سلطنة عمان
وزارة التربية والتعليم

امتحان دبلوم التعليم العام للمدارس الخاصة (ثنائية اللغة)
للعام الدراسي ١٤٣٨/١٤٣٩ هـ - ٢٠١٧ / ٢٠١٨ م
الدور الثاني - الفصل الدراسي الأول

تنبيه:
- المادة: الفيزياء.
- الأسئلة في (١٢) صفحة.
- زمن الإجابة: ثلاث ساعات.
- الإجابة في الورقة نفسها.

تعليمات مهمة:

- يجب الحضور إلى قاعة الامتحان قبل عشر دقائق على الأقل من بدء زمن الامتحان.
- يجب إحضار أصل ما يثبت الهوية وإبرازها للعاملين بالامتحانات.
- يجب الالتزام بالزي (الدشداشة البيضاء والمصر أو الكمة للذكور) والزي المدرسي للطالبات ، ويستثنى من ذلك الدارسون من غير العمانيين بشرط الالتزام بالذوق العام، ويمنع على جميع المتقدمات ارتداء النقاب داخل المركز وقاعات الامتحان.
- يحظر على الممتحنين اصطحاب الهواتف النقالة وأجهزة النداء الآلي وآلات التصوير والحواسيب الشخصية والساعات الرقمية الذكية والآلات الحاسبة ذات الصفة التخزينية والمجلات والصحف والكتب الدراسية والدفاتر والمذكرات والحقائب اليدوية والآلات الحادة أو الأسلحة أياً كان نوعها وأي شيء له علاقة بالامتحان.
- يجب على الممتحن الامتثال لإجراءات التفتيش داخل المركز طوال أيام الامتحان.
- يجب على الممتحن التأكد من استلام دفتر امتحانه، مغلفاً بغلاف بلاستيكي شفاف وغير ممزق ، وهو مسؤول عنه حتى يسلمه لمراقبي اللجنة بعد الانتهاء من الإجابة.
- يجب الالتزام بضوابط إدارة امتحانات دبلوم التعليم العام وما في مستواه وأية مخالفة لهذه الضوابط تعرضك للتدابير والإجراءات والعقوبات المنصوص عليها بالقرار الوزاري رقم ٥٨٨ / ٢٠١٥.
- يقوم المتقدم بالإجابة عن أسئلة الامتحان المقالية بقلم الحبر (الأزرق أو الأسود).
- يقوم المتقدم بالإجابة عن أسئلة الاختيار من متعدد بتظليل الشكل (▭) وفق النموذج الآتي:

س - عاصمة سلطنة عمان هي:

▭ القاهرة ▭ الدوحة

■ مسقط ▭ أبوظبي

ملاحظة: يتم تظليل الشكل (■) باستخدام القلم الرصاص وعند الخطأ، امسح بعناية لإجراء التغيير.

صحيح ■ **غير صحيح** ▭ ◉ ◔ ☒ ☑

مُسَوَّدَة، لا يتم تصحيحها

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Question 1: Multiple Choice Items (28 marks)

There are 14 multiple-choice items worth two marks each.
Shade in the bubble (○) next to the **best** answer for each item.

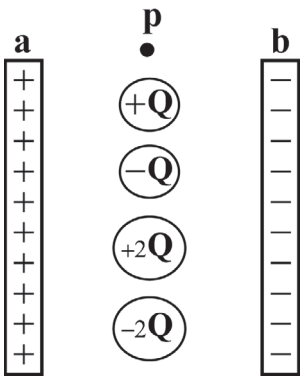
1) Which of the following sentences **is true** about Coulomb's law of charge?

- ○ The force is very weak between the charges.
- ○ The force is always attractive between charges.
- ○ The force is directly proportional to the size of the charges.
- ○ The force is directly proportional to the square of the separation between the charges.

2) If two equal charges of (14μC), were separated by a distance of (5cm), what would be the force between them?

- ○ 50.0 N
- ○ 10.0 N
- ○ 7.1×10^2 N
- ○ 4.3×10^4 N

3) Which of the charges shown on the figure opposite needs more work to move from point (P) to plate (b)?



- ○ +Q
- ○ −Q
- ○ +2Q
- ○ −2Q

4) Which of the following is equivalent to the unit of energy stored in a capacitor?

- ○ $\frac{C}{V}$
- ○ A.V
- ○ $\frac{V}{m}$
- ○ C.V

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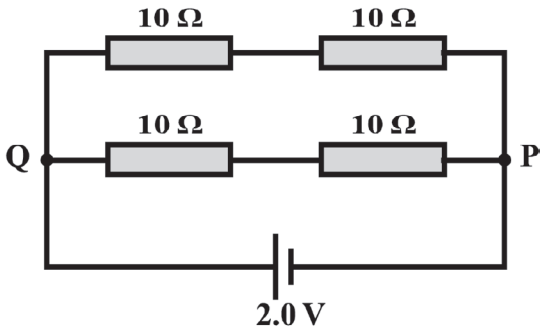
Question 1 continued

5) An electric heater is constructed by applying a potential difference (p.d) to a nichrome wire that has a total resistance (R). If the (p.d) was doubled, what will happen to its current?

- ☐ Double
- ☐ Quadruple
- ☐ Reduce by $\left(\frac{1}{4}\right)$
- ☐ Reduce by $\left(\frac{1}{2}\right)$

6) What is the potential difference (p.d) between points (P) and (Q) in the circuit opposite?



- ☐ 0 V
- ☐ 2 V
- ☐ 3.99 V
- ☐ 7.98V

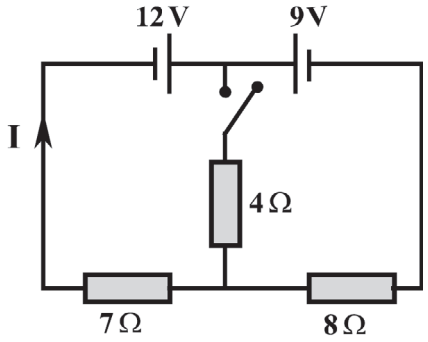
7) A copper wire of a cross-sectional area (3.0 mm^2) carrying a current of (5A) contains (8.5×10^{28} electrons/m^3). What is the magnitude of the drift velocity of the electrons in the copper wire?

- ☐ 1.90×10^{-23} m/s
- ☐ 1.23×10^{-7} m/s
- ☐ 1.23×10^{-4} m/s
- ☐ 2.40×10^{4} m/s

8) What is the potential difference (p.d) between the ends of a wire of (5Ω) resistance, if a charge of (720 C) passes through it in one minute?

- ☐ 0.42 V
- ☐ 2.4 V
- ☐ 60 V
- ☐ 3600 V

9) What is the value of (I) in the circuit opposite?

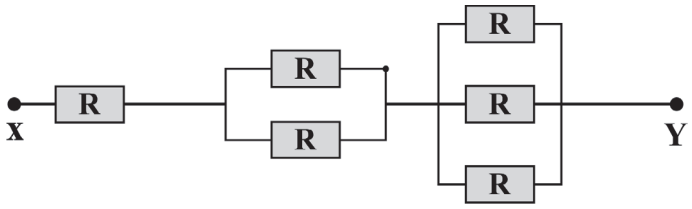


- ☐ 0.2 A
- ☐ 0.7 A
- ☐ 1.4 A
- ☐ 5.0 A

Question 1 continued

10) The figure below shows a network of resistors, if the overall resistance measured between points (X) and (Y) is (22 kΩ), what is the value of (R)?

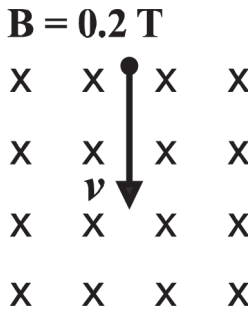
- ☐ 3.67 kΩ
- ☐ 12 kΩ
- ☐ 22 kΩ
- ☐ 132 kΩ



11) In which of the following cases will the force on a current-carrying wire in a uniform magnetic field be strongest?

- ☐ The current is parallel to the field lines.
- ☐ The current is perpendicular to the field lines.
- ☐ The current is at an angle of (30°) with respect to the field lines.
- ☐ The current is at an angle of (60°) with respect to the field lines.

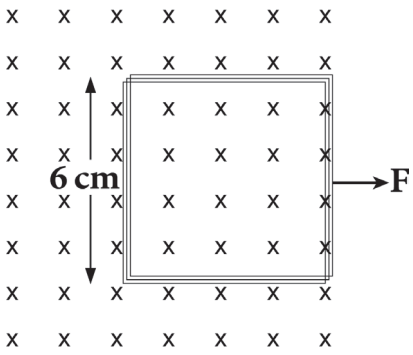
12 An electron is moving with a velocity of (2.0×10^6 m/s) in a uniform magnetic field as shown in the figure opposite. What is the magnitude and the direction of the force acting on the electron?



	Magnitude of F(N)	Direction
☐	4.0×10^5	To the right
☐	4.0×10^5	To the left
☐	6.4×10^{-14}	To the right
☐	6.4×10^{-14}	To the left

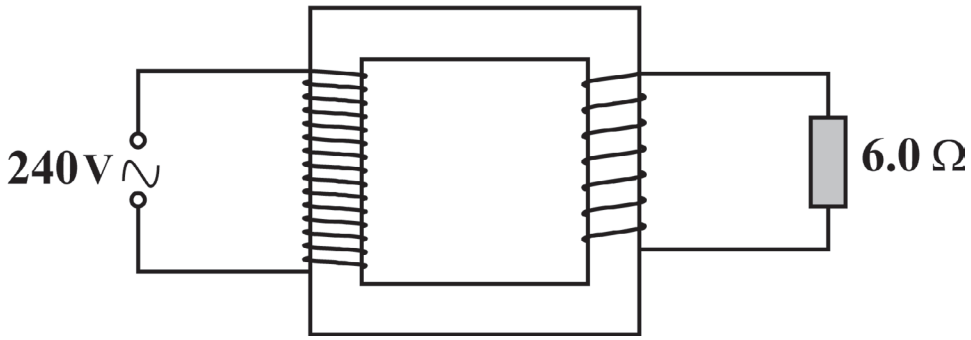
Question 1 continued

13) A square coil of (100) turns is positioned in a uniform magnetic field of (0.5T) as shown in the figure opposite. If the coil is pulled with a constant speed so that it is totally out of the magnetic field region in (0.1s). What is the value of the induced (e.m.f) during the given time.



- ☐ 0 V
- ☐ 1.8×10^{-2} V
- ☐ 1.8 V
- ☐ 1.8×10^{4} V

14) The transformer shown below is assumed to be 100% efficient and the ratio of the secondary turns to the primary turns is (1:20).



If a (240 V) a.c. supply is connected to the primary coil and a (6.0 Ω) resistor is connected to the secondary coil, what will be the current in the secondary coil?

- ☐ 0.10 A
- ☐ 0.14 A
- ☐ 2.0 A
- ☐ 40.0 A

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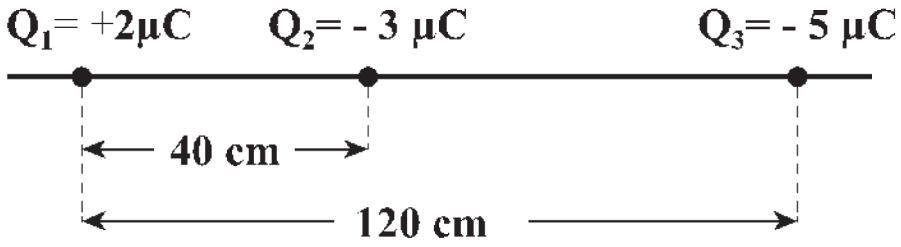
Question 2: EXTENDED QUESTIONS (42 marks)

Write your answer for each of the following questions in the space provided.

Be sure to show all your work, including the correct units where applicable.

15) Three charges are placed as shown in the figure below.



a. Write two factors that affect the force between two charges. (2 marks)

(i) _____

(ii) _____

b. Draw the direction of (F_{net}) at (Q_2) on the above figure. (1 mark)

c. Find the magnitude of the net force at (Q_2). (3 marks)

_____

_____

_____

_____

_____

_____

_____

Question 2 continued

16) A proton is accelerated from the rest by a potential difference of (1×10^6 V).

a. What is the final speed of the proton? (3 marks)

b. If the potential difference is increased what will happen to the final speed of the proton? (1 mark)

○ Increase ○ Decrease ○ Constant

(Shade the correct answer)

17) Figure (1) below shows a circuit containing two identical diodes (A) and (B). Figure (2) represents the characteristic graph of one of these diodes.

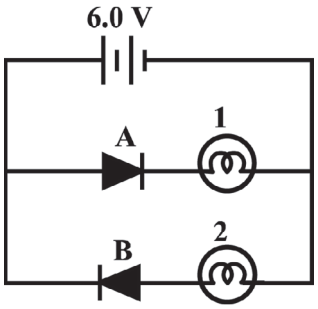


Figure (1)

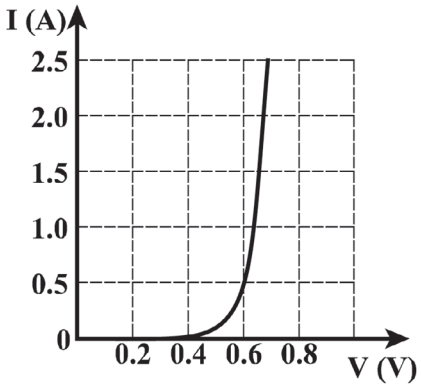


Figure (2)

a. Which diode's characteristic graph is represented in figure (2)? (3 marks)

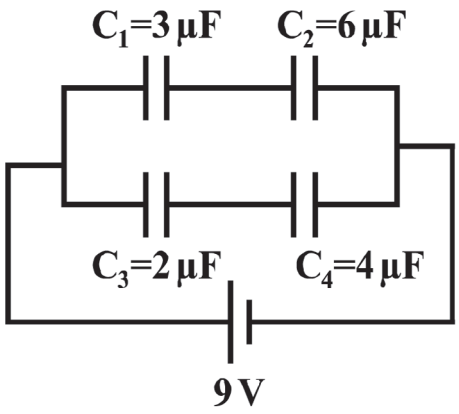
○ Diode (A) ○ Diode (B)

Explain your answer.

b. Find the potential difference across the diode when the current increases rapidly. (1 mark)

Question 2 continued

18) Study the following circuit and answer the questions below.



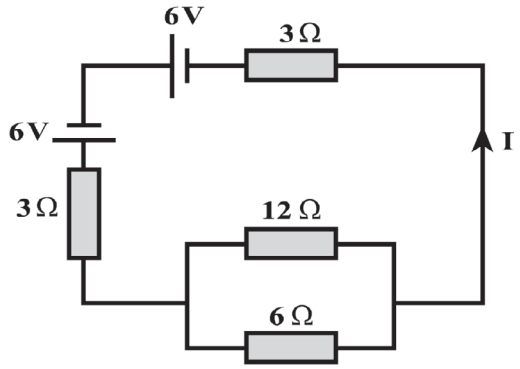
a. Calculate the total charge (Q) in the circuit above. (3 marks)

b. What can we add to the circuit in order to increase the charging time of the capacitors? (1 mark)

c. In the circuit above how much energy is stored if the charging (p.d) is reduced by $\left(\frac{1}{3}\right)$. (2 marks)

Question 2 continued

19) Study the circuit below.



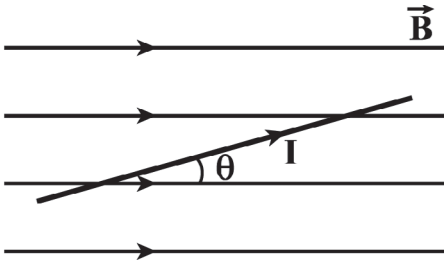
a. State Kirchhoff's second law. (2 marks)

b. Find the current (I) in the above circuit. (3 marks)

Question 2 continued

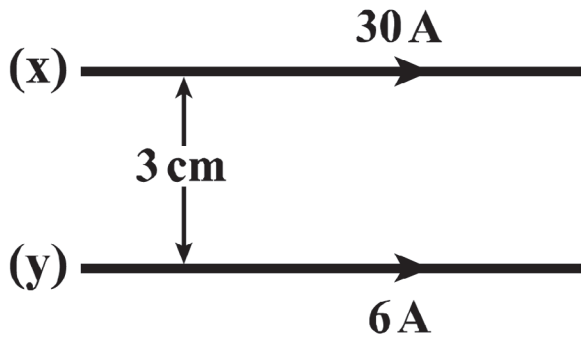
20) A wire of length (40 cm) and a resistance of (R_1), if the length of this wire is increased by (60 cm) and its new resistance is (R_2), find the ratio $\left(\frac{R_2}{R_1}\right)$. (3 marks)

21) A wire in a uniform magnetic field of (12 mT) carries a current of (6.2 A) as shown in the figure opposite. If the magnitude of magnetic force per length of wire is (0.033 N/m), calculate the angle (θ). (2 marks)



Question 2 continued

22) Two long parallel wires (x) and (y) are carrying currents as shown in the figure below.



a. Draw in the figure above the direction of the force effect on each wire. (1 mark)

b. Find the force acting per unit length on each wire. (2 marks)

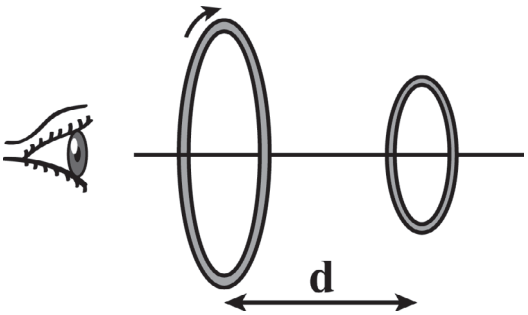
c. If the current in wire (y) was doubled and its direction was reversed, what will happen to each of the following? (2 marks)

(i) The magnitude of the force acting per unit length on each wire.

(ii) The type of force acting per unit length on each wire.

Question 2 continued

23) In the figure opposite two conducting loops are facing each other. An observer sees along the axis of the loops.

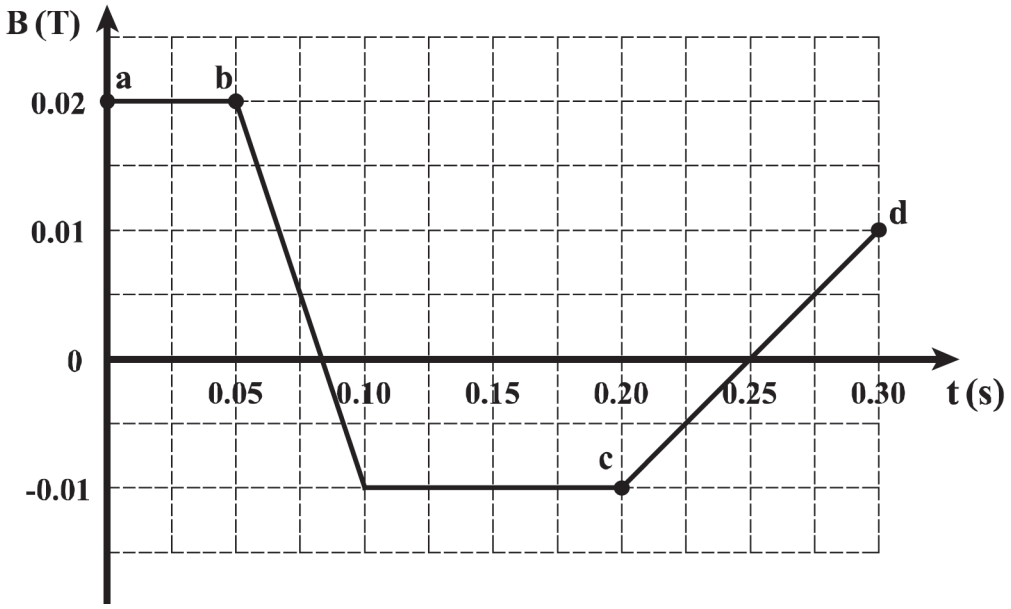


a. State Lenz law of electromagnetic induction. (2 marks)

b. What is the direction of the induced current in the smaller loop if it is moved with a constant speed toward the larger loop which has a clockwise current? (1 mark)

☐ Clockwise. ☐ Counter clockwise. (Shade the correct answer)

24) The figure below shows a graph of the magnetic field (B) as a function of time (t) in the region of a circular coil of (155 turns) that has a radius of (1.9 cm).



Question 2 continued

Calculate the (e.m.f) at each of the following time intervals:

a. (a – b) (1 mark)

b. (c – d) (3 marks)

[End of Examination]

FORMULA AND CONSTANTS

Forces and charge

$$F = K\frac{Q_1 Q_2}{r^2}$$

$$E = K\frac{Q}{r^2}$$

$$E = \frac{V}{d} = \frac{F}{Q}$$

$$v \text{ or } \varepsilon = \frac{W}{Q}$$

$$KE = \frac{1}{2}mv^2$$

$$V = \frac{KQ}{r}$$

$$\frac{1}{2}mv^2 = eV$$

$$W = q\Delta V$$

$$F = mg$$

Magnetic forces and fields

$$F = BIL\sin\theta$$

$$\frac{F}{L} = \frac{\mu_o I_1 I_2}{2\pi r}$$

$$F = Bqv$$

Constants

$$e = 1.6\times10^{-19}C$$

$$K = 9\times10^{9}N.m^2/C^2$$

$$\mu_\circ = 4\pi\times10^{-7}T.m/A$$

$$m_{proton} = 1.673\times10^{-27}kg$$

$$g = 9.8m/s^2$$

Electricity

$$I = nAev$$

$$Q = It$$

$$Q = ne$$

$$V = IR$$

$$R = \rho\frac{L}{A}$$

$$P = VI = I^2R = \frac{V^2}{R}$$

$$W = VIt$$

$$W = \frac{1}{2}QV = \frac{1}{2}CV^2$$

$$\Sigma\varepsilon = \Sigma IR$$

$$V = \varepsilon - Ir$$

$$R = R_1 + R_2$$

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$C = C_1 + C_2$$

$$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2}$$

$$C = \frac{Q}{V}$$

$$V_{out} = V_{in}\frac{R_1}{R_1 + R_2}$$

Electromagnetic induction

$$\phi = NAB$$

$$\varepsilon = -N\frac{\Delta\phi}{\Delta t} = IR$$

$$\frac{Vs}{Vp} = \frac{Ns}{Np} = \frac{Ip}{Is}$$

مُسَوَّدَة

Physics 2017/2018 Bilingual Exam – 1st Semester, 2st Session

Marking Guide

ANSWERS TO MULTIPLE CHOICE QUESTIONS :(28 marks)

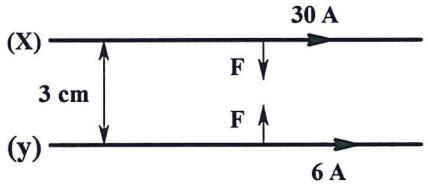
Item	Answer	Answer	Mark	O.B
1	c	The force is directly proportional to the size of the charges.	2	1.4
2	c	7.1×10^{2} N	2	1.4
3	d	-2Q	2	1.13
4	d	C.V	2	2.26
5	a	Double	2	2.13
6	b	2 V	2	2.10
7	c	1.23×10^{-4} m/s	2	2.8
8	c	60 V	2	2.8 2.3
9	a	0.2A	2	2.17
10	b	12 kΩ	2	2.18
11	b	The current is perpendicular to the field lines.	2	3.6
12	d	6.4×10^{-14} | To the left	2	3.6 3.8
13	c	1.8 V	2	4.4
14	c	2.0 A	2	4.8

ANSWER OF EXTENDED RESPONSES: (42 marks)

Item	Part	Answer	Mark	O.B
15	a	1- The distance between the charges. 2- The amount of the charges.	2	1.4
	b	←	1	1.6
	c	$F_{net} = F_{12} + F_{23}$ $= k\left(\frac{(3\times10^{-6})(2\times10^{-6})}{(0.4)^2}\right) + k\left(\frac{(3\times10^{-6})(5\times10^{-6})}{(0.8)^2}\right)$ $= (9\times10^{9})\left(\frac{(3\times10^{-6})(2\times10^{-6})}{(0.4)^2} + \frac{(3\times10^{-6})(5\times10^{-6})}{(0.8)^2}\right)$ $= (9\times10^{9})\left(\frac{6\times10^{-12}}{(0.16)} + \frac{1.5\times10^{-11}}{(0.64)}\right)$ $= 0.55N$	1 1 1	1.4
16	a	$PE = V.Q = (1.6\times10^{-19})(1\times10^{6})$ $\frac{1}{2}mv^2 = eV = 1.6\times10^{-13}$ $\frac{1}{2}(1.67\times10^{-27})v^2 = 1.6\times10^{-13}$ $v = 14\times10^{6} m/s$	$\frac{1}{2}$ $\frac{1}{2}$ 1 1	1.14 1.13
	b	Increase	1	1.13
17	a	Diode A. Because it is the only diode which allows the current to follow. **OR** Because it is forward biased.	1 2	2.9
	b	0.6 V	1	2.9

Item	Part	Answer	Mark	OB
18	a	$\frac{1}{C_5} = \frac{1}{C_1} + \frac{1}{C_2} = \frac{1}{3} + \frac{1}{6} = \frac{1}{2}$ $\frac{1}{C_6} = \frac{1}{C_3} + \frac{1}{C_4} = \frac{1}{2} + \frac{1}{4} = \frac{3}{4}$ $C_{tot} = C_5 + C_6 = \left(\frac{4}{3} + 2\right) \mu F$ $= 3.33\ \mu F$ $Q = CV = 9 \times 3.33$ $Q = 29.97\ \mu C$	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	2.27
	b	A resistor.	1	2.21
	c	$W = \frac{1}{2}CV^2$ C is constant, V reduced to $(\frac{1}{3})$, $W = \frac{1}{2} \times 3.33\ \mu F \times \left(\frac{1}{3} \times 9\right)^2$ $= 1.50 \times 10^{-5}$ J	 1 1	2.26
19	a	Around any closed loop in a circuit, the sum of e.m.fs is equal to the sum of the p.ds.	2	2.16
	b	$\frac{1}{R} = \frac{1}{12} + \frac{1}{6} = \frac{3}{12}$ $R = 4\Omega$ $R_T = 4+3+3 = 10\Omega$ $6 - 3I - 3I - 4I + 6 = 0$ $12 - 10\ I = 0$ $I = \frac{6}{5} = 1.2A$	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ 1 $\frac{1}{2}$	2.17

Item	Part	Answer	Mark	OB
19	b	**Another solution**:		
		By using Kirchhoff' second law:		
		$I_1=1_2+I_3$ (1) $\frac{1}{2}$		
		$6-3I_1-12I_2-3I_1+6=0$		
		$12-6I_1-12I_2=0$		
		$2-I_1-2I_2=0$ (2) $\frac{1}{2}$		
		$6-3I_1-6I_3-3I_1+6=0$		
		$12-6I_1-6I_3=0$		
		$2-I_1-I_3=0$ (3) $\frac{1}{2}$		
		From 1 in 3:		
		$2-I_1-(I_1-I_2)=0$		
		$2-2I_1+I_2=0$		
		$4-4I_1+2I_2=0$ (4) $\frac{1}{2}$		
		From (2) and (4)		
		$2 -I_1 -2I_2=0$		
		$4 -4I_1+2I_2=0$ (4)		
		$6= 5I_1$ $\frac{1}{2}$		
		$I_1 = \frac{6}{5} = 1.2A$ $\frac{1}{2}$		

Item	Part	Answer	Mark	OB
20		$R_1 = \frac{\rho l}{A} = \frac{40\rho}{A}$ (1) $R_2 = \frac{\rho l}{A} = \frac{100\rho}{A}$ (2) From (1) and (2): $R_1 \times 100 = R_2 \times 40$ $\frac{R_2}{R_1} = \frac{100}{40}$	$\frac{1}{2}$ $\frac{1}{2}$ 1 1	2.11
21		$F = BIlsin\theta$ $sin\theta = \frac{F}{l \times BI} = \frac{0.033}{12\times10^{-3}\times6.2} = 0.4435$ $\theta = sin^{-1}0.4435 = 26.3^{\circ}$	 1 1	3.7
22	a		1	3.9
	b	$\frac{F}{l} = \frac{\mu_o I_1 I_2}{2\pi r}$ $\frac{F}{l} = \frac{4\pi\times10^{-7}\times30\times6}{2\pi\times0.03}$ $\frac{F}{l} = 1.2 \times 10^{-3}\ N/m$	 1 1	3.10
	c	i) Double **Or** ($2\times1.2\times10^{-3} = 2.4\times10^{-3}$ N) ii) Repulsion force	1 1	3.10

Item	Part	Answer	Mark	OB
23	a	Lenz law:"The direction of the induced e.m.f is such that it will try to oppose the change in flux that is producing it"	2	4.4
	b	Counter clockwise.	1	4.5ii
24	a	$\varepsilon = 0$	1	4.5i
	b	$A = \pi r^2$ $= \pi \times (0.019)^2$ $= 1.13 \times 10^{-3}\ m^2$ $\varepsilon = -N\frac{\Delta\phi}{\Delta t} = -NA\frac{\Delta B}{\Delta t}$ $\varepsilon = -155 \times 1.13 \times 10^{-3} \times \left(\frac{(0.01-(-.01)}{0.1}\right)$ $= 0.04V$	$\frac{1}{2}$ $\frac{1}{2}$ 1 1	4.5i

End Of Marking Guide