

Mark Scheme 2826/01
June 2005

UNIFYING CONCEPTS IN
PHYSICS

2826/01

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1	(a) $v = u + at$	no, but if u is zero then v is proportional to t provided a is constant	1 1	2
	$pV = nRT$	not unless T is in kelvin and both n and V are constant (R is a constant)	1 1	2
	$P = Fv$	yes if v is constant but all three terms can vary so proportion unlikely then EITHER if v is constant then P and F will also be constant OR P is proportional to F when going up hills of different gradient (at constant v)	1 1 1	2
MAXIMUM 2				
	$A = \pi r^2$	yes (π is a constant and A is directly proportional to r^2)	1	1
	(b)	graph must be a straight line graph must go through the origin	1 1	2
2	(a)	The air in the forest is heated and expands (so it becomes less dense) and rises	1	1
		(cooler) air coming in to take its place (is the wind) {just saying convection current one of first two marks only}	1	3
	(b)	A shiny surface reflects light a black surface absorbs light shoe itself is black because it does not reflect light surface layer (transparent) or polish on shoe reflects light reflection depends on texture of surface	1 1 1 1 1	3

MAXIMUM 3

- (c) the pendulum bob is travelling in a circle 1
 so it is accelerating towards the centre 1
 (it has a constant speed in the time interval just before vertical to just after vertical)
- bob is not in equilibrium 1
 so the tension must be (slightly) larger than the weight of the bob 1 3
- MAXIMUM 3
- (d) X-rays have a very small wavelength (compared with 0.1 mm) 1
 angle of diffraction increases as size of opening decreases 1
 little diffraction when size of opening is much greater than the wavelength 1
 quantitative values - e.g. gap is 10^6 wavelengths 1 3
- MAXIMUM 3
- (e) sound waves are longitudinal waves 1
 longitudinal waves cannot be polarised 1 2
- (f) the heat is extracted from the air in the room 1
 and pumped out the back of the refrigerator 1
 the motor requires power 1
 and its waste heat heats the kitchen 1 2
- MAXIMUM 2
- 3 (a) (a lower resistance will) take a larger current from the supply 1
 (power = $V \times I$) so power to/ brightness of headlamps is greater 1 2
- (b) (first position) has no lights on at all 1
 (second position just) lights the sidelights 1
 (third position turns off the sidelights and) just illuminates the headlamps 1 3
- (c) 4 V across the internal resistance of the generator 1
 so current = $4 \text{ V} / 0.50 \Omega = 8.0 \text{ A}$ 1 2

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|---------|---|---|---|
| (d) (i) | 12 V across headlamp | 1 | |
| | so current = $12 \text{ V} / 4.0 \Omega = 3.0 \text{ A}$ | 1 | 2 |
| (ii) | power = $V \times I$, total current = 6.0 A | 1 | |
| | power supplied = $12 \text{ V} \times 6.0 \text{ A} = 72$ | 1 | |
| | watt | 1 | 3 |
| (e) | 8 A from generator but only 6 A to headlamps | 1 | |
| | therefore current to battery is 2 A (allow -2 A) | 1 | |
| | battery is being charged | 1 | 3 |
| (f) (i) | constant voltage maintained across bulbs (and other components) | 1 | |
| | so brightness of bulbs does not vary (when other components
are being used | 1 | |
| | less energy wastage | 1 | |
| | can give high current (for starter motor) | 1 | 2 |

MAXIMUM 2

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|------|---|---|---|
| (ii) | If the emf of the generator is (equal to or) less than the emf of the battery | | |
| | it is impossible to have it supply more current than the circuit uses | 1 | |
| | Charging the battery is then impossible | 1 | |
| | battery would become discharged | 1 | |
| | or other valid response | 1 | 2 |

MAXIMUM 2

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|-----------|--|---|---|
| 4 (a) (i) | radioactive implies the emission of ionising radiation | 1 | |
| | OR emits alpha, beta and gamma radiation | 1 | 1 |
| (ii) | nuclide refers to a particular nuclear structure (with a stated number
of protons and neutrons) | 1 | |
| (iii) | half-life is the (average) time taken for the activity to fall to half its
original value | 1 | |

(b)	time / hour	activity of material / Bq	activity of nuclide X /Bq	activity of nuclide Y /Bq
	0	4600	4200	400
	6	3713	3334	379
	12	3002	2646	356
	18	2436	2100	336
	24	1984	1667	317
	30	1619	1323	296
	36	1333	1050	283

(i) and (ii)	2100 as first figure to be filled in for nuclide X	1	
	1667	1	
	1050	1	
	idea of subtraction for nuclide Y	1	
	correct values for the ones given in nuclide Y column	1	5
(c)	sensible graph plotted	1	
	extrapolation done	1	
	value 70 ± 5 hours	1	3
OR	$A = A_0 e^{-\lambda t}$	1	
	$\ln A = \ln A_0 - \lambda t$		
	e.g. when $A = 296$, $t = 30$ h		
	$5.6904 = 5.9915 - \lambda \times 30$	1	
	$0.3011/30 = 0.01004 = \lambda$		
	$\tau = \ln 2 / \lambda = 69.0$ h answers will vary slightly dependent on starting and finishing times	1	3

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|------------------|---|---|---|
| (d) | separate the two nuclides (before starting the count) | 1 | |
| | by chemical means (if possible) | 1 | |
| | OR using a centrifuge or diffusion (if isotopes) | | |
| | OR sensible idea about shielding against one of the emitted particles | | |
| | | | |
| (e) | decay constants or half lives are different | 1 | |
| | half-life at the start is approximately that for X | 1 | |
| | X decays more rapidly than Y so after a long time the half-life is that for Y | 1 | |
| | in between it has a value intermediate between the two (which varies) | 1 | 3 |
| MAXIMUM 3 | | | |
| | OR dealt with mathematically, along the lines of | | |
| | two separate exponential decays | 1 | |
| | when added together do not give an exponential graph | 1 | |
| | with back up maths | 1 | 3 |