CHAPTER 11 TEST REVIEW -- MARKSCHEME

1. A
2. B
3. B
4. C
5. B
6. B
7. C
8. C
9. D

10. (a) (i) $I_0 = \frac{100}{25} = 4.0(\text{A})$;

$I_{max} = 2.8$ A; 2

or

$V_{max} = \frac{100}{\sqrt{2}} = 70.7$ V;

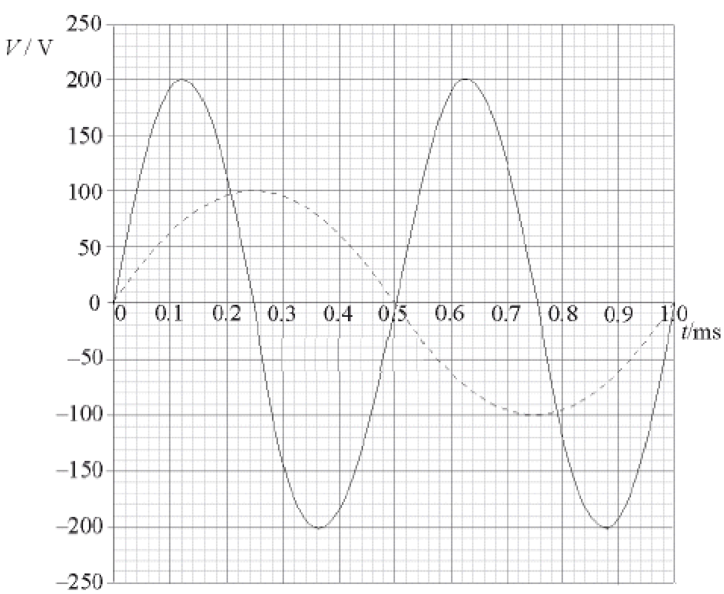
$I_{max} = \frac{V_{rms}}{R} = \frac{70.7}{25} = 2.8\text{A}$;

(ii) 200 W; 1

(iii) $V = 60(\pm 2.0)\text{V}$;

$P = \left[\frac{V^2}{R}\right] = \left[\frac{60^2}{25}\right] = 140(\pm 10)\text{W}$; 2

(b)



peak voltage of 200 V; (*allow 180 to 200 V)*

period = 0.50 ms; 2

11. (a) the product of (the magnitude of) the <u>normal component</u> of magnetic field strength;
and area through which it passes/with which it is associated; 2

or

$\phi = BA\cos\theta$;
all terms defined/shown on a diagram;

(b) (i) letter T clearly marked at 5.0 ms ***or*** 15 ms; 1

(ii) 2.0 V / Wb s^{-1};
em equals rate o change of flux; *(clear statement or equation must be present to award this mark)* 2
Use of slope to obtain answer is incorrect – this yields a value of 1.8.

(iii) 4.2 V; 1

12. (a) the current gives rise to a magnetic field/flux in the coil;
from Faraday's law a time changing field/flux induces an emf;
Lenz's law says that the direction of the induced emf is such as to oppose the growth of the current; 3

(b) (i) the value of the direct voltage that gives the same power dissipation/output;
as the average ac power dissipation/output; 2
Do not accept answer in terms of a formula.

(ii) 4×10^6; 1

13. (a) (i) $v = \sqrt{\dfrac{2eV}{m}}$;

$v = \sqrt{\dfrac{2 \times 1.6 \times 10^{-19} \times 250}{9.1 \times 10^{-31}}}$

$= 9.4 \times 10^6$ m s^{-1} 2

(ii) $evB = m\dfrac{v^2}{r}$;

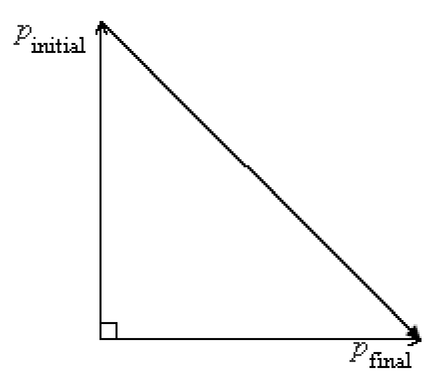
$r = \dfrac{9.1 \times 10^{-31} \times 9.4 \times 10^6}{1.6 \times 10^{-19} \times 0.12}$

$= 4.5 \times 10^{-4}$m 2

(iii) $t = \dfrac{1}{4}\dfrac{2\pi \times 4.5 \times 10^{-4}}{9.4 \times 10^6}$:

$= 7.5 \times 10^{-11}$ s 1

(b) (i) vector as shown;



(ii) $\Delta p = \left(\sqrt{[8.6 \times 10^{-24}]^2 + [8.6 \times 10^{-24}]^2}\right)$;

$= 1.2 \times 10^{-23}$ N s

(iii) $F \left(= \dfrac{\Delta p}{\Delta t} = \dfrac{1.2 \times 10^{-23}}{7.5 \times 10^{-11}}\right) = 16 \times 10^{-13}$ N;

(c) (i) the flux in the loop is changing and so (by Faraday's law)
an emf will be induced in the loop;
(by Lenz's law) the induced current will be (counter-clockwise)
and so there will be a magnetic force opposing the motion;
requiring work to be done on the loop; 3

(ii) it is dissipated as thermal energy (due to the resistance)
in the loop / radiation; 1

14. **a** **i** From $P = VI$ the current is $I = \frac{P}{V} = \frac{120x10^3}{240} = 500A$

And so the power lost in the cables is $P = RI^2 = 0.80 \times 500^2 = 200$ kW

ii The power that must be supplied by the wind generator is 320 kW. ✓

And so the voltage is $V = \frac{P}{I} = \frac{320x10^3}{500} = 640V$

iii The efficiency is $e = \frac{useful\ power}{input\ power} = \frac{120}{320} = 0.375 \approx 0.38$

b The current would be 10 smaller. ✓

And so the power loss 100 times smaller, i.e. 2.0 kW. ✓

c **i** The peak voltage is 340 V and so the rms voltage is $\frac{340}{\sqrt{2}} = 240.4 = 240V$

ii $\bar{P} = V_{rms}I_{rms}$ 18 x 10^3 W hence $I_{rms} = \frac{18x10^3}{240} = 75A$

Hence $I_{peak} = 75 \times \sqrt{2} = 106 \approx 110$ A.

d **i** The alternating current in the primary coil produces an alternating magnetic field.

The iron core confines the magnetic field lines within the core and hence into the secondary.

Because the field is alternating the magnetic flux in the secondary coils varies with time.

And hence by Faraday's law an emf is induced in the secondary coil.

ii The magnetic field in the core creates small currents in the core by exerting magnetic forces on electrons.

These currents dissipate energy as thermal energy in the core due to collisions with the core atoms.

15 **a** An ideal voltmeter has infinite resistance

And so no charge can move through it, hence no current

b **i** $C = \varepsilon_0 \frac{A}{d} = 8.85x10^{-12}x\frac{0.68}{4.0x10^{-3}}$

$C = 1.5x10^{-9}F$

ii $Q = CV = 1.5 \times 10^{-9} \times 9.0$

$Q = 1.35 \times 10^{-8}$ C

iii $E = \frac{1}{2}CV^2 = \frac{1}{2}1.5x10^{-9}x9.0^2$

$E = 6.1x10^{-8}J$

c **i** The charge cannot change since the ideal voltmeter prevents any motion of charge in the circuit

ii The charge in the dielectric will separate

Creating a small electric field in the dielectric directed opposite to the original electric field

Since the net electric field in between the plates has decreased, the potential difference must also decrease

iii Since the potential difference decreased and the charge remained the same

The capacitance increased