MATHIIT™
JEE | NEET | Foundation

NATIONAL STANDARD EXAMINATION IN JUNIOR SCIENCE

NSEJS - 2023

STUDENT QUESTION PAPER

Paper Code 51 | Complete retyped paper for academic practice

TIME	QUESTIONS	MAX. MARKS
120 min	60	216

STUDENT DETAILS

Name _____ **Class** _____ **Roll No.** ____

Centre _____ **Date** _____

Instructions: Attempt all 60 questions. In A-1 only one option is correct. In A-2 one or more options may be correct; credit is awarded only when every correct option and no incorrect option is marked.

SECTION A-1

OUT OF THE FOUR OPTIONS, ONLY ONE IS CORRECT. MARK THE CORRECT OPTION.

1. In animals, the heart is the main pumping station, supplying and collecting blood from different parts of the body. In mammals, which structure is found between the left auricle and the left ventricle and ensures one-way flow of blood?

(a) Tricuspid valve
(b) Aortic semilunar valve
(c) Pulmonary semilunar valve
(d) Mitral valve

2. Which of the following correctly lists the units involved in most reflex arcs?

(a) Stimulus receptor, afferent nerve, efferent nerve and an effector neuron
(b) Two receptor neurons, one or more internuncial neuron(s) and an effector neuron
(c) One receptor neuron, one or more internuncial neuron(s) and an effector neuron
(d) One receptor neuron, afferent nerve and an effector neuron

3. Cross-breeding, mutation breeding and cytoplasmic hybridisation can produce improved varieties or distinct hybrids. Which pair represents cytoplasmic hybrids (cybrids)?

(a) Triticale and Fairchild Mule
(b) Tigon and Leopon
(c) Pomato and Bromato
(d) Jaya and Ratna rice

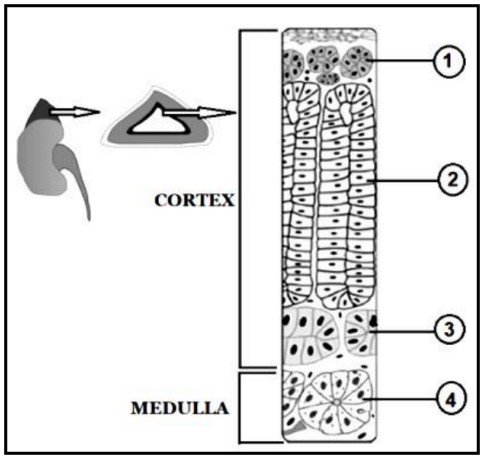
4. In a certain animal epithelium, every cell rests on the basement membrane, but some basal cells do not reach the free surface. The nuclei therefore appear at different levels, making the tissue look multilayered although it is not truly stratified. It is often ciliated and may contain mucus-secreting goblet cells. Where is this epithelium characteristically found?

(a) Thin bronchioles, uriniferous tubules and ciliary body
(b) Bile ducts, lining of stomach and trachea
(c) Skin epidermis, anal canal and cornea
(d) Trachea, vasa deferentia and epididymis

5. Phenylthiocarbamide (PTC) tastes bitter to tasters. The non-tasting condition is caused by a recessive allele. A non-taster woman marries a PTC-taster man. Their first two children are non-tasters. What is the probability that their third child will also be a non-taster?

(a) 0.25 **(b)** 0.50 **(c)** 0.15 **(d)** 0.75

6. The diagram is a sectional view of an endocrine gland. Its characteristic layers are labelled 1, 2, 3 and 4. Which layers secrete the C_{21} hormones cortisol and corticosterone?



(a) 1
(b) 1 and 3
(c) 2 and 4
(d) 2 and 3

7. Which eye defect develops because the ciliary muscles gradually weaken and the flexibility of the eye lens decreases?

(a) Hyperopia **(b)** Presbyopia **(c)** Astigmatism **(d)** Myopia

8. Which genus is the Angoumois grain moth that causes serious damage to stored grains such as paddy and wheat?

(a) *Sitophilus* **(b)** *Sitotroga* **(c)** *Gnorimoschema* **(d)** *Plodia*

9. For fertilisation in angiosperms, pollen grains germinate and pollen tubes carry male gametes to the ovules. Suppose a brinjal fruit is to contain 300 seeds. How many meiotic cell divisions are required to produce the necessary female and male gametophytes?

(a) 250 meiotic divisions
(b) 375 meiotic divisions
(c) 375 mitotic divisions
(d) 300 mitotic and 125 meiotic divisions

10. Which plant is well known for the anatomical features called carinal canals and vallecular canals?

(a) *Magnolia* **(b)** *Gnetum* **(c)** *Equisetum* **(d)** *Lycopodium*

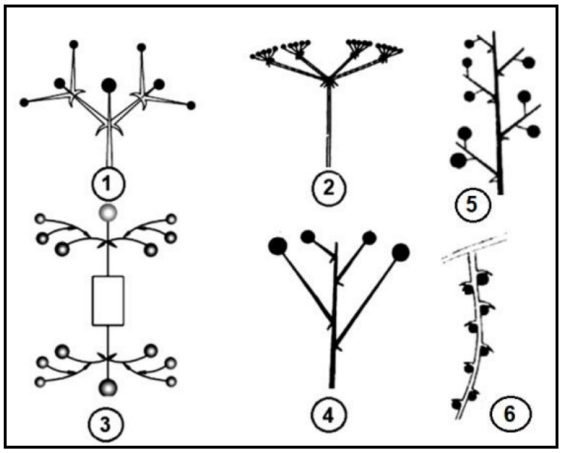
11. Satellite or SAT chromosomes have secondary constrictions at fixed positions. In humans, satellites are usually associated with the short arms of which acrocentric chromosomes?

(a) 1, 10, 15, 16 and Y
(b) 13, 14, 15, 21 and 22
(c) 13, 14, 16, 18 and 21
(d) 13, 14, 18 and 22

12. In bordered pits of some plant cells, what is the central thickening formed on the pit membrane by circular deposition of microfibrils?

(a) Margo **(b)** Torus **(c)** Zona occludens **(d)** Sclereid

13. The diagrams show different types of inflorescences. Select the pair that represents cymose inflorescences.



yogenesis include members of all of the

(a) 2 and 4
(b) 1 and 6
(c) 1 and 3
(d) 3 and 5

14. Genes normally important in mammalian embryogenesis include members of all the following classes, except:

(a) Proto-oncogenes
(b) Growth-factor genes
(c) Tumour-suppressor genes
(d) *Hox* genes

15. In a type of carbon dioxide fixation, stomata remain open at night and CO_2 first combines with phosphoenolpyruvate (PEP) to form four-carbon oxaloacetate. Which plant shows this ecological adaptation?

(a) *Cocos*
(b) *Rhizophora*
(c) *Aloe*
(d) *Vallisneria*

16. Which is the most common hemiparasitic mistletoe found in India?

(a) *Monotropa uniflora*
(b) *Dendrophthoe falcata*
(c) *Orobanche cernua*
(d) *Cuscuta reflexa*

17. During the formation of which pair of ionic species are the first and second processes exothermic and endothermic, respectively?

(a) Na^+ and Cl^-
(b) Cl^- and O^{2-}
(c) He^+ and Mg^{2+}
(d) F^- and Br^-

18. Hydrogen, H_2, reacts with chlorine about 13 times faster than deuterium, D_2, because:

(a) H_2 has a high activation energy
(b) The H-H bond energy is higher than the D-D bond energy
(c) H_2 has a lower activation energy because the H-H bond is weaker than the D-D bond
(d) H_2 has no neutron and therefore reacts faster

19. Select the correct statements comparing water (H_2O) and heavy water (D_2O) at 293 K.

(i) Dielectric constant: $H_2O > D_2O$ **(ii)** $D_2O > H_2O$

(iii) Refractive index: $H_2O > D_2O$ **(iv)** $D_2O > H_2O$

(v) Intermolecular forces: $H_2O > D_2O$ **(vi)** $D_2O > H_2O$

(a) (i), (iii), (vi) **(b)** (i), (iv), (v)

(c) (ii), (iii), (v) **(d)** (i), (iv), (vi)

20. Which compound is used to purify air in space shuttles, submarines and breathing masks?

(a) K_2O_2 **(b)** KO_2 **(c)** K_2O **(d)** Na_2O

21. What is the total number of lone pairs of electrons in I_3^-?

(a) 3 **(b)** 6 **(c)** 2 **(d)** 9

22. Among elements with atomic numbers 1 to 92, the two atomic numbers traditionally identified as not occurring naturally are:

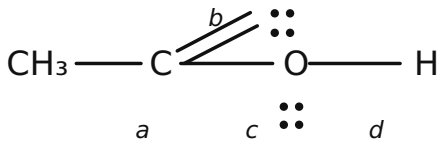
(a) 89 and 92 **(b)** 83 and 89 **(c)** 48 and 61 **(d)** None of these

23. Which states of matter occur at very high temperature and at a temperature close to absolute zero, respectively? (BEC means Bose-Einstein condensate.)

(a) BEC and fermionic condensate **(b)** Plasma and BEC

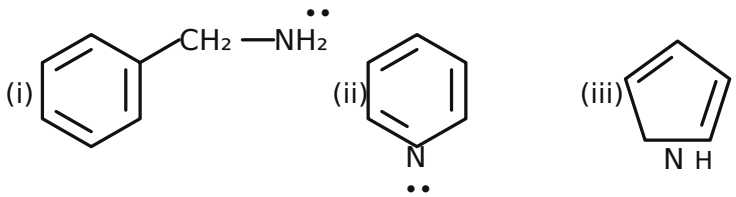
(c) Fermionic condensate and plasma **(d)** Gas and BEC

24. The labelled compound reacts with H_3O^+. Which labelled bond is disrupted in the first step?



(a) Bond a **(b)** Bond b **(c)** Bond c **(d)** Bond d

25. Arrange the three compounds shown in increasing order of Lewis-base strength.



(a) iii, ii, i **(b)** i, ii, iii **(c)** ii, i, iii **(d)** iii, i, ii

26. What is the maximum number of $-CH_3$ groups that can be present in an alkane with molecular formula $C_{11}H_{24}$?

(a) 6 **(b)** 7 **(c)** 8 **(d)** 2

27. A 1 L glass bulb contains 4 g of methane and bursts if the pressure exceeds 10 atm. At what temperature does the gas reach this pressure? (R = 0.0821 L atm K^{-1} mol^{-1})

(a) 480 K **(b)** 487.6 K **(c)** 500 K **(d)** 373 K

28. The pH of a 10^{-8} M HCl solution is:

(a) 7 **(b)** Less than 7 **(c)** 8 **(d)** Greater than 8

29. Element X has two natural isotopes: ^{10}X of mass 10.013 u and abundance 19.8%, and ^{11}X of mass 11.009 u and abundance 80.2%. Its average atomic mass is closest to:

(a) 10.210 u **(b)** 10.511 u **(c)** 10.799 u **(d)** 10.812 u

30. A 0.75 g mixture of Na_2CO_3 and K_2CO_3 is completely neutralised by 50 mL of 0.25 N HCl. The percentage of Na_2CO_3 in the mixture is closest to:

(a) 50.6 **(b)** 49.4 **(c)** 50 **(d)** Data insufficient

31. A diamond ring contains 3 carat of diamond. How many carbon atoms does it contain? (1 carat = 200 mg)

(a) 3.01×10^{23} **(b)** 2.1×10^{23} **(c)** 3.01×10^{22} **(d)** 2.1×10^{22}

32. Which substance will form foam in water containing Ca^{2+} and Mg^{2+} ions?

(a) Barium stearate **(b)** Sodium palmitate
(c) Potassium *n*-dodecylbenzene sulphonate **(d)** All of these

33. Blocks A and B have masses 1 kg and 4 kg and move with equal kinetic energies.
S_1: The ratio of their speeds $v_A:v_B$ is 1:2.
S_2: The ratio of the magnitudes of their momenta $p_A:p_B$ is 1:2.
Choose the correct option.

(a) Both S_1 and S_2 are true **(b)** Both S_1 and S_2 are false
(c) S_1 is true and S_2 is false **(d)** S_1 is false and S_2 is true

34. A straight copper wire has mass 20.95 g and electrical resistance 0.065 Ω. The density of copper is 8900 kg m^{-3} and its resistivity is 1.7×10^{-8} Ω m. What is the length of the wire?

(a) 3 m **(b)** 6 m **(c)** 12 m **(d)** Data insufficient

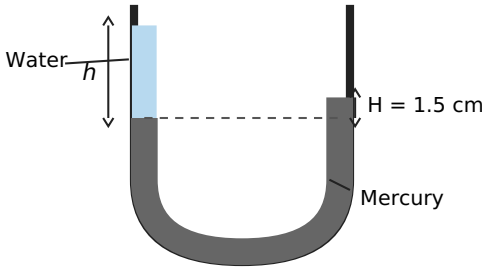
35. The speed of sound in a gas is proportional to the square root of absolute temperature. Its speed in air at 0°C is 332 m s^{-1}. On a hot day it is 360 m s^{-1}. The air temperature is closest to:

(a) 40°C **(b)** 42°C **(c)** 44°C **(d)** 48°C

36. A small bar magnet falls vertically through a conducting metal ring lying in a horizontal plane. Near the ring, the acceleration of the magnet is:

(a) Equal to g **(b)** Less than g and uniform
(c) Less than g and non-uniform **(d)** Greater than g and uniform

37. A U-tube contains water of density 1.0×10^3 kg m^{-3} and mercury of density 13.6×10^3 kg m^{-3}. The mercury levels differ by H = 1.5 cm. The height h of the water column above the mercury is nearly:

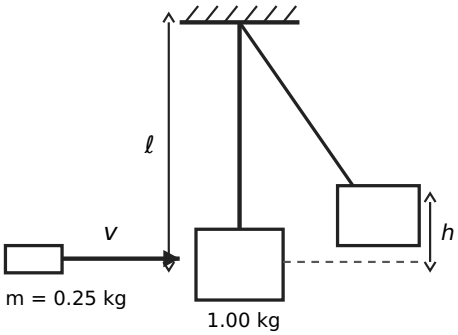


(a) 13.6 cm **(b)** 20.4 cm **(c)** 27.0 cm **(d)** 9.0 cm

38. An object pin is placed 10 cm beyond the first focus of a thin convex lens. Its real, inverted image is formed 40 cm beyond the second focus. What is the focal length of the lens?

(a) 16 cm **(b)** 20 cm **(c)** 25 cm **(d)** 40 cm

39. A 0.25 kg bullet moving horizontally with speed v embeds in a stationary 1.00 kg block suspended by a long light string. The combined system rises through h = 19.6 cm. Find v.

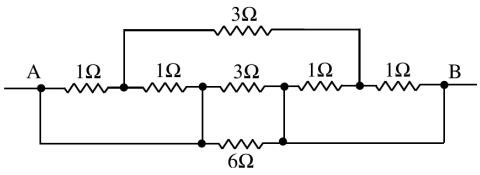


(a) 5.9 m s^{-1} **(b)** 7.8 m s^{-1}

(c) 9.8 m s^{-1} **(d)** 11.8 m s^{-1}

40. Find the equivalent resistance between A and B in the network shown.

ıivalent resistance between points A and B in the following electrical network is



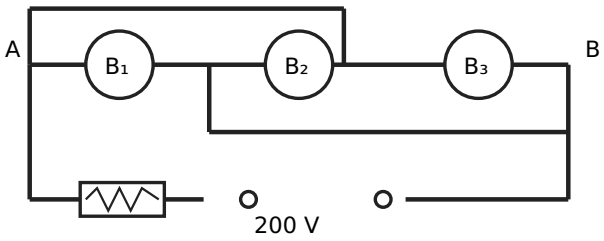
$\frac{3}{4}\ \Omega$ (b) $\frac{4}{3}\ \Omega$ (c) $\frac{2}{5}\ \Omega$ (d) $\frac{9}{14}\ \Omega$

(a) 3/4 Ω **(b)** 4/3 Ω **(c)** 2/5 Ω **(d)** 9/14 Ω

41. The order of magnitude of the pressure exerted on the ground by an adult standing barefoot on both feet is:

(a) 10^2 Pa **(b)** 10^4 Pa **(c)** 10^7 Pa **(d)** 10^9 Pa

42. Three bulbs B_1 (100 W, 200 V), B_2 (60 W, 200 V) and B_3 (40 W, 200 V) are connected to a 200 V supply with a fuse in series, as shown. What fuse-current rating is required to protect the bulbs?



(a) 0.2 A **(b)** 0.3 A **(c)** 0.5 A **(d)** 1.0 A

43. An ant is on the principal axis of a convex mirror of focal length f, at a distance 2f in front of the mirror. It moves towards the mirror. During this motion, the distance between the ant and its image:

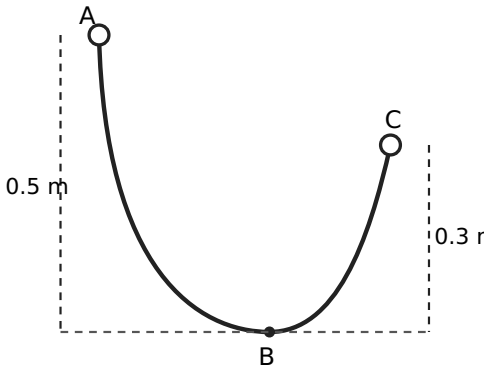
(a) Increases throughout **(b)** Decreases throughout

(c) First increases and then decreases **(d)** First decreases and then increases

44. Three resistors of 2 Ω, 4 Ω and 6 Ω are available. Which equivalent resistance cannot be obtained by arranging all three in a series-parallel circuit?

(a) Less than 2 Ω **(b)** 4.4 Ω **(c)** 5.5 Ω **(d)** 7.6 Ω

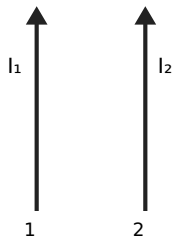
45. ABC is a curved track of length 0.8 m in a vertical plane. A 3 g bead starts from rest at A, slides along the track and comes to rest at C. What is the average frictional force during the trip from A to C?



(a) 18.40×10^{-3} N **(b)** 29.4×10^{-3} N

(c) 11.04×10^{-3} N **(d)** 7.36×10^{-3} N

46. Two long, straight, neutral conductors carry parallel currents I_1 and I_2 in the same direction. F_e and F_m are the electric and magnetic forces exerted by conductor 1 on conductor 2. Which statement is correct?



(a) F_e is repulsive and F_m is attractive

(b) Both F_e and F_m are repulsive

(c) F_e is zero and F_m is repulsive

(d) F_e is zero and F_m is attractive

47. A digital thermometer reads 37.3°C. What temperature should be recorded in kelvin?

(a) 310.30 K **(b)** 310.45 K **(c)** 310.46 K **(d)** 310.31 K

48. Planets P_1 and P_2 move around the Sun in circular orbits of radii 10^{13} m and 10^{12} m, respectively. The ratio v_1/v_2 of their orbital speeds is:

(a) $\sqrt{10}$ **(b)** 10 **(c)** $10\sqrt{10}$ **(d)** $1/\sqrt{10}$

SECTION A-2

ANY NUMBER OF OPTIONS (4, 3, 2 OR 1) MAY BE CORRECT. ALL CORRECT OPTIONS AND NO INCORRECT OPTION MUST BE MARKED.

49. The table matches mammalian orders or examples with characteristics.

Order / example	Characteristic
1. Lagomorpha	(i) First finger clawed; tail enclosed in an interfemoral membrane
2. Microchiroptera	(ii) Toothless and polyembryony
3. Armadillo	(iii) Baleen
4. Proboscidea	(iv) Incisors open-rooted and growing throughout life

Which matches are correct?

(a) 1 → (iv) **(b)** 2 → (i) **(c)** 3 → (ii) **(d)** 4 → (iii)

50. Which historical pedigrees were described as families of beggars and scoundrels?

(a) Bach family of Germany **(b)** Zero family of Switzerland

(c) Kallikaks of America **(d)** Jukes of New York

51. Which statements explain root gravitropism?

(a) Statoliths in root-cap columella cells sediment in the direction of gravity and generate a signal for asymmetric growth.

(b) Auxin influx and efflux carriers create a differential auxin gradient between the upper and lower sides, producing unequal growth and root curvature.

(c) Curvature in gravity-stimulated roots can be explained by lateral redistribution of an inhibitor formed in the root cap.

(d) Proplastids containing carotenoids and protochlorophyll respond to gravity.

52. Which statements describe cyclic photophosphorylation in green plants?

(a) Photosystem II is not involved.

(b) Only ATP is generated; reducing power such as NADPH/NADH is not produced.

(c) Water is required.

(d) P680 is the active reaction centre.

53. Select the correct statements about the Bohr model of the atom.

(a) An electron nearer the nucleus has lower potential energy.

(b) An electron continuously radiates energy while revolving in a discrete orbit.

(c) The model could not explain spectra of multi-electron atoms.

(d) It was the first atomic model based on quantisation of energy.

54. Which first-ionisation-energy orders are correct?

(a) Ag < Au **(b)** Pd < Pt **(c)** Pb > Sn **(d)** Sb > Bi

55. Using the solvent-system idea of acids and bases, which statements are correct?

(a) CH_3COOH acts as a strong acid in liquid NH_3.

(b) H_2SO_4 acts as a strong acid in water and liquid NH_3.

(c) CH_3COOH acts as a base in liquid HCl.

(d) H_2O acts as a base in liquid NH_3.

56. The reaction $KI + I_2 \rightarrow KI_3$ involves:

(a) Oxidation **(b)** Reduction **(c)** Complex formation **(d)** Neutralisation

57. Crane A and crane B take 1 minute and 2 minutes, respectively, to lift the same 2000 kg car through 3 m. Their efficiencies are equal. Which conclusions are correct?

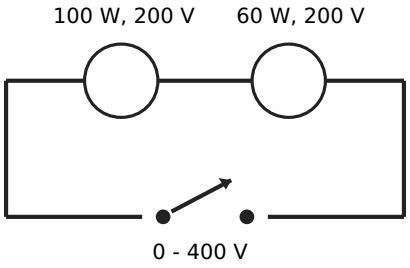
(a) The power supplied by crane B is 1000 kW.

(b) The two cranes consume equal amounts of fuel.

(c) The power supplied by crane A is greater than that supplied by crane B.

(d) Crane A consumes more fuel than crane B.

58. Two tungsten-filament bulbs rated 100 W, 200 V and 60 W, 200 V are connected in series to a variable 0-400 V supply. Which statements are correct?



(a) At 200 V supply, the 60 W bulb glows brighter.

(b) At 200 V supply, the total power dissipated is greater than 37.5 W.

(c) At 400 V supply, the 100 W bulb gets fused.

(d) When the supply reaches 400 V, neither bulb glows.

59. A solid sphere of radius 10 cm floats in water with 60% of its volume submerged and in oil with 80% submerged. The density of water is 1000 kg m^{-3}. Which statements are correct?

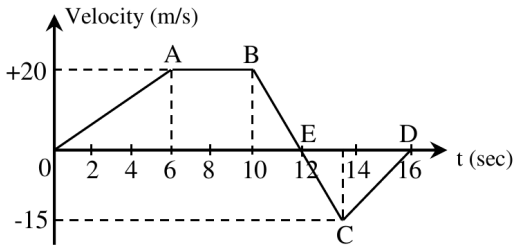
(a) The density of the sphere is 600 kg m^{-3}.

(b) The density of the oil is 750 kg m^{-3}.

(c) The weight of the sphere in air is close to 24.64 N.

(d) The apparent loss of weight while floating in oil is close to 30.82 N.

60. A particle starts at the origin and moves along the x-axis according to the velocity-time graph. Which statements are correct?



(a) Its initial acceleration is 4 m s^{-2}.

(b) Its displacement after 16 s is 130 m.

(c) Its average speed during 0-16 s is 11.88 m s^{-1}.

(d) At some stage its retardation is 10 m s^{-2}.

ROUGH WORK