Marking Scheme

1.

(a)

Either	Or
Flux changes (1) hence emf induced (1) [Because of RH rule or Faraday $\rightarrow$ 2nd mark, but not 1st mark] flux increases and decreases [implies 1st mark] [i.e. $\frac{d\Phi}{dt}$ alternates implied](1) NB. "Change in field" not 1st mark but others available]	B-lines being cut (1) hence emf induced (1) [Because of RH rule or Faraday $\rightarrow$ 2nd mark, but not 1st mark] direction of cutting changing (1) [Not "magnet oscillating" accept "magnet changing direction [of motion]"]

3

(b) (i) $V_{rms} = \frac{Vo}{\sqrt{2}} = 0.5\text{ V}$ — 1

(ii) Rate of change of flux (linkage) = 0.707 [V] (1)

from Faraday's [or Neuman's] law or $E = N\frac{d\Phi}{dt}$ [allow $E = \frac{\Phi}{t}$](1)

[Independent mark – must be stated]

For 1 turn = $\frac{0.707}{200} = 0.0035(35)\text{ Wb s}^{-1}$ (1)

NB. 0.0025 Wb s^{-1} [from use of $V = 0.5$ V]$\rightarrow$ 2 if 2nd mark awarded. — 3

(c) Stating or implying that there is a magnetic field set up in the coil (1)
Opposes motion / due to Lenz's law (1)
Detail given, e.g. loss (dissipation) of energy due to current or resistance, polarity of coil discussed [can imply 1st mark], work done against resistive force (1) — 3

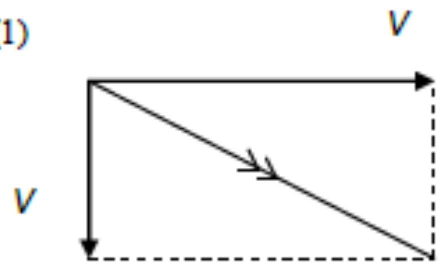
[10]

2.	*(a)*		The [induced] emf is proportional [or equal] to the rate of change [or cutting] of flux [linkage] or d*BAN*/d*t* and terms defined Nearly correct statements award 1 out of 2 marks e.g. The emf is equal to the change of flux The current is **proportional** to the rate of change of flux The emf is proportional to the cutting of flux *BAN*/*t* and terms defined Wrong statements get 0 The emf is equal/proportional to the flux linkage The current is **equal** to the rate of change of flux	2
			Lenz - the [induced] emf [or current] opposes [or tends to oppose etc.] the change [to which it is due]	1
	(b)	(i)	Clockwise (1) any 1 of FLHR(must have correct direction), FRHR, right hand grip rule (1)	2
		(ii)	Area increases ✓ at an increasing rate ✓ or cutting of flux ✓ inside the loop ✓ or $E=Blv$ ✓ and l is increasing ✓	2
		(iii)	$V = \frac{BAN}{t}$ and $t = \frac{20.1}{31}(= 0.648\text{ s})$ or $E = Blv$ used (1) $A = \frac{1.8+2.9}{2} \times 20.1[= 47.2]$ or mean $l = 2.35$ [m] (1) $I = \frac{V}{R}$ (1) Correct answer $I = 77$ [μA] (1)	4

3. *(a)*	(i)	Flux linkage = $NBA\cos\theta$ used (1) 0.251 [Wb] [and 0.251 Wb] (1)	2
	(ii)	No change in flux [linkage] or field lines cut in one direction and then the opposite direction Don't accept rate of change of flux is 0	1
(b)		Flux linkage = 0.0443 or -0.0443 (1) Time = $\frac{20}{360} \times 0.1$ (1) Attempt at change of flux (linkage) divided by time (1) Answer = [-] 15.9 [V] (1)	4
(c)		Peak emf = 17 [V] Sinusoid with peak of 3.4 squares high (ecf) (1) Sinusoid with period of 4 squares (1)	3

4.

Question			Marking details	Marks Available
2	*(a)*	(i)	0	1
		(ii)	$\varphi = B \times l^2$(1) Answer = 4.32 × 10^{-5} [Wb] (1)	2
	(b)		Change in flux or Faraday's law gives emf (1) Complete circuit or accept emf gives current (1) **Award 1 mark only for:** Current due to Faraday's law	2
	(c)		Force / current / emf **opposes the change** (1) Force on PQ opposite to SR **or** the force is clockwise (1)	2
	(d)		$I = \frac{V}{R}$ used (1) $A = \pi\frac{d^2}{4}$ or $\pi \times 3^2(\times 10^{-6})$ i.e. πr^2 used (1) $R = \frac{\rho \times l}{A}$ used (1) $V = \frac{\Delta N\phi}{\Delta t}$ used (1) Answer = 0.19 [A] **ecf** on ϕ and πd^2 (1)	5
			Question 2 Total	**[12]**

5.		(iv)	Ignore capacitance (or $\omega L - \frac{1}{\omega C}$ attempted) (1) Correct calculation for impedance e.g.. $\sqrt{887^2 + 2\,200^2}$ (1) Answer = $\frac{14.4}{2370}$ = 6.1 [mA] (1)	3
	(d)	(i)	**Attempt** at an explanation at low **and** high frequency (1) Correct variation of X_C with frequency (i.e. large at low frequency or low at high frequency) (1) Correct division of pd with respect to frequency (e.g. at high frequency $R >> X_C$ so V_{OUT} is large or the opposite at low frequency) (1)	3
		(ii)	Phasor diagram drawn or implied (1)  $X_C = R$ or $V_C = V_R$ either derived or quoted (implies diagram correct) (1) Answer = 154 [Hz] (1)	3

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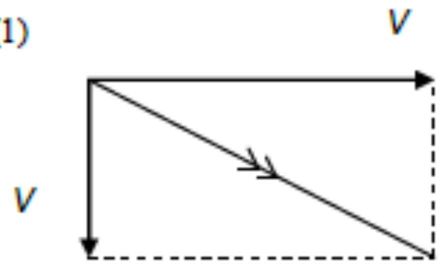
	(ii)	Phasor diagram drawn or implied (1)  $X_C = R$ or $V_C = V_R$ either derived or quoted (implies diagram correct) (1) Answer = 154 [Hz] (1)	3

6.	*(a)*	(i)	Sinusoidal reading on voltmeter @ 0.9 Hz (or across resistor) (1) Sinusoidal (or changing) *B*-field in primary (1) Leads to *B*-field cutting secondary or flux changing in secondary (1) emf induced in secondary due to Faraday's (1)	4
		(ii)	Lost flux or no iron core or low frequency or low turns	1
	(b)	(i)	$\omega L = \frac{1}{\omega C}$ **or** $f = \frac{1}{2\pi}\sqrt{\frac{1}{LC}}$ (1) Answer = 4 490 [Hz] (1)	2
		(ii)	$V_R = 12$ [V] (1) $I = 0.067$ [A] (1) $V_L = \mathrm{I} \times \omega L$ **or** $V_C = \mathrm{I} \times \frac{1}{\omega C}$ (1) $V_L = 71.5$ [V] **and** $V_C = 71.5$ [V] **or** implied e.g. V_C = same (1)	4
	(c)	(i)	$Z = \sqrt{(X_L - X_C)^2 + R^2}$ (1) $Z = 581$ [Ω] or implied (1) Current $= \frac{12}{581} = 21$ [mA] (1)	3
		(ii)	Phasor diagram (1) $\tan\theta = \frac{X_L - X_C}{R}$ (this step implies vector diagram if omitted) (1) Answer = 72° **(ecf)** (1) (18° and similar slips gain 1/2)	3
	(d)		$\frac{R}{X_C} = \frac{3}{4}$ (1) $X_C = \frac{1}{2\pi f C}$ **or** $X_C = \frac{1}{\omega C}$ and $\omega = 2\pi f$ **used** (1) Answer = 20 [kHz] (1)	3