

MARK SCHEME for the May/June 2015 series

**0442 CO-ORDINATED SCIENCES
(DOUBLE AWARD) (US)**

0442/33

Paper 3 (Extended Theory), maximum raw mark 120

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.

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1 (a)	element	Group number in Periodic Table	Number of outer electrons in one atom	reactive / unreactive
	A	(1)	1	reactive
	B	(7)	7	(reactive)
	C	0	(8)	unreactive

(1 for each column correct) ; ; ; [3]

(b) (D)
 an alloy is a mixture of metals ;
 E is not a mixture / is only one substance / is pure / single metal ;
 F does not show metals / is a mixture of gases / is a mixture of compounds ; [max 2]

(c) (i) reaction rate is lower ;
 (ethanol) molecules have lower average energy / are moving more slowly ;
 so frequency of collision with sodium is lower ;
 lower chance of successful collision ;
 R: there are fewer collisions [max 3]

(ii) molar volume $24\,000\text{ cm}^3$;
 $8.4 \div 24\,000 = 0.00035$;
 (allow 1 mark for $8.4 \div 24 = 0.35$)

OR

volume of hydrogen 0.0084 dm^3 ;
 $0.0084 \div 24 = 0.00035$; [2]

[Total: 10]

2 (a) (i) 4.5 (V) ; [1]

(ii) (charge =) current \times time ;
 $= 54$;
 coulombs (C) ; [3]

(iii) conventional current flows from positive to negative ;
 (electric current) is flow of negative charged
 electrons / electrons / charge / electricity flow / s from negative to positive ; [2]

(b) working or $1/R = 1/R_1 + 1/R_2$ or $(R =) R_1R_2/R_1+R_2$;
 $R = 2.5(\Omega)$; [2]

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- (c) (i) **B** (angle of) incidence
C (angle of) reflection ;
(both required for mark)
- (ii) angle **C** will double ; [1]

[Total: 10]

- 3 (a) sex/exchange of sexual fluids ;
shared needles ;
(contaminated) blood transfusion/exchange of blood ;
mother to baby ; [max 2]

(b) (i) increased and then decreased ; [1]

(ii) increased ; [1]

(c) (i) response to infection/pathogen ; [1]

(ii) cells destroyed by virus/disease ;
A: killed [1]

(d) immune system is suppressed ;
more likely to suffer from other diseases/reduced resistance to infection ;
because less antibody production ; [2]

(e) education ;
screening blood transfusions ;
(encouraging) use of condoms/barrier contraception ;
free needles for drug addicts/(encouraging) not sharing ;
AVP ; [max 2]

[Total: 10]

4 (a) (i) electrons ; [1]

(ii) move apart/repel ;
because like charges repel each other ; [2]

(b) (i) sound waves are reflected ; [1]

(ii) compressions are regions where the particles in air are close
together/rarefactions are regions where the particles in air are spread out ;
compressions are regions with air at higher pressure than
normal/rarefactions are regions with air at lower pressure than normal ; [1]

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(iii) particles collide more quickly ;
particles closer together ;

(c) (acceleration =) force / mass ;
acceleration = $350 / 785 = 0.45 \text{ (m/s}^2\text{)}$; [2]

[Total: 9]

5 (a) (i) ionic / electrovalent ; [1]

(ii) correct symbols show alternating sodium and chloride in both directions ;
indication that particles are positive sodium ions and negative chloride ions ; [2]

(b) (i) dissolve in water / make a solution ; [1]

(ii) hydrogen ;
sodium hydroxide ; [2]

(iii) chloride ions lose electrons ;
reference to ions discharged / (each loses) one electron ;
(resulting) chlorine atoms combine in pairs ;
chlorine atoms form covalent bond / share a pair of electrons ; [max 3]

(c) $\text{P}_4 + 6\text{Cl}_2 \rightarrow 4\text{PCl}_3$ [2]
all formulae ;
and then balanced ; [2]

[Total: 11]

6 (a) (i) arrow from cell and out through stoma ; [1]

(ii) stoma / stomata ; [1]

(b) (i) faster water loss ;
faster / more evaporation ; [2]

(ii) faster water loss ;
more escape routes (for diffusion) ; [2]

(c) smaller air spaces / fewer pores ; [1]

[Total: 7]

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- 7 (a) (i) rust ;
- (ii) (K)
(rusting requires) air / oxygen and water present (together) ;
- (b) (i) nitrogen ; ignore aluminium / copper
reference to pH 7 in water ; [2]
- (ii) (phosphorus oxide)
forms an acidic oxide ;
means that it must be a non-metal oxide and phosphorus is a non-metal ; [2]
- (c) (less)
reaction is exothermic / gives out heat / thermal energy ;
the idea that chemical energy (of reactants) is transferred to
surroundings / released as heat / thermal energy,
so less chemical energy remains ; [2]
- (d) sulfur dioxide + oxygen → sulfur trioxide
(reactants and products) ; ; [2]
- (e) (dilute) sulfuric acid ; [1]
- [Total: 11]**
- 8 (a) useful power output / total power input OR working (1.2 / 4.0)
- OR**
- useful energy output / total energy input OR working (1.2 / 4.0) ;
= 30 (%) ; [2]
- (b) (i) nuclei split ; [1]
- (ii) (nuclear) fusion ;
nuclei fuse / join together ; [2]
- (c) (i) to reduce current ;
to reduce power / energy losses ; [2]
- (ii) $V_s / V_p = N_s / N_p$;
output voltage = $500\,000 \times 33\,000 / 40\,000 = 412\,500$ (V) ; [2]
- (d) sulfur dioxide / nitrogen oxide ; [1]

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(e) damages leaves/kills animals ;
acidifies soils ;
leaches mineral ions from soil ;
acidifies water ;
toxic compounds soluble in acidic water ;
denatures enzymes ; [max 2]

(f) ref to CO₂ ;
trap solar radiation/greenhouse effect ;
(re-)radiate it back to Earth ; [max 2]

[Total: 14]

9 (a) both increasing ;
group 2 increasing faster / more ; [2]

(b) (i) growth / repair ; [1]

(ii) energy ; [1]

(c) calcium ;
for bones ;

OR

iron ;
for blood ; [2]

(d) (named) vitamin ; [1]

(e) genetically similar / so this is not a variable ; [1]

(f) (i) a control /
shows that the difference is due to the diet / not due to the mice ; [1]

(ii) grow more slowly / decreases, because no milk / vitamins ;

OR

continue to grow (for a while), as Group 2 did ; [1]

(g) taking in nutrients / organic substances and ions ;
containing raw materials / energy ;
absorbing / assimilating them ; [max 2]

[Total: 12]

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- 10 (a) (i) (L or O)
 contain only one type of atom / contain only carbon atoms ;
 (M or N)
 more than one type of atom / elements bonded together ;
- (ii) (M)
 idea that no hydrocarbon has less than five atoms / could be
 butane / C₄H₁₀ / contains C and H atoms but could not be CH₂ or C₂H / N is
 CO₂ / other logical deductive statement ; [1]
- (iii) (N)
 this must be carbon dioxide ;
 supporting detail, e.g. only one with three bonded atoms / fits the formula
 CO₂ / double bonds ; [2]
- (b) (i) covalent ; [1]
- (ii) 10 ;
 there are ten (single) bonds /
 each (single) bond represents a shared pair ; [2]
- [Total: 8]**
- 11 (a) C₆H₁₂O₆ + 6O₂ = 6CO₂ + 6H₂O
 (one mark for correct formulae, one mark for balanced equation) ; ; [2]
- (b) (i) does not use oxygen ; [1]
- (ii) releases less energy ; [1]
- (c) produces alcohol / ethanol ;
 produces carbon dioxide / makes "fizzy" / AW ; [2]
- [Total: 6]**
- 12 (a) (i) speed / transverse waves / passes through vacuum ; [1]
- (ii) frequency or wavelength ; [1]
- (iii) wavelength = velocity / frequency ;
 wavelength = $\frac{3.0 \times 10^8}{6.7 \times 10^{14}} = 4.5 \times 10^{-7} \text{ (m)}$; [2]
- (iv) *amplitude*: **B** and *wavelength*: **E** ;
 (both required in this order) [1]

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- (b) (i) area under graph or evidence of working ;
= $(90 \times 40) + (\frac{1}{2} \times 30 \times 40) = 3600 + 600 = 4200$ (m) ;
- (ii) **A** written anywhere on section from 1½–2 minutes ;
- (iii) (acceleration =) change in speed / time = $40/30$;
= 1.3 (m/s²) ; [2]
- (iv) (kinetic energy =) $\frac{1}{2} mv^2$;
= $\frac{1}{2} \times 1200 \times 40 \times 40 = 960\,000$ (J) ; [2]

[Total: 12]