Paper 1 Practice questions (A Level) Answers

Question	Answer	Marks
Section A		
1 a	C	
1 b	B	
1 c	A	
2	A	
3	D	
4	B	
5 a	A	
5 b	C	
6	D	
7	B	
8	D	
9	C	
10	B	
11	D	
12	D	
13 a	C	
13 b	D	
13 c	D	
14	A	
15	B	
16	C	
17	C	
18	D	
19	B	
20	D	
21	A	
22	B	
23	D	
24	D	
Section B		
25 a	$F = \frac{-G \times 2.5 \times 2.5}{2.0^2}$ $= 1(.04) \times 10^{-10}$ N	1 1

25 b	work done in removing masses from a separation of 2.0 m to infinity $= \frac{-G \times 2.5 \times 2.5}{2.0}$ $= 2.1 \times 10^{-10}$ J	1 1
26 a	$Q = 2200 \times 10^{-6} \times 15$ = 0.033 C	1 1
26 b	$E = \frac{1}{2} \times 2200 \times 10^{-6} \times 15^2$ = 0.25 J	1 1
27	$3.0 = 6.0 \times e^{-t/(4000 \times 0.00047)}$ $0.5 = e^{-t/(4000 \times 0.00047)}$ $\ln 0.5 = {}^{-t/(4000 \times 0.00047)}$ $t = 0.693 \times 4000 \times 0.00047$ = 1.3 s	 1 1 1
28	Accept answers where two initial activities are stated (e.g. 100 Bq & 200 Bq) and activities after 6.6 years are calculated and shown to be approximately equal. Or: $2A_0e^{-t \ln 2/5.3} = A_0e^{-t \ln 2/28}$ $\ln 2 - \frac{\ln 2}{5.3} t = -\frac{\ln 2}{28} t$ $1 = t\left(\frac{1}{5.3} - \frac{1}{28}\right)$ t = 6.5 years	 1 1 1 1
29 a	$k = \frac{4\pi^2 m}{T^2} = \frac{4\pi^2 \times 0.1 \text{ kg}}{0.25 \text{s}^2}$ $= 15.8 \text{ N m}^{-1}$	1 1
29 b	$a = \frac{-kx}{m} = \frac{-15.8 \times 0.05}{0.1}$ $= 7.9 \text{ m s}^{-2}$	1 1
30	$\frac{GM_E}{r_E{}^2} = \frac{GM_m}{r_m{}^2}$ (subscript E represents Earth, m represents Moon) $r_E = r_m\sqrt{\frac{M_E}{M_m}}$ $r_E = 8.99\, r_m$ so $r_E + r_m = 3.8 \times 10^8$ m so $10r_E = 3.8 \times 10^8$ m $r_E = 3.8 \times 10^7$ m	 1 1 1
31 a	$pV = nRT$ therefore $V = \frac{nRT}{P} = \frac{2.5 \times 8.3 \times 290}{8.8 \times 10^5}$ $V = 6.8 \times 10^{-3} \text{ m}^3$	1 1
31 b	$P = \frac{1}{3}\rho c_{rms}{}^2$ $c_{rms} = \sqrt{\frac{3P}{\rho}} = \sqrt{\frac{3 \times 8.8 \times 10^5}{\left(\frac{28 \times 2.5 \times 10^{-3}}{6.8 \times 10^{-3}}\right)}}$ 506 m s^{-1}	 1 1
32 a	$f = e^{(E_2 - E_1)/kT} = e^{(6.9 \times 10^{-20} - 3.9 \times 10^{-21})/(1.4 \times 10^{-23} \times 283)}$ $= 7.8 \times 10^{-8}$	1 1

32 b	$2.9 \times 10^{-8} = e^{-4650/T}$ therefore $T = \dfrac{-4650}{\ln(2.9 \times 10^{-8})}$ = 267.9 K	1 1
33 a	e.m.f. = $\dfrac{\Delta\Phi}{\Delta t}$ ≈ 40 V	1 1
33 b	The maximum e.m.f. would double and the time period of oscillation would halve.	1 1
34 a	$\gamma = 1 + \dfrac{0.0012}{0.51}$ = 1.002 This is very near unity, hence relativistic effects unimportant.	1 1 1
34 b	$\lambda = \dfrac{h}{\sqrt{2Em}}$ $= \dfrac{6.6 \times 10^{-34}}{\sqrt{2 \times 1200 \times 1.6 \times 10^{-19} \times 1.9 \times 10^{-31}}}$ = 3.5×10^{-11} m	1 1 1
35	Any three statements from: • Changing magnetic field/flux in copper tube. • Currents produced in copper tube. • Currents set up their own magnetic fields/flux. • (providing) an upwards force on magnet/force against the weight of the magnet. • Change in net force leads to reduced acceleration/reduced relative motion between tube and magnet.	3
36 a	Force acting on alpha particle is the greatest at the smallest separation.	1
36 b	The alpha particle would be deflected more as it is acted upon by the force from the nucleus for a longer time.	1 1
Section C		
37 a	Use of area under graph to gain answer in region of 40 mC. Any method of estimating area acceptable.	3
37 b	$C = \dfrac{Q}{V} = \dfrac{40 \times 10^{-3}}{9.0}$ = 4400 μF	1 1
37 c	$RC = 41 \times 4400 \times 10^{-6} = 0.18\ldots$ s $5RC = 0.9$ s Refer to the graph to show that the current is approaching zero at this time, showing that capacitor is nearly fully discharged (calculated value of charge at 0.9 s = 0.27 mC)	1 1 1
37 d	$E = \dfrac{1}{2}QV = 0.5 \times 40 \times 10^{-3} \times 9.0$ = 180 mJ	1 1
37 e	$\Delta\theta = \dfrac{180 \times 10^{-3}}{6 \times 10^{-4} \times 420}$ = 0.7 °C	1 1
38 a	Wavelength of radiation emitted from galaxies increases. this is shown in a shift of the spectral lines to longer wavelengths.	1 1
38 b	gradient, e.g. $\dfrac{35 \times 10^{6}\ \text{m s}^{-1}}{2 \times 10^{9}\ \text{l.y.}}$ = 0.0175 m s^{-1} l.y.$^{-1}$	1 2

38 c	The answer can include the following points: Description/explanation of cosmological redshift: • More distant galaxies recede more quickly – whichever direction the observation is made. • This shows (nearly all) galaxies are moving away from each other. • Some observed redshifts cannot be explained by galaxies moving through space. • As light travels from distant galaxies it is stretched as space expands. • The greater the distance, the greater the time of travel, the greater the expansion of space and hence the greater the redshift. • Shows that earlier in time the Universe was smaller. Cosmic microwave background radiation: • Produced when Universe first became cool enough for neutral atoms to form. • Photons travelling from that time will have experienced great cosmological redshifts. • Background radiation nearly uniform. • Near-uniformity shows that the Universe was uniform in its early history. • Small anisotropy (non-uniformity) is observed. • CMBR gives evidence that the Universe was in a hot dense state early in its history.	6
39 a	Iron is a magnetic material. therefore electrostatic forces can be induced or exerted when a current flows through the coil (or similar answer).	1 1
39 b	Using thin sheets (laminations) prevents eddy currents in the core that generate an electric field and therefore affect the motion of the magnetic coils.	1 1 1
39 c	Any sensible suggestions, e.g.: • Increase the number of turns on the (rotor) coil to generate a greater magnetic force for a given current. • Increase the diameter of the (rotor) coil to increase the magnetic flux linkage through the coil (and hence the force). • Use a different rotor core (with greater magnetic permeability) to increase the force for a given magnetic flux linkage.	Maximum 4 marks (2 for modifications and 2 for explanations)