AFFIX SEAL HERE

CANDIDATE – PLEASE NOTE!

You must sign below and return this booklet with the Answer Sheet. Failure to do so may result in disqualification.

Signature

FORM TP 2007254

TEST CODE 02238010

MAY/JUNE 2007

CARIBBEAN EXAMINATIONS COUNCIL

ADVANCED PROFICIENCY EXAMINATION

PHYSICS

Unit 2 - Paper 01

90 minutes

05 JUNE 2007 (p.m.)

READ THE FOLLOWING DIRECTIONS CAREFULLY

1. In addition to this test booklet, you should have an answer sheet.
2. Each item in this test has four suggested answers lettered (A), (B), (C), (D). Read each item you are about to answer and decide which choice is best.
3. On your answer sheet, find the number which corresponds to your item and shade the space having the same letter as the answer you have chosen. Look at the sample item below.

Sample Item

Which of the following lists one scalar quality and one vector quantity?

(A) mass : temperature
(B) momentum : pressure
(C) force : velocity
(D) potential energy : volt

Sample Answer

The best answer to this item is "momentum : pressure", so answer space (B) has been blackened.

4. If you want to change your answer, be sure to erase your old answer completely and fill in your new choice.
5. When you are told to begin, turn the page and work as quickly and as carefully as you can. If you cannot answer an item, omit it and go on to the next one. You can come back to the harder item later. Your score will be the total number of correct answers.
6. You may do any rough work in this booklet.
7. Figures are not necessarily drawn to scale.
8. The use of non-programmable calculators is allowed.
9. This test consists of 45 items. You will have 90 minutes to answer them.
10. Do not be concerned that the answer sheet provides spaces for more answers than there are items in this test.

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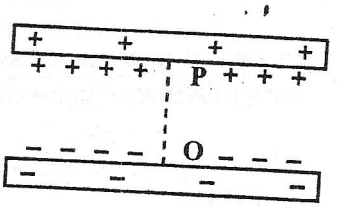
DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

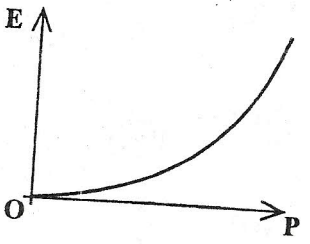
LIST OF PHYSICAL CONSTANTS

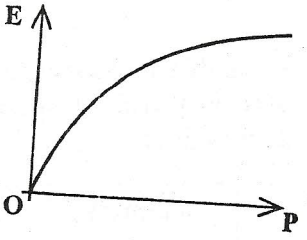
Speed of light in free space	c	=	3.00×10^{8} m s^{-1}
Permeability of free space	μ_0	=	$4\pi \times 10^{-7}$ H m^{-1}
Permittivity of free space	ε_0	=	8.85×10^{-12} F m^{-1}
Elementary charge	e	=	1.60×10^{-19} C
The Planck constant	h	=	6.63×10^{-34} J s
Unified atomic mass constant	u	=	1.66×10^{-27} kg
Rest mass of electron	m_e	=	9.11×10^{-31} kg
Rest mass of proton	m_p	=	1.67×10^{-27} kg
Acceleration due to gravity	g	=	9.81 m s^{-2}
1 Atmosphere	Atm	=	1.00×10^{5} N m^{-2}
Avogadro's number	N_A	=	6.02×10^{23} per mole

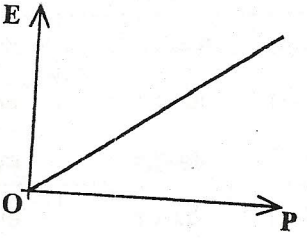
1. An electric field exists between charged parallel plates.

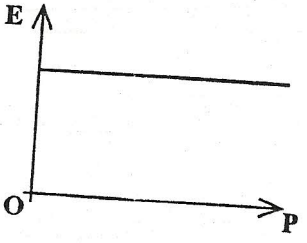


Which graph shows how the electric field strength varies along the line OP?

(A)


(B)


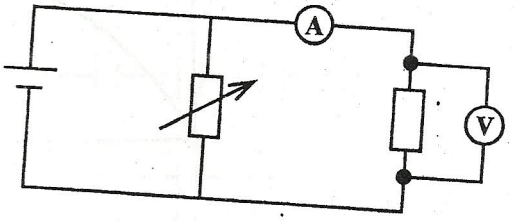
(C)


(D)


2. A unit equivalent to 1 volt is

(A) $1\ JC^{-1}$
(B) $1\ WC^{-1}$
(C) $1\ JA^{-1}$
(D) $1\ WA^{-1}$

3. A circuit is set up as shown in the diagram.



What happens to the readings on the ammeter and volmeter if the resistance of the variable resistor is increased?

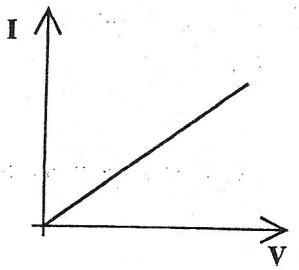
	Ammeter	Volmeter
(A)	Increase	Increase
(B)	Decrease	Decrease
(C)	Increase	No change
(D)	No change	No change

4. A wire of diameter 1.0 mm is carrying a current of 1.5 A. The charge carriers are electrons and the net drift velocity of the electrons is 0.5 mm s^{1}. The number of conduction electrons per unit volume in the conductor is

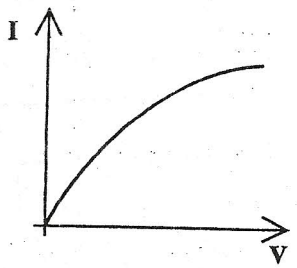
(A) $9.6 \times 10^{28}\ m^{-3}$
(B) $2.4 \times 10^{28}\ m^{-3}$
(C) $6.0 \times 10^{23}\ m^{-3}$
(D) $9.5 \times 10^{23}\ m^{-3}$

5. Which of the following shows the IV characteristic of a filament lamp?

(A)



(B)



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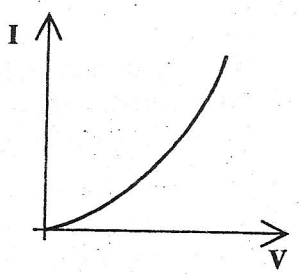
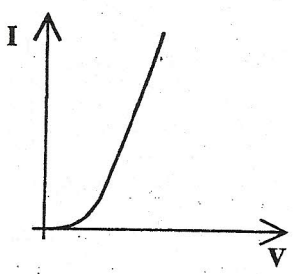


(D)



6. A cell of internal resistance r is connected to a load of resistance R.

The efficiency of such an arrangement is found from the expression

$$\frac{\text{energy dissipated in the load}}{\text{energy dissipated in the complete circuit}}$$

Which expression represents the efficiency in this case?

(A) $\frac{r}{R+r}$

(B) $\frac{r}{R}$

(C) $\frac{R}{R+r}$

(D) $\frac{R}{r}$

7. Kirchoff's Laws are derived from the laws of conservation. On which conservation laws do they depend?

	Kirchoff's 1st law	**Kirchoff's 2nd law**
(A)	mass	current
(B)	current	energy
(C)	charge	current
(D)	charge	energy

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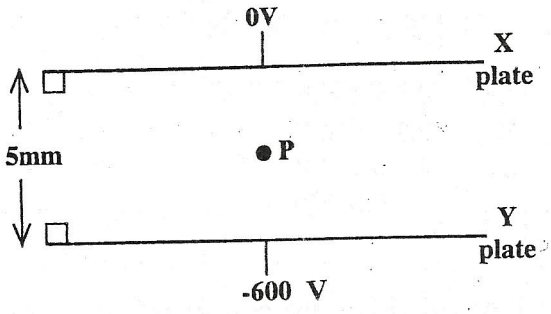
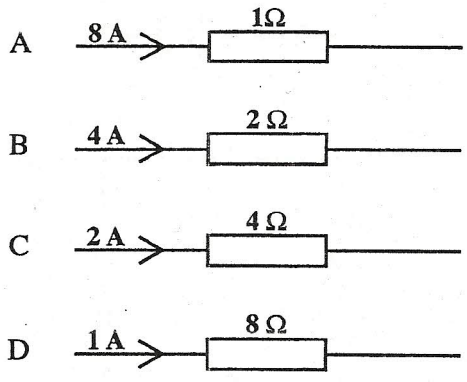
8. In the diagram below, a potential difference of 600V is applied between two parallel metal plates, X and Y, 5 mm apart.

What is the magnitude and direction of the electric field at point P?

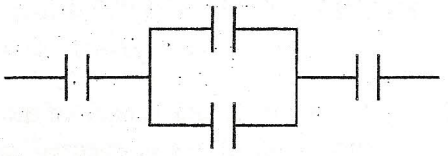


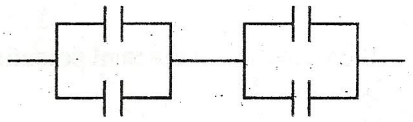
(A) $1.2 \times 10^{2}\ NC^{-1}$; X → Y
(B) $1.2 \times 10^{2}\ NC^{-1}$; Y → X
(C) $1.2 \times 10^{5}\ NC^{-1}$; X → Y
(D) $1.2 \times 10^{5}\ NC^{-1}$; Y → X

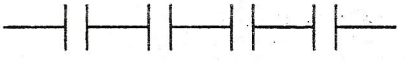
9. In which resistor below is the GREATEST power dissipated?

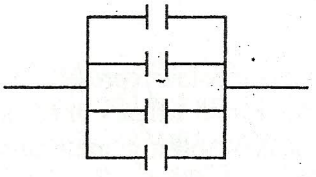


10. Which arrangement of four similar capacitors has the HIGHEST effective capacitance?

(A)


(B)


(C)


(D)


11. A wire, 1.00 m long and of uniform cross-sectional area 2.00 mm^2, has a resistance of 0.5 Ω

What is the resistivity of the wire material?

(A) $1.0 \times 10^{-3}\ \Omega$ m
(B) $1.0 \times 10^{-6}\ \Omega$ m
(C) $2.0 \times 10^{-6}\ \Omega$ m
(D) $3.1 \times 10^{-6}\ \Omega$ m

12. The force acting per unit current length is the

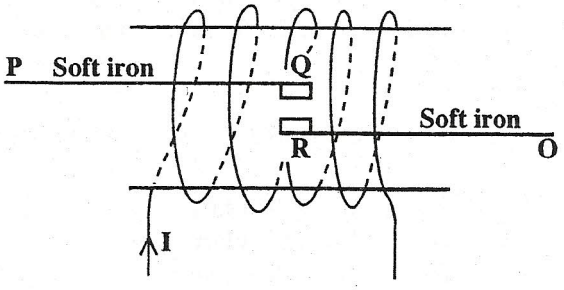
(A) electric field strength
(B) magnetic flux density
(C) electric potential
(D) potential difference

13. Two wires X and Y, each of the same length and material are connected in series to a battery. The diameter of X is twice that of Y.

What fraction of the total potential difference is across X?

(A) 0.20
(B) 0.25
(C) 0.33
(D) 0.50

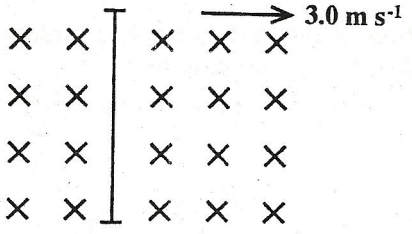
14. The diagram below represents a simple relay. When a current I flows in the solenoid, the two pieces of soft iron materials PQ and RO become magnetized.



Which combination BEST illustrates the polarities at the ends P, Q, R and O?

	P	Q	R	O
(A)	N	N	S	S
(B)	N	S	N	S
(C)	S	S	N	N
(D)	S	N	S	N

15. The diagram shows a piece of wire 0.5 m long moving with a speed of 3.0 m s^{-1} perpendicular to a magnetic field of field strength 1.5 m T. What is the e.m.f. induced across the ends of the wire?



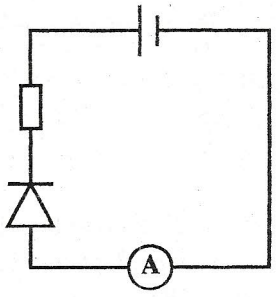
(A) 4.5×10^{-3} V
(B) 2.25×10^{-3} V
(C) 7.5×10^{-3} V
(D) 2.25×10^{3} V

16. The MAJORITY charge carriers in an n-type material are

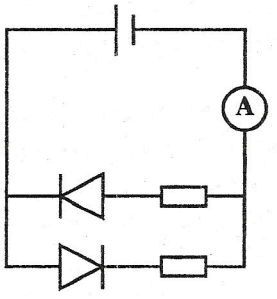
(A) protons
(B) electrons
(C) holes
(D) neutrons

17. The circuits below contain diodes, a cell, resistors and an ammeter. In which circuit will the ammeter register a current?

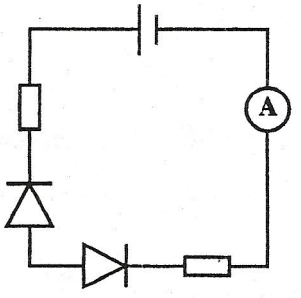
(A)



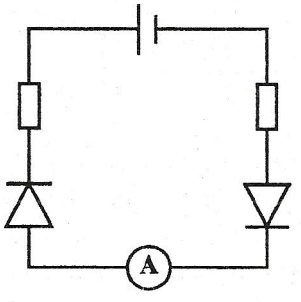
(B)



(C)



(D)



18. A direct current (I) dissipates power in a resistor (R). A sinusoidal alternating current dissipates the same power in another resistor of one quarter the value. What is the r.m.s. value of the alternating current?

(A) $\frac{I}{4}$

(B) $\frac{I}{\sqrt{2}}$

(C) $\sqrt{2I}$

(D) $2I$

19. An ideal transformer has N_s turns in its secondary coil and N_p turns in its primary coil. The alternating voltages in the secondary and primary coils are V_s and V_p respectively and the alternating currents in the secondary and primary coils are I_s and I_p respectively.

Which of the following relationships is correct?

(A) $\frac{N_s}{N_p} = \frac{V_s}{V_p} = \frac{I_p}{I_s}$

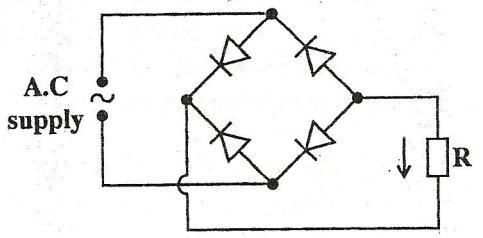
(B) $\frac{N_s}{N_p} = \frac{V_p}{V_s} = \frac{I_p}{I_s}$

(C) $\frac{N_s}{N_p} = \frac{V_s}{V_p} = \frac{I_s}{I_p}$

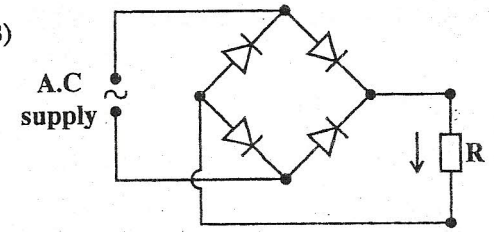
(D) $\frac{N_s}{N_p} = \frac{V_p}{V_s} = \frac{I_s}{I_p}$

20. Which one of the circuits below will give a full-wave rectified current through the load R in the direction shown?

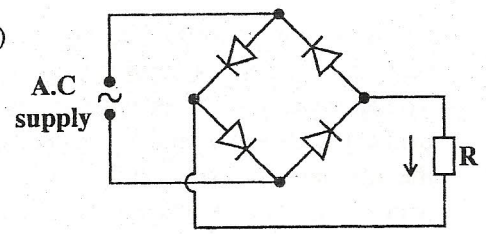
(A)



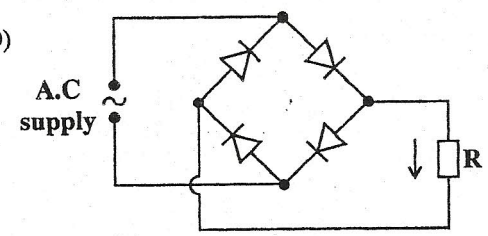
(B)



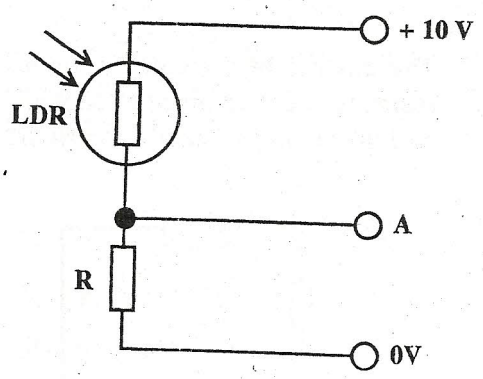
(C)



(D)



Item 21 refers to the following figure.



21. The potential divider in the figure above is formed from a light dependent resistor (LDR) and a resistor (R).

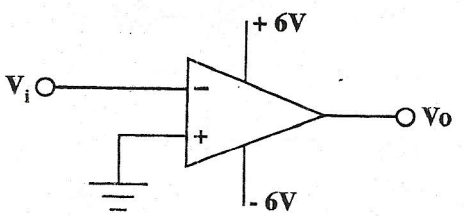
The LDR has a resistance of 5 000 Ω in the dark and 50 Ω in bright light.

The potential at A changes from near zero in the dark to 8 V in bright light.

The value of the resistor R is

(A) 12.5 Ω
(B) 150 Ω
(C) 200 Ω
(D) 20 000 Ω

22. The figure shows an op-amp used as a comparator.



The open loop voltage gain of the op-amp is 3×10^5 and the voltage of the power supply is ± 6 V. The MINIMUM input voltage (V_i) which will cause saturation is

(A) $\pm 20\ \mu v$
(B) $\pm 30\ \mu v$
(C) $\pm 40\ \mu v$
(D) $\pm 180\ \mu v$

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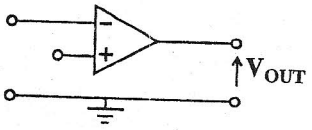
23. Which of the following is NOT an advantage of using negative feedback in an op-amp?

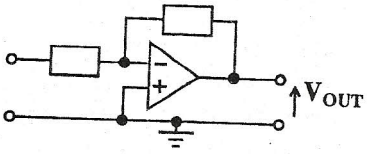
(A) The gain is predictable and constant.
(B) Feedback reduces distortion of the output.
(C) Bandwidth is increased.
(D) Feedback increases the gain.

24. Which diagram shows the circuit for a non-inverting amplifier?

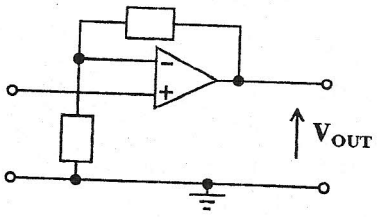
(A)



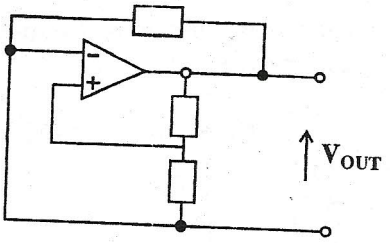
(B)



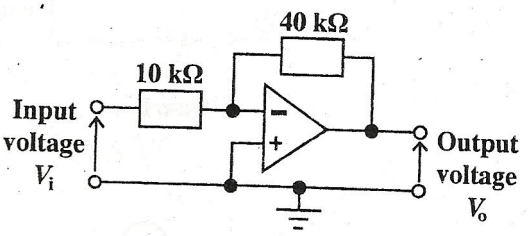
(C)



(D)



Item 25 refers to the following diagram.



25. The gain of the op-amp circuit in the diagram above is

(A) - 4
(B) - 0.25
(C) + 0.25
(D) + 5

Item 26 refers to the following figures.

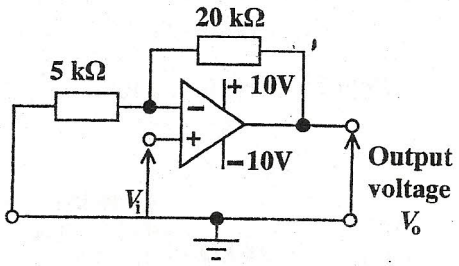


Figure 1

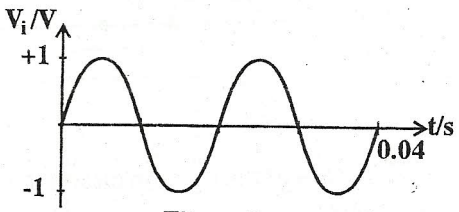
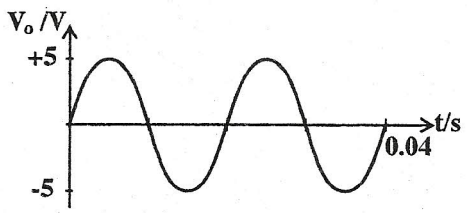


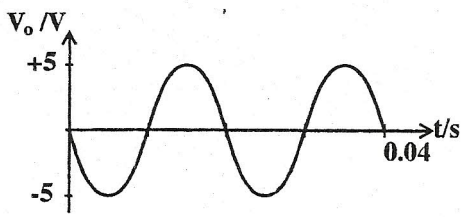
Figure 2

26. The sinusoidal alternating voltage shown in Figure 2 is applied to the input of the op-amp shown in Figure 1. The voltage of the power supply is ±10V. Which one of the following graphs correctly shows output voltage with time?

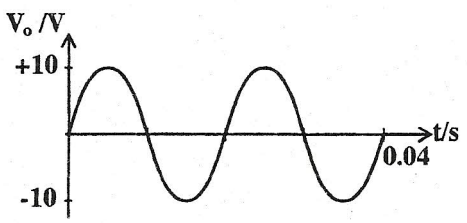
(A)



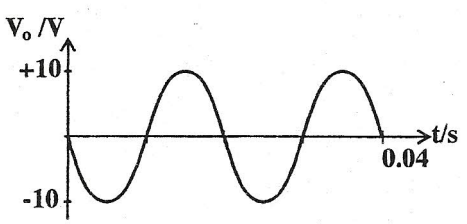
(B)



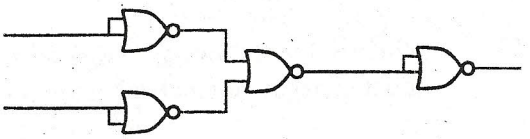
(C)



(D)



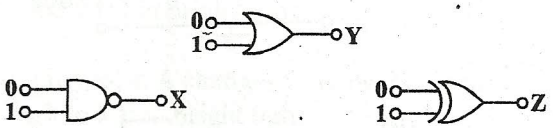
Item 27 refers to the following diagram.



27. The circuit is equivalent to

(A) an AND gate
(B) a NAND gate
(C) an OR gate
(D) an XOR gate

Item 28 refers to the following diagram.



28. Which one of the following combinations gives the correct output from EACH of the gates shown above?

	X	Y	Z
(A)	0	0	0
(B)	1	1	1
(C)	0	1	0
(D)	1	0	1

29. How many inputs and outputs does a half adder have?

	INPUTS	OUTPUTS
(A)	2	2
(B)	2	1
(C)	1	2
(D)	3	2

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30. Choose the response which will BEST complete the following statement.

A flip-flop has two output states,

(A) one stable and one unstable. It remains in the stable state until a trigger pulse switches it to the unstable.
(B) both of which are unstable. It switches from one state to another after a short interval.
(C) one stable and one unstable. It remains in the unstable state for a short time and then switches to the stable state.
(D) both of which are stable. It remains in either state until a trigger pulse sends it to the other.

31. Which of the following phenomena led to the discovery of the particle nature of electromagnetic radiation?

(A) Interference
(B) Reflection
(C) Polarisation
(D) Photoelectric Effect

32. A T.V. station broadcasts at a rate 200 kW and frequency 200 MHz. How many photons are emitted every second?

(A) 1.5×10^{36}
(B) 1.5×10^{33}
(C) 1.5×10^{30}
(D) 1.5×10^{27}

33. A work function of a metal is the

(A) cut-off wavelength of electro-magnetic radiation for that metal, above which no photoelectrons are emitted
(B) minimum energy of electro-magnetic radiation needed for a photoelectron to be produced from the metal
(C) threshold frequency of electro-magnetic radiation required, below which no photoelectrons are emitted from the metal
(D) the maximum kinetic energy of photoelectrons emitted from the metal surface when electro-magnetic radiation of a given frequency is used

34. The maximum wavelength of electromagnetic radiation that causes emission of photoelectrons from a metal, X, is 600 nm. What is the work function of X?

(A) 3.32×10^{-19} J
(B) 5.30×10^{-38} J
(C) 3.98×10^{-40} J
(D) 2.48×10^{-21} J

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35. The figure below shows an energy level diagram for a hydrogen atom.

E_5 _____ -0.54eV

E_4 _____ -0.85eV

E_3 _____ -1.5eV

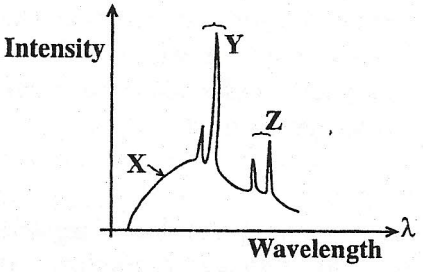
E_2 _____ -3.4eV

E_1 _____ -13.6eV

An electron moves from one energy state to another with the production of a photon of frequency 2.46×10^{15} Hz. Which energy transition accounts for this?

(A) $E_4 \rightarrow E_2$
(B) $E_5 \rightarrow E_3$
(C) $E_3 \rightarrow E_1$
(D) $E_2 \rightarrow E_1$

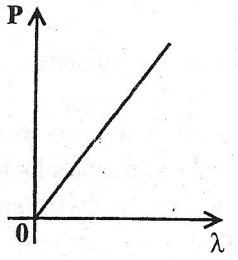
Item 36 refers to the following diagram.

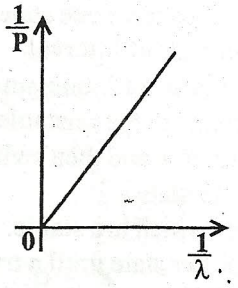


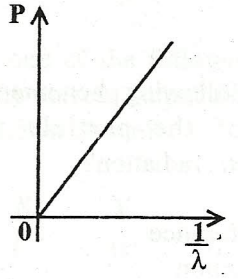
36. This graph illustrates the x-ray spectrum from a given x-ray tube. What do X, Y and Z represent?

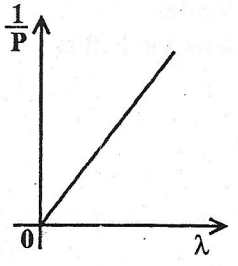
	X	Y	Z
(A)	K – series Line spectrum	L – series Line spectrum	Continuous spectrum
(B)	L – series Line spectrum	Continuous spectrum	K- series Line spectrum
(C)	K – series Line spectrum	Continuous spectrum	L – series Line spectrum
(D)	Continuous spectrum	K – series Line spectrum	L – series Line spectrum

37. P is the momentum of a particle and λ is its wavelength. For which of the following graphs would the gradient be equal to the Planck's constant?

(A)


(B)


(C)


(D)


38. The results of the Geiger - Marsden α - particle scattering experiment provides evidence for

(A) quantum theory
(B) size of the nucleus
(C) existence of neutrons
(D) radioactive decay

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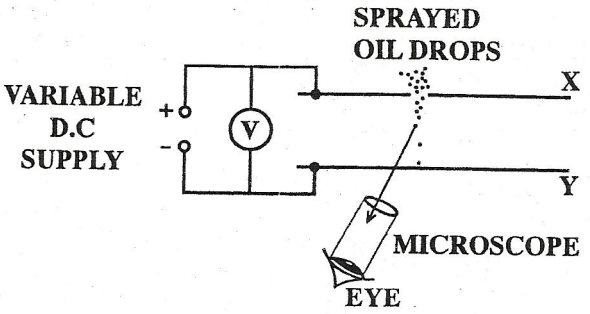
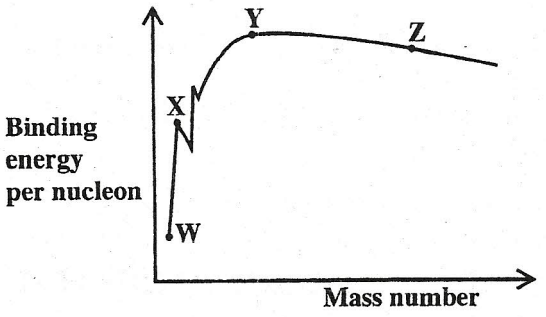
39. The diagram shows the set up for a Millikan's oil drop experiment.



A variable voltage, V, is applied between the plates X and Y, which are separated by a distance, d. The microscope is focussed on a charged oil drop of mass, m, which is held stationary between the plates. If q is the charge on the oil drop, which of the following expressions is correct?

(A) $q = mg\ V/d$
(B) $q = mg/Vd$
(C) $q = V/mg\ d$
(D) $q = mg\ d/V$

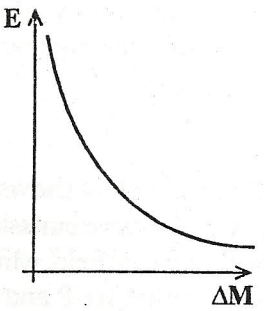
40. The diagram represents the relationship between binding energy per nucleon and mass number. W, X, Y and Z are different elements.

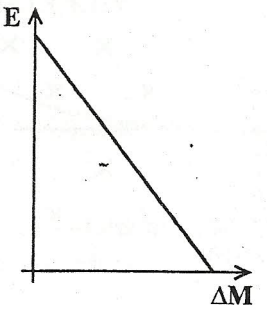


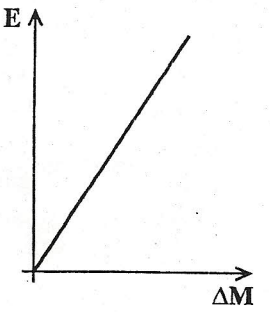
Which of the following statements is true of nuclear stability?

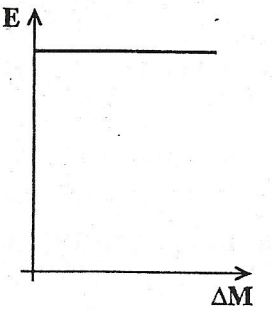
(A) Z could undergo nuclear fission to become more stable.
(B) W and X could undergo nuclear fission to become more stable.
(C) W and Y could undergo nuclear fusion to become more stable.
(D) Z could undergo nuclear fusion to become more stable.

41. Which of the following graphs shows the correct relationship between the energy evolved, E, and the mass coverted, Δm, in a nuclear reaction?

(A)


(B)


(C)


(D)


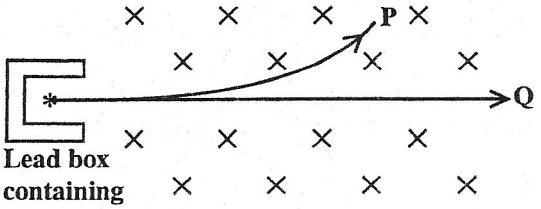
42. What is the energy equivalent of the atomic mass unit, u?

(A) 1.49×10^{-10} J
(B) 4.98×10^{-19} J
(C) 5.53×10^{-36} J
(D) 5.12×10^{-44} J

43. Atoms undergo redioactive decay because

(A) the number of protons in the nucleus is greater than the number of neutrons
(B) their nuclei are unstable
(C) they are heated under high pressure
(D) the number of electrons is greater than the number of protons in the atom

44. The diagram below shows the paths of two types of radioactive emissions, P and Q, in a uniform magnetic field, which is directed into the page. What are P and Q?



	P	Q
(A)	alpha	beta
(B)	beta	alpha
(C)	beta	gamma
(D)	alpha	gamma

45. A radioactive nuclide is represented by the symbol $^{76}_{33}$P. It decays into a nuclide of element Q by beta decay. Q then decays into a nuclide of element R by alpha decay and releases gamma radiation. What symbol represents nuclide R?

(A) $^{75}_{34}$R
(B) $^{72}_{32}$R
(C) $^{74}_{32}$R
(D) $^{72}_{31}$R

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.