Selected Questions – Set 3 - Answers

1.

a		$Q_o = CV = 1.2 \times 10^{-11} \times 5.0 \times 10^3 ; = 6.0 \times 10^{-8}$; C		**3**
b	**i**	$RC = 1.2 \times 10^{15} \times 1.2 \times 10^{-11}$ *or* $= 1.44 \times 10^4$ (s)		**1**
	ii	$I = V/R = 5000/1.2 \times 10^{15}$ *or* $= 4.16 \times 10^{-12}$ (A)		**1**
	iii	$t = Q_o/I; = 6 \times 10^{-8} / 4.16 \times 10^{-12} = 1.44 \times 10^4$ (s)		**2**
	iv	$Q = Q_o e^{-1}$; $Q = 0.37Q_o$ so Q lost = $0.63Q_o$		**2**
c	**i**	capacitors in parallel come to same voltage		**1**
		so Q stored α C of capacitor		**1**
		capacitors in ratio 10^3 so only 10^{-3} Q_o left on football		**1**
	ii	$V = Q/C = 6.0 \times 10^{-8} / 1.2 \times 10^{-8}$ *or* $6.0 \times 10^{-11} / 1.2 \times 10^{-11}$ *or* only 10^{-3}		
		Q left so 10^{-3} V left; = 5.0 (V)		**2**

2.

a	**i**	5.0 (V)	**1**	
	ii	10.0 (V)	**1**	**2**
b	**i**	$Q = CV ; = 1.0 \times 10^{-3}$ (C)	**2**	
b	**ii**	The total capacitance of each circuit is the same (namely 100 μF) ;	**1**	
		because capacitors in series add as reciprocals/ in parallel add/ supply	**1**	
		voltage is the same and Q = VC, etc. *max 2 marks*		**2**
c	**i**	A1 will give the same reading as A2; because the two ammeters are	**1**	
		connected in series /AW	**1**	
		answer only in terms of exponential decrease for a maximum of 1 mark		
	ii	A4 will show the same reading as A2 at all times;	**1**	
		A3 will show half the reading of A2 initially; and at <u>all</u> subsequent times	**2**	**5**

3.

(a)		Is in the opposite direction to the displacement Increases as the speed of the object decreases	B1 B1	If more than 2 ticks are given mark all and deduct 1 mark for each error
(b)	**(i)**	$f = \frac{1}{T} = \frac{1}{1.2}$ $f = 0.83 \quad (\text{Hz})$	 B1	 **Allow:** the fraction 5/6 only
	(ii)	$v_{max} = (2\pi f)\ A$ $0.08 = (2\pi \times 0.83)A$ $A = \frac{0.08}{(2\pi \times 0.83)} = 0.015 \quad (\text{m})$	 C1 A1	Possible **ecf** from **(b)(i)** **Note:** Mark is for substitution; any subject Answer is 0.0153 (m) to 3 sf
	(iii)	$a_{max} = (2\pi f)^2 A$ $a_{max} = (2\pi \times 0.83)^2 \times 0.015$ $a_{max} = 0.42 \quad (\text{m s}^{-2})$	 C1 A1	Possible **ecf** from **(b)(i)** and **(ii)** **Note:** Mark is for substitution **Ignore sign** Expect to see 0.41 if 2 sf values are used **Allow:** tangent used at $v = 0$ (M1) gradient of tangent calculated in range 0.37 to 0.44 (m s^{-2}) to 2sf (A1). Accept gradient of tangent =0.4 (m s^{-2})
(c)	**(i)**	Graph(s) tending to single peak with axes labelled in words or appropriate symbols Peak labelled as natural / resonant frequency (of system) or f_o • Resonance occurs when the driving frequency matches natural / resonant frequency (of system) • the amplitude of vibrations / energy (transferred) is then a maximum (AW)	B1 B1 B1 B1	Can be scored even if horizontal axis is not correctly labelled
	(ii)	A valid example of resonance Explanation to include • what does the driving and what is being driven • that this occurs at specific (driver) frequency	B1 B1	**Allow:** Mirror in car, Washing machine, Child on swing, microwave (oven), radio (tuning), Structures (in wind etc) MRI **Not** musical instruments

4.

a	**i**	Towards centre of circle	**1**
	ii	$F = mv^2/r$; $= 800 \times 15^2/30$; $= 6000$ (N)	**3**
	iii1	Two arrows, one vertical, the other along string;	**1**
		correctly labelled weight/W/mg and tension/T	**1**
	2	(Moves along same circular path at higher speed so) <u>needs</u> greater centripetal force	**1**
		provided by larger horizontal component of tension	**1**
		(can only be) achieved by having larger angle (and larger T)	**1**

5.