	**(a)**		boiling point increases (down the group / with atomic number) ;	[1]	
	(b)		accept any number between –170 and –240 (actually –189)	[1]	
	(c)		helium or neon(no mark) recognition only helium and / or neon are less dense than air ; comment that average density of He balloon less than density of air OR average density of Ne filled balloon is greater than air ;	[1] [1]	**[2]**
					[Total 4]
4	**(a)**		Wire 1 named <u>metal</u>, (not Group 1 nor Hg) ; Wire 2 and 3 different <u>metal</u> ;	[1] [1]	**[2]**
	(b)		Needle moves across dial or clear the reading changes (not accept flicks up then down); e,m.f. / voltage produced (accept current) ; <u>due to</u> junctions are at a different temperatures ;	[1] [1] [+1]	**[3]**
	(c)		follows rapidly changing temperature ; measures high temperature (ignore ref to low temp or wide range) ; measures temperature at a point ; operator remote from thermometer / can be linked to computer ; clear link to specific task (e.g. temperature very high <u>in engine</u>) ;	ANY 2 [+1]	**[3]**
					[Total 8]

5 (a) (i) diamond strong / covalent bonds or bonds in all directions ; [1]
graphite has layers which slide / weak bonds between layers ; [1] **[2]**

(ii) diamond has no free electrons and / or graphite has free electrons ; [1]
in graphite electrons are between layers and / or in diamond all electrons involved in (strong) bonding ; [1] **[2]**

(iii) recognition of covalent / strong bonds (so similar mp) ; [1]
large amount of energy needed to separate atoms joined by covalent bonds ; [+1] **[2]**

(Do not allow either mark if the candidate states that graphite has a much lower melting point / has much weaker bonds than diamond)

(b) methane has weak forces <u>between molecules</u> ; [1]
little energy is needed to separate the molecules ; [1] **[2]**

(c) (i) $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$
one mark for formulae ; one mark for balance ; [2]

(ii) energy carried by e.m. radiation ; [1]
absorbed by the plant ; [1] **[2]**

[Total 12]

6 (a) (i) Only a fraction of incident wave is reflected / wave spreads out etc. ; [1]

(ii) 4 ½ squares × 0.05 × 10^{-3} = 2.25 × 10^{-4} s (0.000225 s) ; [1]

(iii) distance = ½ × 3 × 10^{8} × 2.25 × 10^{-4} ; [1]
= 34 000 m (accept 33750 m) ; [1] **[2]**
(1_c if ½ missed leading to 68 000 m) ;

(b) (i) <u>Use of</u> $c = f\lambda$ ($\rightarrow f = 3 \times 10^{8} / 7.5 \times 10^{-3}$) ; [1]
$f = 4.0 \times 10^{10}$ Hz ; [1] **[2]**

(ii) Mobile phone communication / cooking / uhf radio communication etc. ; [1] **[1]**
Note: Penalise power of ten error once only in the whole question.

[Total 7]

7 (a) (i) All points, including (0,0) plotted to within one small square ; [2]
(one mark if one point only is missing.incorrect)

(ii) smooth curve within one small square of each point ; [1]

(b) (bubble through) lime water ; [1]
turns cloudy / milky ; [1] **[2]**

	(c)	**(i)**	all of the hydrochloric acid had reacted ;	[1]	
		(ii)	RFM $CaCO_3$ = 100 ;	[1]	
			number of moles = 40 / 24 × 10^3 ;	[1]	
			(ignore power of ten for this mark, but not carry forward)		
			= 0.17 g ;	[1]	**[3]**
	(d)		line that is steeper than original and starts from (0,0) (to the left of original line) ;	[1]	
			and levels at 40 cm^3 (same as original line) ;	[1]	**[2]**
					[Total 11]
8	**(a)**	**(i)**	Transformer 1 step up / increases the voltage (for transmission) ;	[1]	
			Transformer 2 step down / decreases the voltage (for homes) ;	[1]	**[2]**
			(accept in correct reference to decrease / increase of current)		
			(give 1_c mark if both 'step up transformer and 'step down' are correct)		
		(ii)	Less energy loss (in power lines) ;	[1]	
			reference to lower current for same power ;	[1]	**[2]**
	(b)	**(i)**	good conductor ;	[1]	
			lattice of positive ions (not accept if +ve ions move) ;	[1]	
			in a sea of electrons ;	[1]	
			electrons free to move ;	[1]	**[4]**
		(ii)	Reference to malleability of copper or increase strength of cable ;	[1]	**[1]**
			(Zero for reference to alloying) ;		
					[Total 9]
9	**(a)**		diagram showing four shared electrons between two carbon atoms and 8 electrons around the carbons ;	[1]	
			diagram showing two hydrogen atoms for each carbon atom, each sharing two electrons with the carbon atom ;	[1]	**[2]**
	(b)	**(i)**	cracking (accept thermal decomposition) ;	[1]	
		(ii)	high temperature (not accept heat) ;	[1]	
			catalyst ;	[1]	**[2]**
	(c)	**(i)**	RFM C_2H_4 = 28 and RFM C_2H_5OH = 46 ;	[1]	
			mass of ethanol = 46 / 28 (= 1.6 kg);	[1]	**[2]**
		(ii)	fermentation ;	[1]	
			yeast ;	[1]	
			added to sugar (allow source of sugar e.g. grapes) ;	[1]	**[3]**
			(not allow 2^{nd} and 3^{rd} marks if the yeast is killed by high temperature, lose one mark if in the presence of oxygen)		
					[Total 10]

10 (a) (i) The joining together of two <u>nuclei</u> ; [1]
extra detail (e.g. the release of energy, small (light) nuclei,
high energy collision) ; [+1] **[2]**

(ii) radio waves
microwaves
thermal (Heat), IR
U.V.
X-ray
γ-rays
visible radiation / light
neutrinos / neutrons ; ANY 2 **[2]**

(b) (i) $((3.3434 \times 2) - 6.6810) \times 10^{-27} = 0.0058 \times 10^{-27}$ kg $= 5.8 \times 10^{-30}$ kg ; [1] **[1]**

(ii) $E = mc^2 = (5.8 \times 10^{-30} \times (3 \times 10^8)^2)$ (Formula on its own gains the mark) ; [1]
$= 5.2 \times 10^{-13}$ J ; [1] **[2]**

(iii) number of reactions / s = power / energy of each reaction =
$4 \times 10^{26} / 5.22 \times 10^{-13}$; [1]
$= 7.67 \times 10^{38}$ (s^{-1}) ; [1] **[2]**

Note: Penalise power of ten error once only in the whole question.

[Total 9]