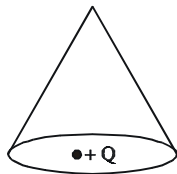## Section 1: Physics

1. A point charge Q is placed at the center of the base of a conical surface as shown in the figure.

The electric flux coming out of the curved face of the cone is

(A) $\dfrac{Q}{\varepsilon_0}$ (B) $\dfrac{Q}{2\varepsilon_0}$

(C) $\dfrac{Q}{4\varepsilon_0}$ (D) $\dfrac{Q}{24\varepsilon_0}$

2. An equiconvex lens of focal length 10 cm (refractive index of glass = 1.5) has one of its faces silver coated. The focal length of the effective concave mirror thus formed is

(A) 10 cm   (B) 5 cm

(C) 2.5 cm   (D) 5/3 cm

3. A beam of unpolarized light of intensity I_0 falls on a system of four identical linear polarizers placed in a line as shown in the figure.
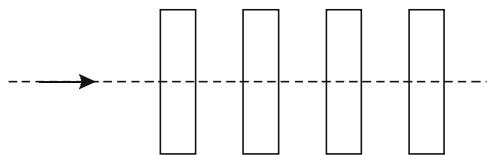
The transmission axes of any two successive polarizers make an angle of 30° with each other. If the transmitted light has intensity I, then the ratio I/I_0 is

(A) $\dfrac{81}{256}$ (B) $\dfrac{9}{16}$

(C) $\dfrac{27}{64}$ (D) $\dfrac{27}{128}$

4. The ratio of the angular velocities of an electron in the 2nd to the 1st orbit of a hydrogen atom in Bohr's atom model is

(A) 1:2   (B) 1:4

(C) 1:8   (D) 1:1

5. A photosensitive surface is illuminated successively by monochromatic light of wavelength λ and $\lambda/3$. If the maximum kinetic energy of the emitted photoelectrons in the second case is 4 times that in the first case, the work function of the material is

(A) $\dfrac{hc}{\lambda}$ (B) $\dfrac{hc}{2\lambda}$

(C) $\dfrac{hc}{3\lambda}$ (D) $\dfrac{hc}{4\lambda}$

6. Consider the propagation of a plane electromagnetic wave.

1. They travel in free space with the speed of light

2. The electric vector, magnetic vector and the direction of propagation are mutually perpendicular

3. They can be deflected by electric and magnetic fields

4. The ratio of the magnitude of magnetic field to that of electric field is the speed of light.

(A) Only (1) is correct
(B) Only (1) & (2) are correct
(C) Only (1), (2) & (3) are correct
(D) All are correct

7. Consider an electrostatic field $\vec{E}$ in a region of space. Identify the incorrect statement.

(A) The workdone in moving a charge in a closed path inside the region is zero

(B) The curl of $\vec{E}$ is zero

(C) The field can be expressed as the gradient of a scalar potential

(D) The potential difference between any two points in the region is always zero

8. Three resistors having resistances r_1, r_2 and r_3 are connected as shown in the given circuit. The ratio $\dfrac{i_3}{i_1}$ of currents in terms of resistances used in the circuits is:
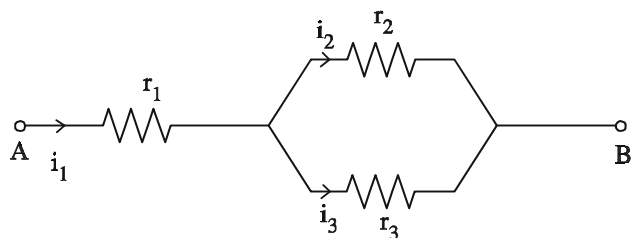
(A) $\dfrac{r_1}{r_2 + r_3}$

(B) $\dfrac{r_2}{r_2 + r_3}$

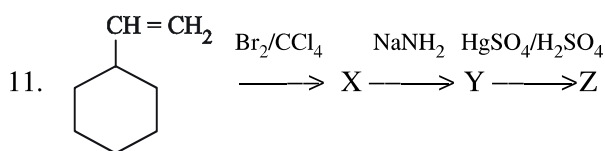(C) $\dfrac{r_1}{r_1 + r_2}$

(D) $\dfrac{r_2}{r_1 + r_3}$

9. The universal logic gates are

(A) NAND and OR gates
(B) XOR and AND gates
(C) NAND and NOR gates
(D) NOR and AND gates

10. Assume that light of wavelength 600 nm is coming from a star. The limit of resolution of telescope whose objective has a diameter of 2m is:

(A) 1.83×10^{-7} rad

(B) 7.32×10^{-7} rad

(C) 6.00×10^{-7} rad

(D) 3.66×10^{-7} rad

Section 2: Chemistry

11.


The product 'Z' is

(A) (B) (C) (D)

12. An alkene, $C_{16}H_{16}$ on ozonolysis followed by hydrolysis gives only one product, A. Compound 'A' on reaction with I_2/NaOH gives an yellow precipitate and a compound B. Compound B reacts with NH_2NH_2/KOH gives a hydrocarbon. The alkene is

(A) $C_6H_5 - CH_2 - CH = CH - CH_2 - C_6H_5$

(B) $C_6H_5 - C\,(CH_3) = C\,(CH_3) - C_6H_5$

(C) $(C_6H_5 - CH_2)_2C = CH_2$

(D) $C_6H_5 - CH = CH - CH = CH - C_6H_5$

13. The IUPAC name of the following compound is:
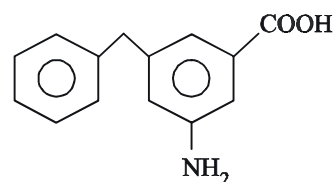
(A) 3-benzyl-5-carboxyaniline
(B) 3-amino-5-phenylbenzoic acid
(C) 1-amino-3-carboxyldiphenylmethane
(D) 3-amino-5-benzylbenzene-1-carboxylic acid

14. If a I order chemical reaction is 50% completed in 100 minutes, the time taken for 90% completion at the same temperature approximately in minutes, is

(A) 240
(B) 330
(C) 690
(D) 1000

15. When equal volumes of aq.HCl of pH = 1 and aq.NaOH of pOH = 1 are mixed. The resulting concentration of the solution is

(A) 0 M (B) 1 M
(C) 0.05 M (D) 2 M

16. **Assertion:** Ionic product of water, K_w increases with increase of temperature.

    Reason: Hot water is more acidic than cold water.

    (A) Both assertion and reason are correct, and reason is the correct explanation of assertion

    (B) Both assertion and reason are correct but reason is not the correct explanation of assertion

    (C) Assertion is correct but reason is wrong

    (D) Assertion is wrong but reason is correct

17. When aqueous copper sulphate solution is electrolysed, the gas liberated at anode is

    (A) SO_2 (B) H_2S

    (C) H_2 (D) O_2

18. In the extraction of copper from copper pyrites, the one which is not obtained on heating in a reverberatory furnace is

    (A) CuS   (B) FeS

    (C) Cu_2S (D) SO_2

19. Match the methods used for refining the metals in the following

Metal	Process
(1) Germanium	(i) Electrolytic refining
(2) Zirconium	(ii) Mond's process
(3) Silver	(iii) Zone refining
(4) Nickel	(iv) Van-Arkel method

    (A) (1) → (ii)   (2) → (iii)   (3) → (i)   (4) →(iv)

    (B) (1) → (iii)   (2) → (i)   (3) → (iv)   (4) → (ii)

    (C) (1) → (iv)   (2) → (iii)   (3) → (ii)   (4) → (i)

    (D) (1) → (iii)   (2) → (iv)   (3) → (i)   (4) → (ii)

20. A primitive crystal system with edge sides $a \neq b \neq c$ and angle between the edges $\alpha = \beta = \gamma = 90°$ is

    (A) Rhombohedral   (B) Triclinic

    (C) Orthorhombic   (D) Monoclinic

Section 3:   MATHEMATICS (OR) BIOLOGY

21. The order and degree of $y' + (y'')^2 = (x + y'')^2$ are _____

    (A) 1, 1

    (B) 1, 2

    (C) 2, 1

    (D) 2, 2

22. If $z = 2 + 3i$, then $z^5 + (\bar{z})^5$ is equal to:

    (A) 244

    (B) 224

    (C) 245

    (D) 265

23. $\tan\left(2\tan^{-1}\dfrac{1}{5} + \sec^{-1}\dfrac{\sqrt{5}}{2} + 2\tan^{-1}\dfrac{1}{8}\right)$ is equal to:

    (A) 1   (B) 2

    (C) $\dfrac{1}{4}$ (D) $\dfrac{5}{4}$

24. If A is a square matrix of order 3 and if $\det(A) = 3$, then $\det[\text{adj}\{\text{adj}(\text{adj}\,A)\}]$ is equal to:

    (A) 81^2

    (B) 81

    (C) 729

    (D) 27

25. If vectors P, Q and R have magnitude 5, 12 and 13 units and $\vec{P} + \vec{Q} = \vec{R}$, then angle between Q and R is

    (A) $\cos^{-1}\dfrac{5}{12}$

    (B) $\cos^{-1}\dfrac{5}{13}$

    (C) $\cos^{-1}\dfrac{12}{13}$

    (D) $\cos^{-1}\dfrac{7}{13}$

26. Magnitude of moment of force $-2\vec{i}+6\vec{j}-8\vec{k}$ acting at point $2\vec{i}-\vec{j}+3\vec{k}$ about point $\vec{i}+2\vec{j}-\vec{k}$

   (A) $\sqrt{211}$
   (B) 0
   (C) $\sqrt{54}$
   (D) None of these

27. The eccentricity of an ellipse, with its centre at the origin, is $\frac{1}{2}$. If one of the directices is $x=4$, then the equation of the ellipse is

   (A) $3x^2 + 4y^2 = 1$
   (B) $3x^2 + 4y^2 = 12$
   (C) $4x^2 + 3y^2 = 12$
   (D) $4x^2 + 3y^2 = 1$

28.

List I	List II
(i) Imaginary roots occur in pairs	(a) Zero sum of all co-efficients
(ii) A polynomial of degree $n \geq 1$ has atleast one root in c.	(b) Complex conjugate root theorem.
(iii) $\Sigma \alpha\beta = \frac{c}{a}$ in $ax^3 + bx^2 + cx + d = 0$	(c) fundamental theorem of Algebra
(iv) $x^3 - 3x^2 - 33x + 35 = 0$	(d) Vieta's formula

The correct match is

	(i)	(ii)	(iii)	(iv)
(A)	b	c	a	d
(B)	c	b	a	d
(C)	a	b	c	d
(D)	b	c	d	a

29.

List I	List II
(i) $f'(c) = \dfrac{f(b)-f(a)}{b-a}$	(a) Rolle's theorem
(ii) $f'(c) = 0$	(b) Maclaurin's series
(iii) $\displaystyle\sum_{n=0}^{\infty} \dfrac{f^n(a)}{n!}(x-a)^n$	(c) Lagranges mean value theorem
(iv) $\displaystyle\sum_{n=0}^{\infty} \dfrac{f^n(0)}{n!}\cdot x^n$	(d) Taylor's series

The correct match is

	(i)	(ii)	(iii)	(iv)
(A)	b	c	d	a
(B)	c	a	d	b
(C)	c	a	b	d
(D)	c	d	a	b

30. If $u = (x-y)^4 + (y-z)^4 + (z-x)^4$ then $\Sigma \dfrac{\partial u}{\partial x} =$

   (A) 4
   (B) 1
   (C) 0
   (D) -4

31. A random variable X has the following probability mass function?

X	-2	3	1
$P(X=x)$	$\dfrac{\lambda}{6}$	$\dfrac{\lambda}{4}$	$\dfrac{\lambda}{12}$

Then which of the following is incorrect?

   (A) $\dfrac{\lambda}{6}+\dfrac{\lambda}{4}+\dfrac{\lambda}{12}=1$
   (B) $\lambda = 2$
   (C) $P(X=3)=\dfrac{1}{8}$
   (D) $P(1 \leq x \leq 3) = \dfrac{2}{3}$

32. The number of commutative binary operations which can be defined on a set containing n elements is

   (A) $n\dfrac{n(n+1)}{2}$
   (B) n^{n^2}
   (C) $n^{n/2}$
   (D) n^2

33. The value of the definite integral $\displaystyle\int_{1}^{e} \sqrt{x}\ \ln(x)\ dx$ is

(A) $\dfrac{4}{9}\sqrt{e^3} + \dfrac{2}{9}$ (B) $\dfrac{2}{9}\sqrt{e^3} - \dfrac{4}{9}$

(C) $\dfrac{2}{9}\sqrt{e^3} + \dfrac{4}{9}$ (D) $\dfrac{4}{9}\sqrt{e^3} - \dfrac{2}{9}$

34. The critical points of the function $f(x) = (x-2)^{2/3}(2x+1)$ are

(A) $-1, 2$ (B) $1, \dfrac{-1}{2}$

(C) $1, 2$ (D) none

35. Choose the incorrect answer in the following. The area of the region bounded by the graph of $y = \sin x$ and $y = \cos x$ between $x = 0$ and $x = \dfrac{\pi}{4}$ is

(A) $\displaystyle\int_{0}^{\pi/4} (\cos x - \sin x)\ dx$

(B) $[\ \sin x + \cos x\ ]_{0}^{\pi/4}$

(C) $\displaystyle\int_{0}^{\pi/4} (\sin x - \cos x)\ dx$

(D) $\sqrt{2} - 1$

Section 3: Biology

21. Read the statements given below regarding the types of ovule.

(i) In arthotropous type, micropyle, funicle and chalaza lie in one straight vertical line.

(ii) In anatropous type, micropyle and funicle lie at distal ends to each other.

(iii) In hemianatropous type, the ovule is placed transversely and at right angles to the funicle.

(iv) In campylotropous hilum, micropyle and chalaza are adjacent to one another.

Find out true and false statements.

(A) (i) true, (ii) false, (iii) true, (iv) false
(B) (i) false, (ii) True, (iii) false, (iv) true.
(C) (i) true, (ii) False, (iii) true, (iv) true
(D) (i) true, (ii) true, (iii) false, (iv) False

22. In a test cross between BbLl X bbll, the obtained ratio is 1:7:7:1. Find out the recombination frequency.

(A) 10 %   (B) 12.5%
(C) 25%   (D) 50%

23. Assertion (A): PCR technique is used for identification of particular RNA.
Reason (R) : Reverse transcriptase is used for this process.

(A) (A) is true but (R) is false
(B) (A) is false but (R) is true

(C) Both (A) and (R) are true. (R) explains (A)
(D) (A) is true but (R) does not explain (A)

24. Which one of the following is not true regarding fermentation process?

(A) The study of fermentation is called zymology.

(B) Fermentation takes place in absence of any electron transport chain.

(C) Bio fortification can be done with the help of fermentation.

(D) Sterilization of fermenter is a upstream process.

25. Match the following and find the correct answer.

	List 1		list 2
(i)	Eastern blotting	(a)	post translational modification in protein
(ii)	western blotting	(b)	transfer of DNA
(iii)	southern blotting	(c)	transfer of RNA
(iv)	Northern blotting	(d)	transfer of protein

(A) (i)-(d), (ii)-(c), (iii)-(b), (iv)-(a)
(B) (i)-(d), (ii)-(b), (iii)-(c), (iv)-(a)
(C) (i)-(b), (ii)-(c), (iii)-(d), (iv)-(a)
(D) (i)-(a), (ii)-(d), (iii)-(b), (iv)-(c)

26. How can we produce viral free germ plasm by using plant tissue culture?

(A) Sterilization of tissues and their propagation.

(B) Obtaining viral free cells from apical meristem and then propagating the cells.

(C) Killing viruses by using antibiotic chemicals and later propagating the cells.

(D) Viral free cells can not be produced by tissue culture.

27. Which one of the following is incorrectly matched?

(A) Dates of india   -   tamarind

(B) Pigeon pea   -   red gram

(C) Queen of spices   -   cardamom

(D) King of spices   -   green chilly

28. Different kinds of syngamy are prevalent among living forms. Match the following:

(a) Merogamy   (i) *Monocystis*

(b) Hologamy   (ii) protozoans

(c) Isogamy   (iii) *Actinophrys*

(d) Paedogamyiv   (iv) *Trichonympha*

(A) (a)-(iv)   (b)-(ii)   (c)-(i)   (d)-(iii)

(B) (a)-(ii)   (b)-(iv)   (c)-(i)   (d)-(iii)

(C) (a)-(ii)   (b)-(i)   (c)-(iv) (d)-(iii)

(D) (a)-(iii) (b)-(ii)   (c)-(i)   (d)-(iii)

29. Choose the answer from the following:
Assertation(A): Syphilis is a sexually transmitted disease in human beings.
Reason (R): It is caused by *Chlamydia trachomatis*.
Choose the answer from the following:

(A) Both assertion and reason are correct and reason is correct explanation of the assertion.

(B) Both assertion and reason are correct and reason is not the correct explanation of assertion.

(C) Assertion is correct but reason is incorrect.

(D) Both Assertion and reason are incorrect.

30. Marriage between colour blind man and normal visioned woman gives rise to the following phenotype in F2 generation.

(A) Normal female, colour blind female, normal male, colour blind male

(B) Normal female, normal male, normal but carrier male, colour blind female

(C) Normal male, normal male, normal but carrier female, colour blind male

(D) Normal female, normal male, normal but carrier female, colour blind male

31. In search of the genetic material, Griffith?s experiments were repeated by

(A) Maclyn and McCarty in 1944.
(B) Altman in 1889.
(C) Alfred Hershey and Martha Chase in 1952.
(D) Waston and Crick I 1953.

32. Absorescent lycopods appeared in _____ period.

(A) Permian   (B) Triassic
(C) Jurassic   (D) Silurian

33. One of the following diseases is caused by bacteria.

(A) Mumps
(B) Athlete's foot
(C) Kala-azar
(D) Pneumonia

34. Which one of the following statements is false?

(A) Transgenic mice are not used for testing the safety of vaccines.

(B) Cloning refers to copies of DNA fragments.

(C) Animal cloning could help to save endangered species.

(D) Genetic manipulation may lead to unknown consequences.

35. Organisms which can tolerate only a narrow range of temperature are called

(A) Homeotherms
(B) Poikilotherms
(C) Stenotherms
(D) Eurytherms

36. The diagram and the numbers follow certain principle. Select the missing number indicated by question mark '?'
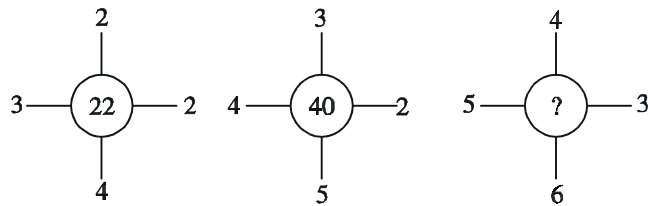
   (A) 42   (B) 58
   (C) 59   (D) 68

37. Words are in coded language. Identify the coded word depending upon the given situation.
If 'JAISALMER' is coded as 'JAILSARME' then 'HYDERABAD' is coded as:

   (A) HYDAERDBA   (B) HYDRBEDAA
   (C) HYDBDREAA   (D) HYDEADRAB

38. Read the contents, sense the direction and answer the questions.
Village B is situated to the North of village A. Village C is situated to the East of village B. Village D is situated to the left of village A. In which direction is village D situated with respect to Village C?

   (A) West   (B) South-East
   (C) South   (D) None of these

39. In a row A is 8th from the left and B is 17th from the right. If they interchange their positions A becomes 14th from left. How many persons are there in the row?

   (A) 25   (B) 27
   (C) 31   (D) 30

40. The following question is based on the series of figures. Complete the series by selecting suitable figure from the given alternatives.
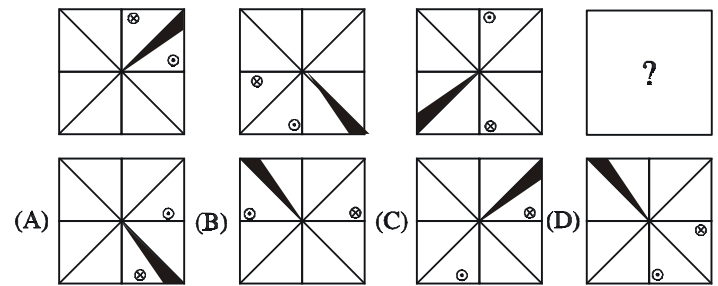
41. There are eight people A, B, C, D, E, F, G and H sitting around a circular table facing centre. B is sitting second to the left fo G who is sitting third to the right of F. Only E is sitting between A and C. C is sitting third to the left of B. Only one person is sitting between E and H.

Which of the following is correct ?

   (A) D is sitting third to the left of H
   (B) F is sitting third to the left of G
   (C) C is sitting third to the left of D
   (D) H is sitting second to the right of C

42. Take the given statements as true and decide which of the conclusions logically follow from the statements.

Statement

All Actors are Musicians.

No Musician is a Singer.

Some Singers are Dancers.

Some Dancers are Musicians.

Conclusions

I: Some Actors are Singers

II: Some Dancers are Actors

III: No Actor is a Singer

   (A) Only conclusion I follows.
   (B) Only conclusion III follows.
   (C) Exactly one of conclusion I, III follows.
   (D) Only conclusion II follows

43. Mother was asked how many gifts she had in the bag. She replied that there were all dolls but six, all cars but six, and all books but six. How many gifts had she in all?

    (A) 9   (B) 18
    (C) 27   (D) 36

44. The square boxes in the figures below are to be painted with different colours such that no two adjacent boxes (even diagonally) have same colour. How many minimum colours do you need in each case?
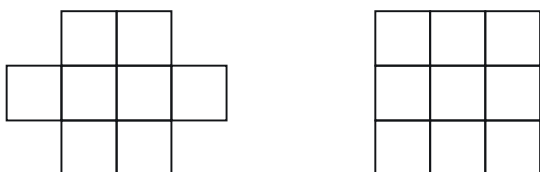

(A) (3, 4)
(B) (4, 4)
(C) (4, 5)
(D) (3, 5)

45. Peter puts his alarm clock on the table in such a way that 6.00 pm, hour handpoints to North. In which direction will the minute hand point at 6.15 pm?

    (A) South - East
    (B) South
    (C) North
    (D) West

Section 5:   Extrapolative Questions

46. For the arrangement given in the given figure, the coherent light sources A, B and C have intensities of $2\,mW/m^2$, $2\,mW/m^2$ and $5\,mW/m^2$ respectively.
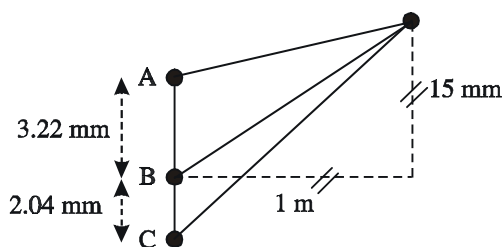
If the wavelength of all of the sources is 600 nm, the resultant intensity at point P is (in mW/m^2)

    (A) 2   (B) 3
    (C) 4   (D) 5

47. In a LCR series resonant circuit, the value of current is slightly less than the maximum value when

    (i)   the inductive reactance is slightly more than capacitive reactance

    (ii) the capacitive reactance is slightly more than the inductive reactance

    (iii) the inductive reactance is equal to the capacitive reactance
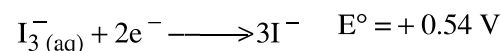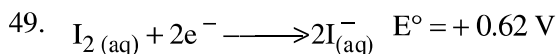
    (iv) the circuit becomes purely resistive.

    (A) Only (i) is correct
    (B) Only (i) & (ii) are correct

(C) Only (i), (ii) & (iii) are correct
(D) All are correct

48. Which of the following statement/s is/are wrong?

    (1) $t_{1/2}$ of a I order reaction is directly proportional to initial concentration

    (2) Order of a reaction is never fractional

    (3) Time taken for 100% completion of a I order reaction is infinity

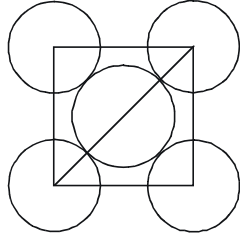   (4) Hydrolysis of an ester in acid medium is a second order reaction

    (A) (1) and (3) only   (B) (1) and (2) only
    (C) (2), (3) and (4) only (D) 1, 2 and 4 only

49. $I_{2\,(aq)} + 2e^- \longrightarrow 2I^-_{(aq)}$ $E° = +0.62\,V$

    $I^-_{3\,(aq)} + 2e^- \longrightarrow 3I^-$ $E° = +0.54\,V$

    K_c for the reaction $I_{2\,(aq)} + I^-_{(aq)} \rightleftharpoons I^-_{3\,(aq)}$ is approximately

    (A) 4.0
    (B) 25.3
    (C) 710.5
    (D) 1520.2

50. The packing efficiency of the following two dimensional square unit cell is about

(A) 24.8%   (B) 39.4%

(C) 64.5%   (D) 78.5%