

**CARIBBEAN EXAMINATIONS COUNCIL
ADVANCED PROFICIENCY EXAMINATION**

**SPECIMEN PAPER
MULTIPLE CHOICE QUESTIONS
FOR**

**PHYSICS
UNIT 2**

READ THE FOLLOWING DIRECTIONS CAREFULLY

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.

Sample Item

Kirchoff's first law for electric currents can be derived by using the conservation of

- (A) energy
- (B) current
- (C) charge
- (D) power

Sample Answer

- A
- B
- C
- D

The best answer to this item is "charge", so answer space (C) has been blackened.

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LIST OF PHYSICAL CONSTANTS

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

1. A 3V battery causes a current of 0.5 A to flow along a wire for 4 seconds. What is the quantity of charge that passes in this time?

(A) 0.125 C
(B) 1.5 C
(C) 2 C
(D) 6 C

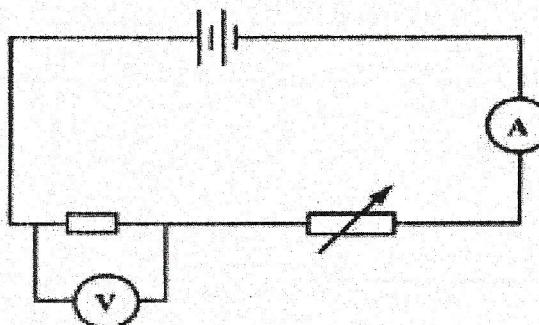
2. Energy per unit of charge is a measure of

(A) power
(B) capacitance
(C) electric field strength
(D) potential difference

3. A current of 0.25 A flows in a uniform wire of length 2 metre and cross-sectional area $2 \times 10^{-9} \text{ m}^2$, when the potential difference across the wire is 4.25V. What is the resistivity of the material from which the wire is made?

(A) $5.9 \times 10^{-11} \Omega\text{m}$
(B) $4.25 \times 10^{-9} \Omega\text{m}$
(C) $1.7 \times 10^{-8} \Omega\text{m}$
(D) $3.4 \times 10^{-8} \Omega\text{m}$

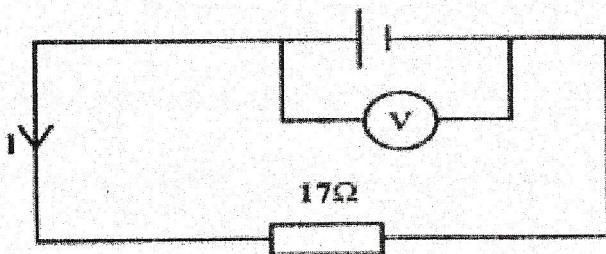
Item 4 refers to the following diagram which shows an arrangement of electrical components in a circuit.



4. The variable resistor is adjusted to provide a smaller resistance. Which changes BEST describe the changes in the ammeter and voltmeter readings?

| | Ammeter Reading | Voltmeter Reading |
|-----|-----------------|-------------------|
| (A) | decrease | increase |
| (B) | decrease | decrease |
| (C) | increase | increase |
| (D) | increase | decrease |

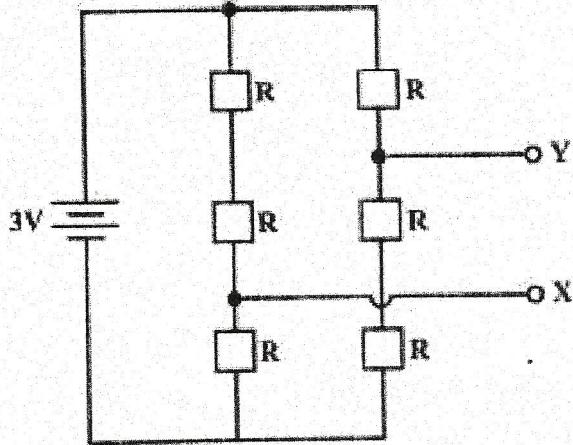
5. In the diagram below, the cell has an e.m.f of 9.0 V. The reading on the high resistance voltmeter is 5.0V.



What is the current I?

- (A) $\frac{14}{17}$ A
- (B) $\frac{9}{17}$ A
- (C) $\frac{5}{17}$ A
- (D) $\frac{4}{17}$ A

6. A 3V battery of negligible internal resistance is connected to six identical resistors as shown.



What is the potential difference between X and Y?

- (A) 1.0V
- (B) 1.5V
- (C) 2.0V
- (D) 3.0V

7. In closed circuit or loop the algebraic sum of the e.m.f. is equal to the algebraic sum of the products of current and resistance.

Which of the following statements is correct?

- (A) This is Kirchhoff's first law which is a consequence of conservation of energy.
- (B) This is Kirchoff's first law which is a consequence of conservation of charge.
- (C) This is Kirchoff's second law which is a consequence of conservation of energy.
- (D) This is Kirchoff's second law which is a consequence of conservation of charge.

Item 8 refers to the following diagram which shows a positive point charge in free space. The distances from the charge to points X and Y are shown.

$$X \longleftrightarrow r \oplus \longleftrightarrow 4r \longrightarrow Y$$

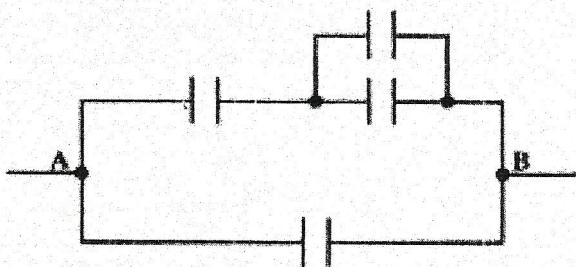
8. What is the ratio of the electric field strength at X, to the field strength at Y?

- (A) 1:4
- (B) 4:1
- (C) 16:1
- (D) 1:16

9. The force per unit charge on a positive test charge placed at a point in a field is called

- (A) electric energy
- (B) electric potential
- (C) electric field strength
- (D) dielectric constant

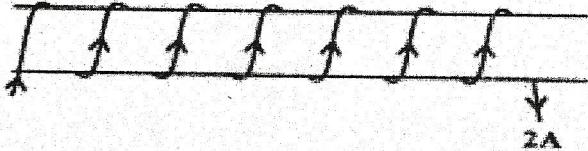
Item 10 refers to the following diagram.



10. Each capacitor in the diagram above has capacitance C . What is the effective capacitance between A and B?

- (A) $\frac{3C}{5}$
- (B) $\frac{C}{4}$
- (C) $\frac{5C}{3}$
- (D) $4C$

Item 11 refers to the following diagram.



11. A hollow solenoid has 100 turns in a length of 0.5 m. If a steady current of 2A flows in the solenoid as shown in the diagram, what is the magnitude and direction of the flux density in the middle.

- (A) 1.3×10^{-4} T to the left
- (B) 5.0×10^{-4} T to the left
- (C) 1.3×10^{-4} T to the right
- (D) 5.0×10^{-4} T to the right

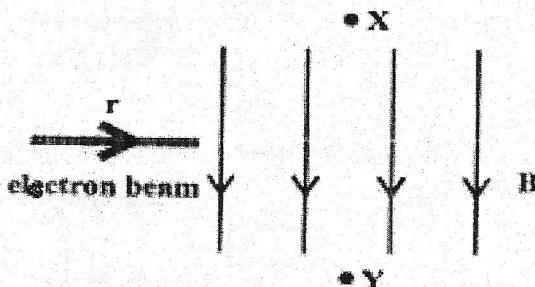
12.

A wire of length 0.5 m and resistance 5Ω moves vertically with a velocity of 10 m s^{-1} perpendicular to a uniform magnetic field of flux density 4.0×10^{-5} T. What is the magnitude of the e.m.f. generated between the ends of the wire?

- (A) 1.0×10^{-4} V
- (B) 2.0×10^{-4} V
- (C) 4.0×10^{-4} V
- (D) 8.0×10^{-4} V

13.

An electron beam moving with speed v enters a uniform magnetic field B , acting down the page as shown.



The beam of electrons will bend

- (A) into the paper
- (B) out of the paper
- (C) towards X
- (D) towards Y

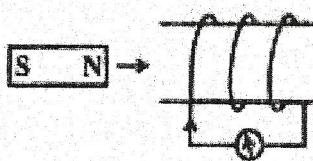
14.

Which diagram correctly shows the direction of the forces acting on adjacent current carrying conductors?

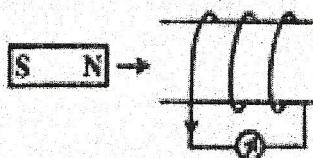
- (A) $\otimes \rightarrow \leftarrow \odot$
- (B) $\otimes \rightarrow \odot \rightarrow$
- (C) $\leftarrow \otimes \leftarrow \odot$
- (D) $\otimes \odot \rightarrow$

15. The diagram illustrate a demonstration of Lenz's law of electromagnetic induction. In which diagram is the current in the correct direction?

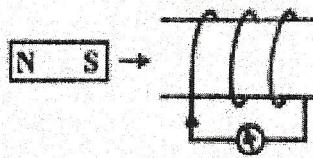
(A)



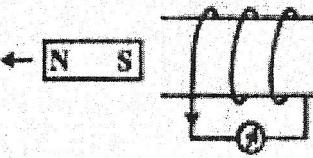
(B)



(C)



(D)

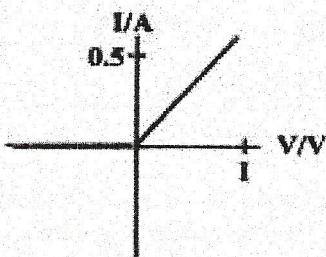


16. A sinusoidal alternating current of a peak value 20A dissipates power of 50W in a resistor R. The value of the resistor is

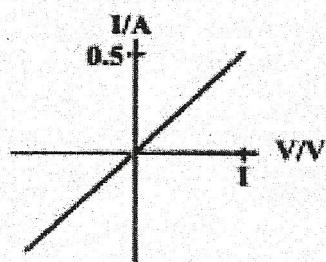
- (A) 0.03Ω
 (B) 0.06Ω
 (C) 0.13Ω
 (D) 0.25Ω

17. Which of the graphs below BEST represent the I - V characteristics of a silicon p - n junction diode.

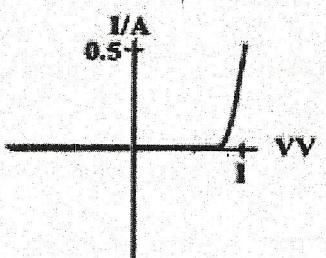
(A)



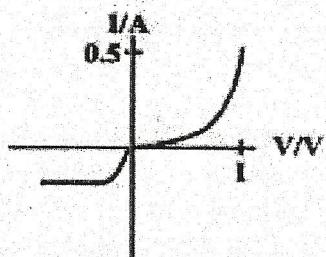
(B)



(C)



(D)



- 18.

- A direct current of 5A dissipates heat in a given resistor at the same rate as a sinusoidal alternating current flowing through the same resistor. What is the root mean square value of the alternating current.

- (A) $\sqrt{2}A$
 (B) $5A$
 (C) $\sqrt[3]{2}A$

- (D) $\frac{5}{\sqrt{2}}A$

GO ON TO THE NEXT PAGE

19. The ratio of the secondary turns to the primary turns in an ideal transformer is 1:30. A 120V a.c. supply is connected to the primary coil and a load of $20\ \Omega$ connected to the secondary coil. What is the secondary current?

- (A) 180A
- (B) 6A
- (C) 1.5A
- (D) 0.2A

Item 20 refers to the following diagram.

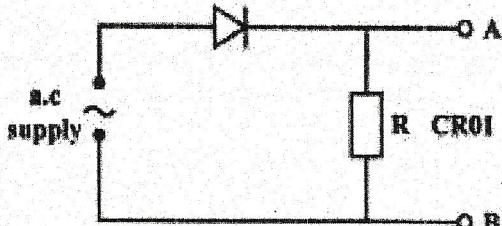


Figure 1

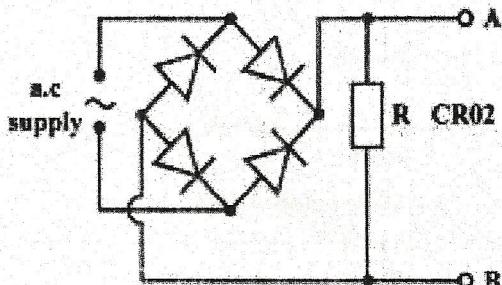
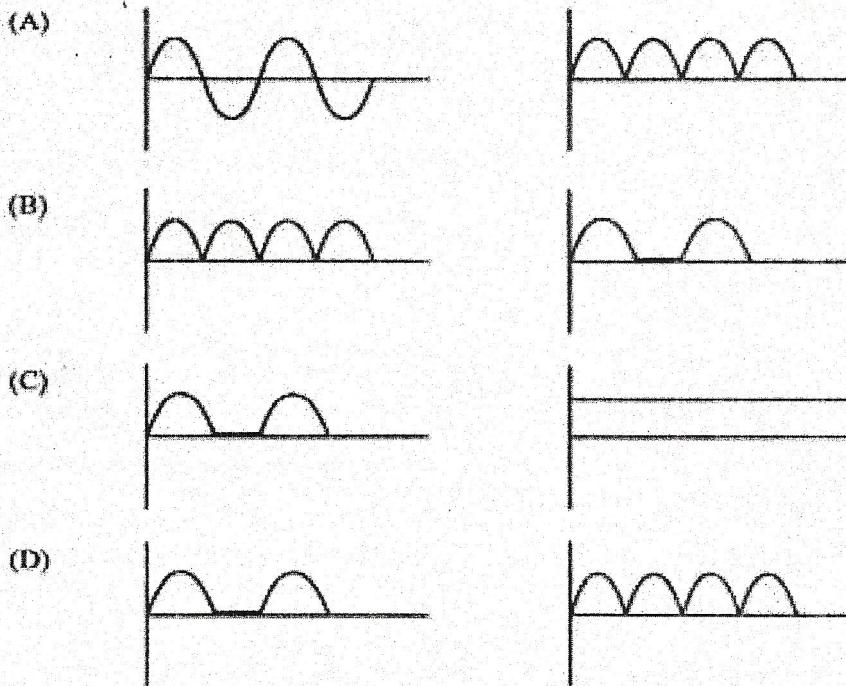


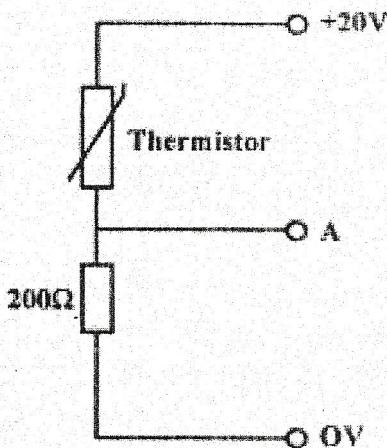
Figure 2

20. Which of the traces below will be seen on the cathode ray oscilloscopes in Figure 1 and Figure 2 above?



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Item 21 refers to the following diagram.



21. The potential divider above is formed from a thermistor and a 200Ω resistor.

The thermistor has a resistance of $2\text{k}\Omega$ at room temperature and 200Ω at 100°C .

What is the change in the potential at A when the thermistor is moved from water at room temperature to boiling water?

- (A) Rise of about 8V
(B) Fall of about 8V
(C) Rise of about 18V
(D) Fall of about 18V

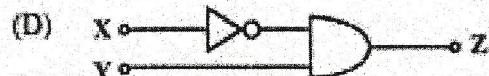
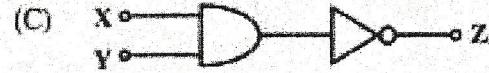
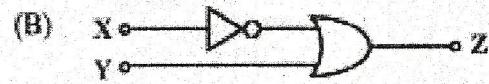
22. Which pair of values gives the open-loop gain of an ideal op. amp. and that of a typical op. amp.

| | Ideal | Typical |
|-----|----------|----------|
| (A) | 0 | 100 |
| (B) | ∞ | 100 000 |
| (C) | 100 000 | ∞ |
| (D) | 0 | 100 000 |

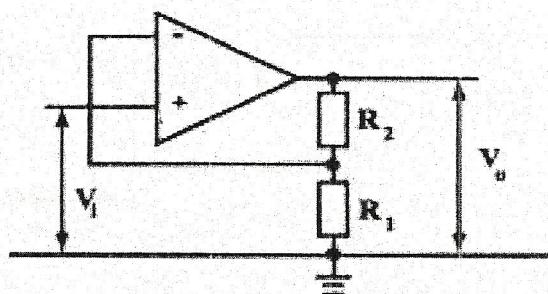
Item 23 refers to the following table.

| X | Y | Z |
|---|---|---|
| 0 | 0 | 1 |
| 0 | 1 | 1 |
| 1 | 0 | 0 |
| 1 | 1 | 1 |

23. Which one of the following combinations gives the truth table shown above?



Item 24 refers to the following diagram which shows a non-inverting amplifier with negative feed back.



24. Which of the following represents the gain of the amplifier?

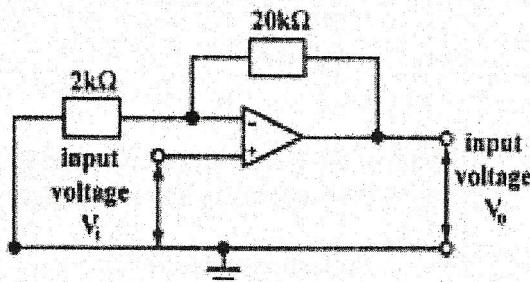
(A) $1 + \frac{R_2}{R_1}$

(B) $-\frac{R_2}{R_1}$

(C) $\frac{R_1}{R_1 + R_2}$

(D) $1 + \frac{R_1}{R_2}$

Item 25 refers to the following diagram.



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

(A) -10

(B) -9

(C) 10

(D) 11

Item 26 refers to the following diagrams.

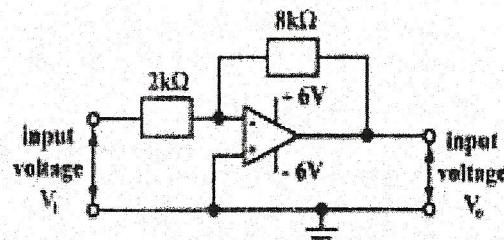


Figure 1

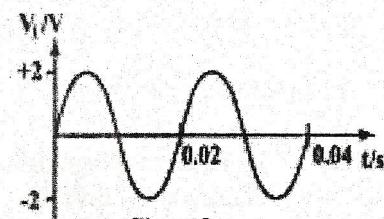
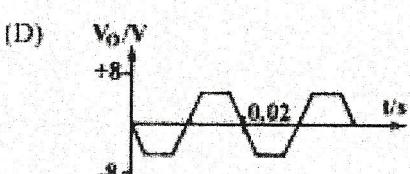
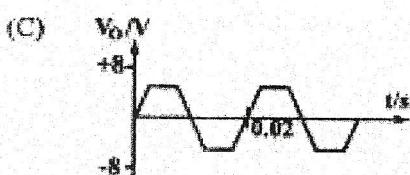
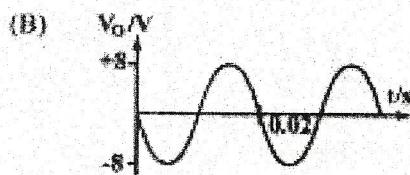
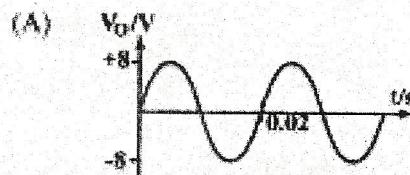
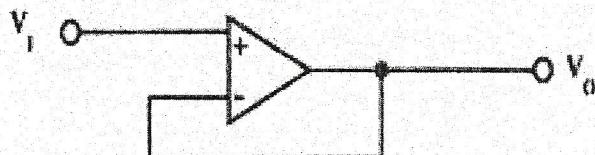


Figure 2

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 $\pm 6V$. Which one of the following graphs correctly shows the output voltage with time?



Item 27 refers to the following diagram.

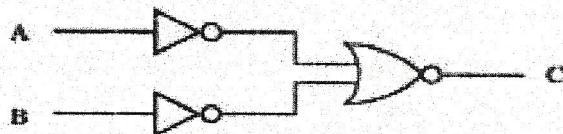


27. Which of the following statements does NOT apply to the op-amp in the diagram above?

The op-amp circuit

- (A) is called a voltage follower
- (B) is used as an inverter
- (C) is used as a buffer
- (D) has a gain of one

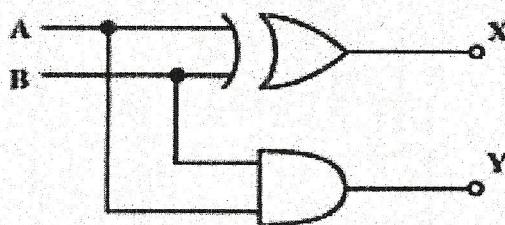
Item 28 refers to the following diagram.



28. Which of the following gates is equivalent to the combination above?

- (A) OR
- (B) EXOR
- (C) AND
- (D) NAND

Item 29 refers to the following diagram of a half-adder.



29. If $A = 1$ and $B = 0$, what are the values of the outputs X and Y?

- (A) $X = 0, Y = 0$
- (B) $X = 1, Y = 1$
- (C) $X = 1, Y = 0$
- (D) $X = 0, Y = 1$

30. Which of the following statements about a flip-flop is/are correct?

- I. It contains 2 cross-linked NAND or NOR gates
- II. It has 2 input and 2 stable output states
- III. It has 2 input and one stable output state.

- (A) I only
- (B) I and II only
- (C) II only
- (D) I and III only

31. Which of the following phenomena BOTH demonstrate the wave nature of matter?

- (A) Reflection and Refraction
- (B) Polarisation and Photoelectric effect
- (C) Line spectra and Interference
- (D) Interference and Diffraction

32. In which of the following radiations do the photons have the LEAST energy?

- (A) x-rays
- (B) ultra violet
- (C) γ -rays
- (D) infra red

33. Photoelectrons are emitted from the surface of zinc metal when light of intensity, I , and wavelength, λ , is incident on it. What is the effect on the work function of the zinc metal if the intensity is doubled and the wavelength

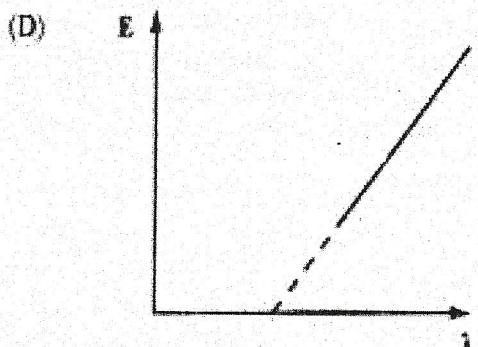
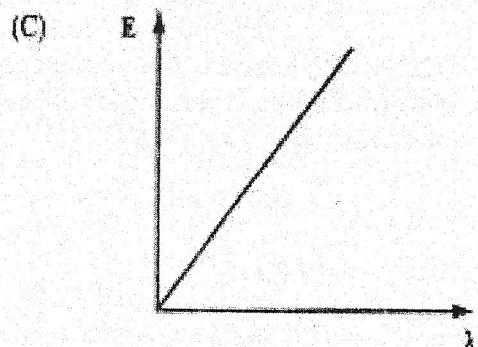
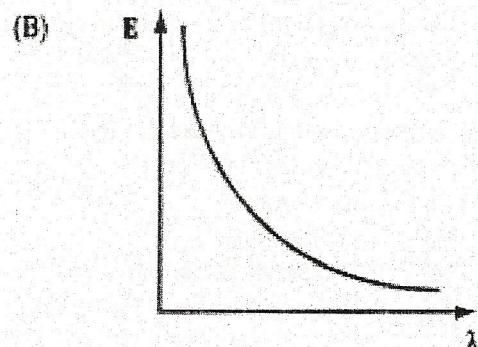
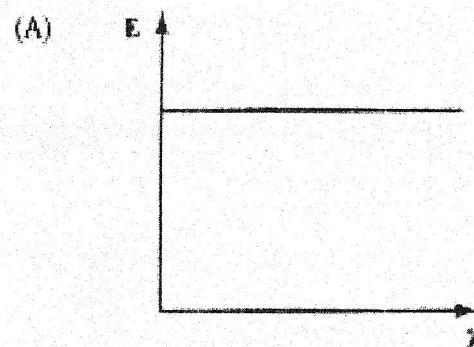
is reduced to $\frac{1}{4}$ of its previous value? The work function is

- (A) doubled
- (B) halved
- (C) quartered
- (D) unchanged

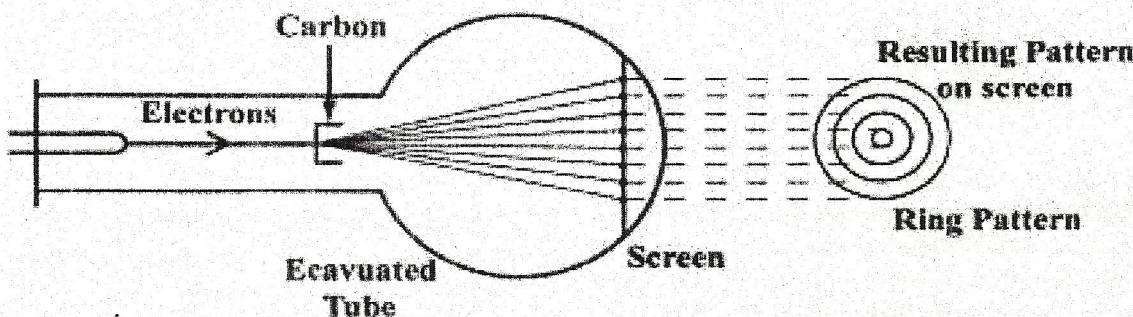
34. E.M. radiation is produced when very high speed electrons strike a hard target. This type of electromagnetic radiation is known as

- (A) U.V.
- (B) x-rays
- (C) γ -rays
- (D) Microwaves

Which of the following graphs correctly show the relationship between the energy, E , of photons of light and their wavelength?



Item 36 refers to the diagram below.



36. A beam of electrons are made to strike a thin layer of carbon in an evacuated tube as shown in the diagram above.

This experiment provides evidence for

- (A) interference
- (B) polarisation
- (C) the particle nature of light
- (D) the wave nature of particles

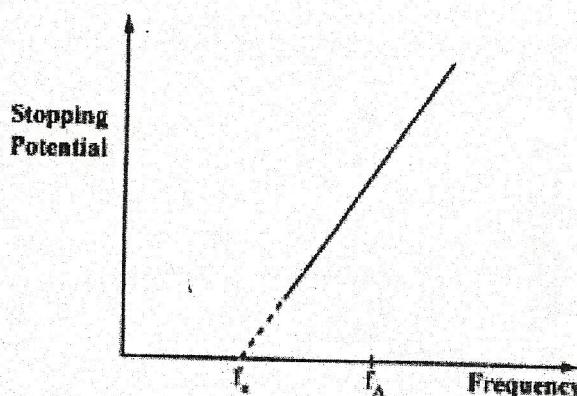
37. An object of mass m has kinetic energy, E_k . Which of the following is a correct expression for its de Broglie wavelength?

- (A) $\lambda = E_k/h$
- (B) $\lambda = h / (2m E_k)^{\frac{1}{2}}$
- (C) $\lambda = \frac{h}{(2m E_k)^{\frac{1}{2}}}$
- (D) $\lambda = \frac{2h}{(m E_k)^{\frac{1}{2}}}$

38. An isotope of nickel is represented by $^{60}_{28} \text{Ni}$. Which line in the table correctly describes a neutral atom of this isotope?

| | Number of neutrons | Number of protons | Number of electrons |
|-----|--------------------|-------------------|---------------------|
| (A) | 32 | 28 | 32 |
| (B) | 32 | 28 | 28 |
| (C) | 60 | 32 | 28 |
| (D) | 28 | 32 | 28 |

Item 39 refers to the following diagram.



39. In an experiment to investigate photoelectricity a graph of stopping potential of photoelectrons is plotted against frequency of incident radiation. What is the MAXIMUM kinetic energy of photoelectrons emitted by photons with frequency f_A ?

- (A) hf_o
- (B) hf_A
- (C) $hf_o - hf_A$
- (D) $hf_A - hf_o$

40. The mass of a nucleus is found to be 8.0032 u and that of its individual constituent nucleus is 8.0045 u. What is the binding energy of this nucleus?

- (A) $6.5 \times 10^{22} \text{ J}$
- (B) $1.9 \times 10^{-13} \text{ J}$
- (C) $6.9 \times 10^{-16} \text{ J}$
- (D) $2.4 \times 10^{-47} \text{ J}$

41. The decay constant of a radioactive sample of radon gas $1 \times 10^{-2} \text{ s}^{-1}$. If there were 1.6×10^5 atoms of radon gas present at a certain time, T, how much time must elapse before there is only 1.2×10^5 atoms of radon left?

- (A) 25s
- (B) 29s
- (C) 45s
- (D) 400s

42.

A nucleus of element A decays to mendelevium $^{255}_{101}\text{Md}$ by a sequence of three α particle emissions. How many neutrons are there in a nucleus of A?

- (A) 154
- (B) 160
- (C) 207
- (D) 267

43.

A radioactive substance emits a type of ionising radiation, P, with the following properties:

mass: zero
speed: $3 \times 10^8 \text{ m s}^{-1}$

Which of the following statement about P is true?

- I. P is not deflected by an electric field
- II. P has a charge of equal to that of an electron
- III. P maybe stopped by a piece of cardboard

- (A) I only
- (B) II only
- (C) II and III only
- (D) I and II only

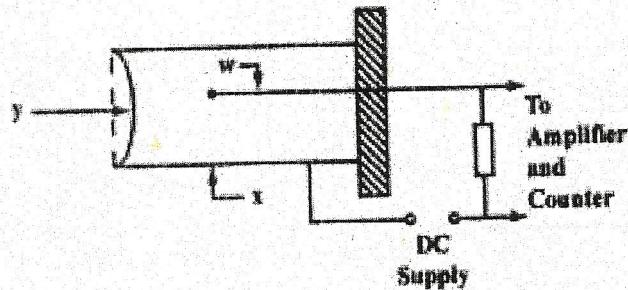
44.

An archaeologist finds an ancient wooden relic and obtains its count rate as 20 counts per minute per gram of sample. The count rate obtained form the bark of a living tree is 104 counts per minute per gram and the background count rate is 8 counts per minute. What is the approximate age of the relic?

[Radioactive carbon $^{14}_6\text{C}$ has a half life of 5600 years]

- (A) 3000 years
- (B) 11 000 years
- (C) 17 000 years
- (D) 22 000 years

Item 45 refers to the diagram below which shows a geiger-muller tube.



45. What are the parts labelled w, x and y?

| | w | x | y |
|-----|---------|---------|--------------|
| (A) | Cathode | Anode | Glass window |
| (B) | Anode | Cathode | Glass window |
| (C) | Cathode | Anode | Mica window |
| (D) | Anode | Cathode | Mica window |

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