MATHIIT™

JEE | NEET | Foundation

NSEJS 2021-22

Student Question Paper

RE-TYPED STUDENT QUESTION PAPER

TIME	QUESTIONS	MAX. MARKS
75 minutes	33	126

PAPER CODE 51

A clean, searchable copy of the original Paper Code 51.

Student name: _____

Class: _____ **Date:** _____

ORIGINAL EXAMINATION INSTRUCTIONS

Retyped and arranged for easy reading.

- Write Paper Code 51 on the OMR answer sheet. An incorrect or missing paper code may prevent evaluation.
- Mobile phones, smart watches and tablets are prohibited during the examination.
- Use only a blue or black ball-point pen for OMR entries. Fill candidate details carefully in block capitals and darken the appropriate bubbles.
- Part A-1: Questions 1-24 have one correct option. A correct answer carries 3 marks and a wrong answer has a penalty of 1 mark.
- Part A-2: Questions 25-33 may have one, two, three or four correct options. Six marks are awarded only when all correct alternatives and no incorrect alternative are marked. There is no negative marking in this part.
- A non-programmable scientific calculator was allowed in the original examination.
- Do not scratch, overwrite or change an OMR entry. Machine evaluation may treat such changes as wrong.
- The original examination time was 2:30 PM to 3:45 PM. The paper was titled IOQJS 2021-22 Part I (NSEJS).

Physical constants provided in the paper

Mass of electron, $m_e = 9.10 \times 10^{-31}$ kg	Electron charge magnitude, $e = 1.60 \times 10^{-19}$ C
Mass of proton, $m_p = 1.67 \times 10^{-27}$ kg	Planck constant, $h = 6.625 \times 10^{-34}$ J s
Acceleration due to gravity, $g = 9.81$ m s^{-2}	Sea-water density, $\rho = 1.03 \times 10^{3}$ kg m^{-3}
$G = 6.67 \times 10^{-11}$ N m^2 kg^{-2}	$(1 + x)^n \approx 1 + nx$ when $\lvert x \rvert$ is much smaller than 1
$R = 8.31$ J mol^{-1} K^{-1}	1 eV $= 1.6 \times 10^{-19}$ J
$k = 1.38 \times 10^{-23}$ J K^{-1}	$\sin(A - B) = \sin A \cos B - \cos A \sin B$
$N_A = 6.02 \times 10^{23}$ mol^{-1}	$E = mc^2$
$c = 3.0 \times 10^{8}$ m s^{-1}	1 unit of electrical energy = 1 kWh

SECTION A-1

Questions 1-24 | Only one of the four options is correct.

1 Which of the following is not a function of mature red blood cells (RBCs)?

(a) Help in classifying blood into different blood groups

(b) Help in transport of gases

(c) Synthesis of immunoglobulins

(d) Help in maintaining acid-base balance in the body

2 In which of the following classes of vertebrates are there groups of animals without limbs?

(a) Fish, reptiles and mammals

(b) Reptiles only

(c) Reptiles and amphibians

(d) Amphibians only

3 Which of the following groups has only one pair of wings?

(a) Honey bee, beetle and ant

(b) Butterfly, housefly and fruit fly

(c) Dragonfly, butterfly and fruit fly

(d) Housefly, fruit fly and mosquito

4 During an expedition to planet 'Imagitica', scientists analysed the genetic material of its organisms and noted:
i. Purines and pyrimidines are unequal in amount.
ii. Thymine is absent.
iii. The material is unstable and mutates frequently.
iv. It is rapidly degraded at pH above 12.
What genetic material might these organisms contain?

(a) Single-stranded DNA

(b) Double-stranded DNA

(c) Single-stranded RNA

(d) Double-stranded RNA

5 Which of the following is most likely to show aerenchyma?

(a) Leaf base of mango

(b) Petiole of water hyacinth

(c) Seta of moss

(d) Stem of Opuntia

6 Consider the following statements about bryophytes:
i. Their plant body is differentiated into true root, stem and leaves.
ii. They lack xylem and phloem.
iii. They require water for completion of the life cycle.
Which statement(s) is/are true?

(a) ii only

(b) i and ii

(c) i and iii

(d) ii and iii

7 Carbon fixation in most succulent plants takes place through which pathway?

(a) Calvin cycle
(b) Glycolate pathway
(c) Crassulacean acid metabolism pathway
(d) Hatch-Slack pathway

8 A flower is large, wide-mouthed and white, opens after sunset, and gives out a fruity or musky fragrance. It is most likely pollinated by:

(a) Birds
(b) Bats
(c) Insects
(d) Baboons

9 Coal contains sulphur which, on burning, produces a gas responsible for acid rain. The number of atoms in one mole of this gas is:

(a) 6.02×10^{23}
(b) 1.81×10^{23}
(c) 1.81×10^{24}
(d) 1.21×10^{24}

10 Human stomach fluid contains HCl, KCl and NaCl. It is highly acidic and helps in digestion and killing bacteria, but excess acidity may cause abdominal pain, nausea, bloating and heartburn. An antacid tablet mainly contains aluminium hydroxide, $Al(OH)_3$ (molar mass 78 g mol^{-1}). If the concentrations of HCl, KCl and NaCl are 0.01 M each and the stomach-fluid volume is 2 L, the amount of $Al(OH)_3$ required to neutralise the fluid is:

(a) 0.52 g
(b) 1.08 g
(c) 0.81 g
(d) 2.16 g

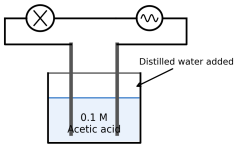
11 A 0.500 g mixture of calcium carbonate and calcium oxide is strongly heated. The residue weighs 0.434 g. What percentage of calcium oxide was present initially?

(a) 70%
(b) 30%
(c) 35%
(d) 60%

12 Arrange Na, C, O, Li and Be in increasing order of metallic character.

(a) C < O < Na < Li < Be
(b) O < C < Be < Na < Li
(c) O < C < Be < Li < Na
(d) C < O < Be < Li < Na

13 A 50 mL sample of 0.1 M acetic acid solution is taken in a beaker and two wires are dipped in it as shown. When the electric supply is switched on, the bulb glows. Distilled water is then added slowly until the volume doubles. During the addition of water, the intensity of the bulb:



(a) Remains unchanged
(b) Goes on decreasing
(c) Goes on increasing
(d) Suddenly becomes zero

14 A compound X gives a pungent gas that turns red litmus blue when heated with NaOH. With $AgNO_3$, its aqueous solution gives a white precipitate that turns grey in sunlight, releasing a pale yellowish-green gas. The aqueous solution of X is:

(a) Neutral
(b) Slightly acidic
(c) Slightly alkaline
(d) Strongly acidic

15 Equal masses of two gases among N_2, NO, O_2, CO, CO_2 and SO_2 occupy the same volume at STP. The gases are:

(a) N2 and O2
(b) CO and NO
(c) SO2 and CO2
(d) N2 and CO

16 When a solution and its pure solvent are separated by a semipermeable membrane, the solution exerts osmotic pressure on the membrane. Osmotic pressure increases with the number of solute particles. Ten millimoles each of the sulphates of sodium, magnesium and aluminium are dissolved separately in 1.0 L water in beakers P, Q and R respectively. Assuming complete ionisation, the osmotic pressures follow:

(a) P < Q < R
(b) Q < P < R
(c) P > Q > R
(d) P > R > Q

17 The origins of coordinate systems S_1 and S_2 coincide, and their axes are inclined. Particle P_1 starts from (-2, 0) in S_1 and moves from rest for 4 s along $+X_1$ with acceleration 1.25 m s^{-2}. Particle P_2 starts from the common origin and moves from rest for 2 s along $+X_2$ with acceleration 5 m s^{-2}. Their final separation is 6 m. The angle between $+Y_1$ and $+X_2$ is:

(a) 36.8°
(b) 53.2°
(c) 106.8°
(d) 126.8°

18 A physical parameter Z varies with u as $Z = A[R/(R + u)]^3$, where R and A are constants and u is much smaller than R. A graph of Z on the Y-axis against u on the X-axis is expected to be:

(a) A straight line through the origin with slope R/3

(b) A straight line with intercept 3A/2 and slope -R/(3A)

(c) A straight line with intercept A and slope -3A/R

(d) A straight line with intercept -A/2 and slope -3R

19 A submarine is at a depth of 200 m in an ocean on Earth. At what approximate depth in an ocean on Mars will another submarine experience the same water pressure? Take g on Mars as 3.7 m s^{-2} and the same seawater density on both planets.

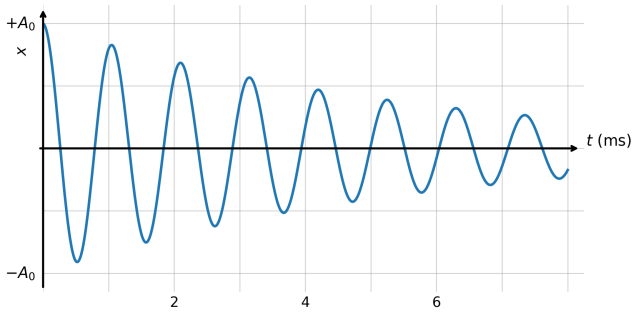
(a) 158 m

(b) 435 m

(c) 530 m

(d) 616 m

20 The graph shows displacement x against time t for an oscillating system. Which statement best describes the motion?



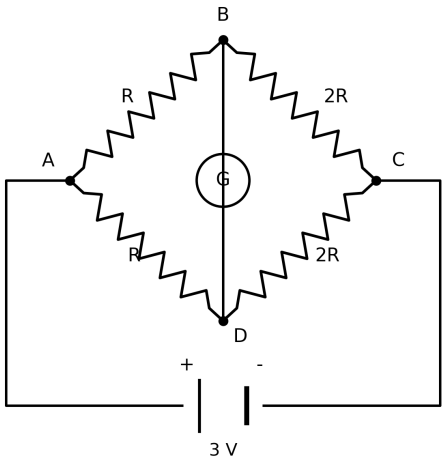
(a) Oscillatory motion without damping

(b) Damped oscillation with time measured from the mean position

(c) Damped oscillation with decreasing time period

(d) Damped oscillation with time measured from a position of maximum potential energy

21 In the shown circuit, the galvanometer G shows no deflection. If R = 2 Ω, the current drawn from the 3 V cell is:



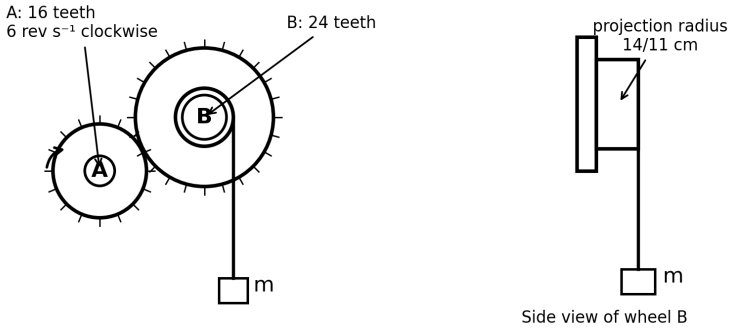
(a) 1 A

(b) 9 A

(c) 4 A

(d) 9/4 A

22 A gear transfers rotary motion from one wheel to another. In the shown system, driving wheel A has 16 teeth and drives wheel B, which has 24 teeth, without slipping. Wheel B has a circular projection of radius 14/11 cm over which a long massless, inextensible string can be wound or unwound. A mass m is attached to the free end. If wheel A makes 6 revolutions per second clockwise, then in 1/2 s the potential energy of m, in CGS units:



(a) Increases by 32mg
(b) Decreases by 32mg
(c) Increases by 16mg
(d) Decreases by 16mg

23 Canopus is about 300 light years away. If the energy flux received from it is 5.0×10^{-8} W m^{-2}, how much mass does it lose per second?

(a) 1.70×10^{-6} kg
(b) 1.91×10^{9} kg
(c) 5.62×10^{13} kg
(d) 6.34×10^{31} kg

24 An average adult radiates about 100 W. Fifty people sit in a hall whose air-conditioning system is 50% efficient. How much electrical energy is required to maintain the temperature for 4 h?

(a) 5 units
(b) 10 units
(c) 20 units
(d) 40 units

SECTION A-2

Questions 25-33 | Any number of options may be correct. Select every correct option and no incorrect option.

25 Given below are four statements about viruses. Which statement(s) is/are incorrect?

(a) All known viruses contain RNA as the genetic material.
(b) During viral multiplication, a complementary DNA is produced in riboviruses.
(c) Viruses are the smallest, freely living cells found on the planet.
(d) DNA-containing viruses are more susceptible to mutations than RNA-containing viruses and hence show very rapid evolution.

26 A person suffers an injury to the front part of the head. Which outcomes are possible?

(a) Trouble in speaking properly
(b) Inability to smell
(c) Inability to walk on a narrow path
(d) Inability to maintain blood pressure

27 Which molecules are primarily responsible for structural support and motility?

(a) Actin
(b) Alpha-tubulin
(c) Lamins
(d) Desmin

28 Which types of bonding are found in dry ice?

(a) Covalent bonding
(b) Ionic bonding
(c) Metallic bonding
(d) van der Waals forces

29 Which substances raise the temperature of water when dissolved in it?

(a) Ammonium chloride
(b) Potassium hydroxide
(c) Glucose
(d) Concentrated HCl

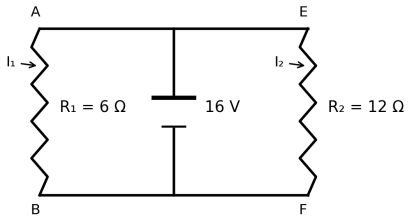
30 A 1% soap solution X and a 1% detergent solution Y are each divided into two parts. NaCl is added to X_1 and Y_1, while $CaCl_2$ is added to X_2 and Y_2. Which observation is correct?

(a) X1 shows a slimy precipitate
(b) X2 shows a slimy precipitate
(c) Y1 shows a slimy precipitate
(d) Y2 shows a slimy precipitate

31 According to Einstein's photon description, light of frequency nu consists of energy packets of energy E = h nu. In a surgical procedure, a surgeon uses a LASER beam of wavelength 650 nm in pulses of duration 30.0 ms. The average power of each pulse is 0.6 W. Which statements are correct?

(a) Photon frequency is 4.6×10^{14} Hz
(b) Energy in one pulse is 1.1×10^{17} eV
(c) Energy of one photon is 3.1×10^{-19} J
(d) Number of photons in one pulse is 5.9×10^{16}

32 In the parallel circuit shown, $R_1 = 6\ \Omega$, $R_2 = 12\ \Omega$ and $V = 16$ V. Currents through them are I_1 and I_2. Which statements are correct?



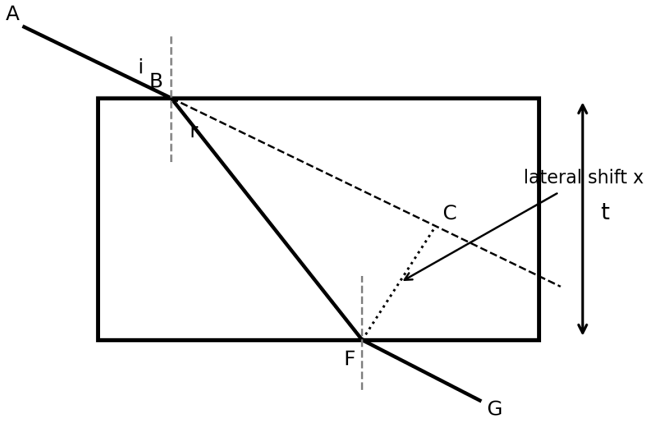
(a) Power in R1 is about 42.6 W

(b) I1/I2 = 2

(c) Total current drawn is 4 A

(d) Voltage across R2 is twice the voltage across R1

33 A ray passes through a parallel-sided glass plate of thickness t and refractive index μ. The incidence and refraction angles are i and r, and x is the lateral shift. Which statements are correct?



(a) $x = t[\sin i - (\cos i \sin r)/(\cos r)]$

(b) x depends on refractive index μ

(c) x is independent of the wavelength of light

(d) The maximum value of x approaches t when i is close to 90°

ROUGH WORK