

DATE : 17/01/2021

Question Paper Code:

51



# Aakash

Medical | IIT-JEE | Foundations

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Time : 60 Minutes

## Questions & Answers

Max. Marks : 120

*for*

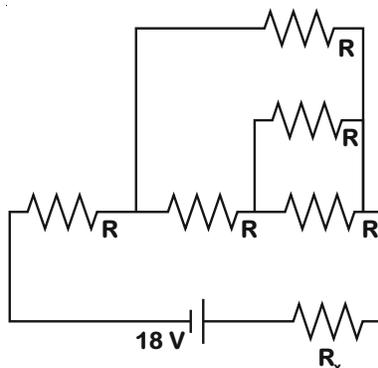
## Indian Olympiad Qualifier in Junior Science 2020-21 (IOQJS)

### Important Instructions :

1. Use of mobile phones, smart watches, and iPad during examination is **STRICTLY PROHIBITED**.
2. In addition to this question paper, you are given OMR Answer Sheet along with candidate's copy.
3. On the OMR Sheet, make all the entries carefully in the space provided **ONLY** in **BLOCK CAPITALS** as well as by properly darkening the appropriate bubbles. **Incomplete/ incorrect/ carelessly filled information may disqualify your candidature.**
4. On the OMR Answer Sheet, use only **BLUE or BLACK BALL POINT PEN** for making entries and filling the bubbles.
5. All questions are compulsory.
6. There are 32 questions. All the questions are objective type.
7. The question paper consists of two parts.
  - (a) **Part A1:** This section contains **TWENTY FOUR** multiple choice questions (Q. No. 1 to 24). Each question has four alternatives, out of which **ONLY ONE** is correct.  
Each correct answer carries **3 marks** whereas 1 mark will be deducted for each wrong answer.
  - (b) **Part A2:** This section contains **EIGHT** multiple choice questions (Q. No. 25 to 32). Each question has four alternatives, out of which any number of alternatives may be correct. (**MORE THAN ONE CORRECT OPTIONS**).  
Each correct answer carries **6 marks** if all the correct alternatives are marked and no incorrect. No negative marks in this part.
8. Rough work should be done only in the space provided.
9. Use of **non-programmable** scientific calculator is allowed.
10. After submitting answer paper, take away the question paper & candidate's copy of OMR for your reference.



6. In the adjoining circuit,  $R = 5 \Omega$ . It is desired that the voltage across  $R_x$  should be 6 V, then the value of  $R_x$  should be



- (a)  $4 \Omega$  (b)  $12 \Omega$   
 (c)  $16 \Omega$  (d)  $20 \Omega$

**Answer (a)**

7. In one process for waterproofing, a fabric is exposed to  $(\text{CH}_3)_2\text{SiCl}_2$  vapors. The vapors react with the hydroxyl groups on the surface of the fabric or with traces of water to form the waterproofing film  $[(\text{CH}_3)_2\text{SiO}]_n$ , by the reaction;  $n(\text{CH}_3)_2\text{SiCl}_2 + 2n\text{OH}^- \rightarrow 2n\text{Cl}^- + n\text{H}_2\text{O} + [(\text{CH}_3)_2\text{SiO}]_n$  where  $n$  stands for a larger integer. The waterproofing film is deposited on the fabric layer upon layer. Each layer is  $6 \text{ \AA}$  thick [the thickness of the  $(\text{CH}_3)_2\text{SiO}$  group]. How much  $(\text{CH}_3)_2\text{SiCl}_2$  is needed to waterproof one side of a piece of fabric, 1m by 2m, with a film 300 layers thick? The density of the film is  $1.0 \text{ g/cm}^3$ .

- (a) 0.63 g (b) 0.36 g  
 (c) 6.3 g (d) 3.6 g

**Answer (a)**

8. Given that at a certain temperature, in 1.5 L vessel, 5.0 mole of A, 7.0 mole of B and 0.1 mole of C are present. Then the value of equilibrium constant for the reaction:  $\text{A} + \text{B} \rightleftharpoons 2\text{C} + \text{heat}$  is about

- (a)  $7.22 \times 10^{-4}$  (b)  $2.31 \times 10^{-4}$   
 (c)  $7.22 \times 10^{-5}$  (d)  $6.11 \times 10^{-4}$

**Answer (b)**

9. An alcohol (A) on dehydration with conc.  $\text{H}_2\text{SO}_4$  at a high temperature yields compound (B). On ozonolysis every molecule of compound (B) yields two molecules of acetaldehyde. Which of the following is the starting alcohol (A)?

- (a) 1- butanol (b) 2- butanol  
 (c) propanal (d) 2-propanol

**Answer (b)**

10. In an experiment with 100 mL 0.1 M solution of Copper Chloride, by mistake 5 gms of a mixture containing equal weights of Tin, Silver, Lead and Calcium, was added. Finally after some time the solution gets completely decolorized. This is mainly due to :

- (a) Silver reacts with Copper Chloride  
 (b) Calcium reacts with Copper Chloride  
 (c) All the metals react with Copper Chloride  
 (d) Only Lead reacts with Copper Chloride forming white precipitate of lead chloride

**Answer (b)**

11. Triclosan ( $C_{12}H_7Cl_3O_2$ ) is an antibacterial and antifungal agent. It is a polychloro phenoxy phenol. It is widely used as a preservative and antimicrobial agent in personal care products such as soaps, skin creams, and deodorants etc. A label on a 200 mL hand sanitizer bottle claims that it contain Triclosan 0.2% w/v. What will be the number of molecules of Triclosan present in the bottle? ( $N_A$  is Avogadro's Number)

- (a)  $1.4 \times 10^{25} N_A$  (b)  $1.4 \times 10^{24} N_A$   
(c)  $1.4 \times 10^{23} N_A$  (d)  $1.4 \times 10^{22} N_A$

Answer (\*)

12. Suppose that A and B forms compound  $B_2A_3$  and  $B_2A$ . If 0.05 mole of  $B_2A_3$  weighs 12 g and 0.1 mole of  $B_2A$  weighs 10 g, what are the atomic weight of A and B respectively?

- (a) 70 and 25 (b) 50 and 20  
(c) 40 and 30 (d) 30 and 40

Answer (\*)

13. If in a wheat mutant, the length of chromosome 1B was found to be  $6.7 \mu\text{m}$  instead of  $5.0 \mu\text{m}$ , approximately how many additional base pairs are incorporated in the mutant chromosome?

- (a)  $0.5 \times 10^4$  bp  
(b)  $5 \times 10^4$  bp  
(c)  $1.7 \times 10^4$  bp  
(d)  $5.78 \times 10^4$  bp

Answer (a)

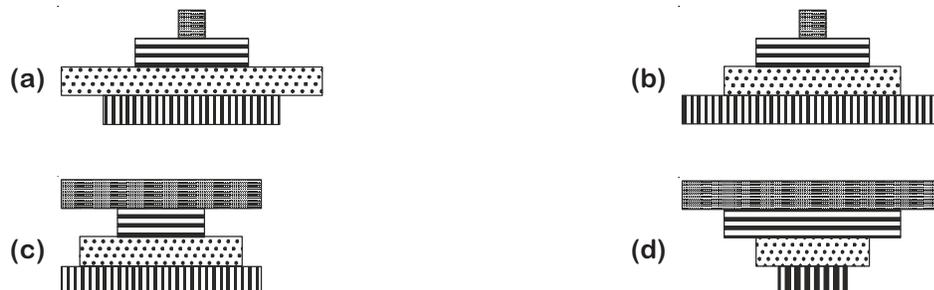
14. Considering following characteristics, identify the correct inheritance pattern from the given options.

- Most affected individuals are male.
- Affected sons result from female parents who are either affected or who are known to be carriers because they have affected brothers, fathers, or maternal uncles.
- Affected daughters are born to affected fathers and either affected or carrier mothers.
- The sons of affected mothers should be affected.
- Approximately half the sons of carrier mothers should be affected.

- (a) Autosomal Recessive Inheritance (b) Autosomal Dominant Inheritance  
(c) Sex-Linked Recessive Inheritance (d) Sex-Linked Dominant Inheritance

Answer (c)

15. In a marine ecosystem with rich diversity of fauna, which of the following images would be a correct representation of pyramid of biomass?



Answer (d)

16. The transpiration pull is maximum under which of the following conditions?

- (a) Closed stomata, low light intensity, humid air
- (b) Open stomata, dry air, moist soil
- (c) Open stomata, dry air, dry soil
- (d) Open stomata, high humidity in air, moist soil

Answer (b)

17. *Curcuma longa*, *Azadirachta indica*, Basmati Rice, Indian Ginseng are all related to which of the following concepts?

- (a) Bioterrorism
- (b) Biomagnification
- (c) Biopiracy
- (d) Biodegradation

Answer (c)

18. Read following criteria carefully.

- Slow evolutionary change relative to similar entities
- Gross similarity to an ancestral fossil
- Very low taxonomic richness today compared to the past
- Phylogenetic inference of specific characters as plesiomorphic
- Phylogenetic inference of genealogical divergence between other groups that diverged in the distant past
- Known in the fossil record before being discovered alive

These criteria can be used to categorize a group of organisms the most probably into

- (a) Connecting links
- (b) Living fossils
- (c) Endangered species
- (d) Extinct species

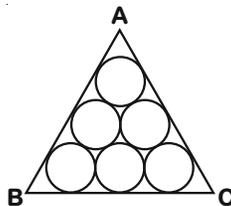
Answer (b)

19. If  $x^2 + ax + b = 0$  and  $x^2 + bx + a = 0$  have one common root, then

- (a)  $a + b = 0$
- (b)  $a + b = 1$
- (c)  $a + b = -1$
- (d)  $a^2 + b^2 = 1$

Answer (c)

20. Six circles each of radius 3 cm are inscribed in an equilateral triangle ABC such that they touch each other and also touch the sides of the triangle as shown in the adjacent figure. Then height of triangle ABC is



- (a)  $6(2\sqrt{3} + 3)$
- (b)  $3(2\sqrt{3} + 6)$
- (c)  $3(2\sqrt{3} + 3)$
- (d)  $6(2 + \sqrt{3})$

Answer (c)

21. Find the remainder when  $x^{51}$  is divided by  $x^2 - 3x + 2$

- (a)  $x$
- (b)  $(2^{51} - 2)x + 2 - 2^{51}$
- (c)  $(2^{51} - 1)x + 2 - 2^{51}$
- (d) 0

Answer (c)

22. If  $\frac{3}{x-2} < 1$ , where  $x$  is a real number, then

- (a)  $2 < x < 5$  (b)  $x < 2$  or  $5 < x$   
(c)  $x < -2$  or  $x > 5$  (d) None of these

Answer (b)

23. If  $100^{25} - 25$  is written in decimal notations, then the sum of its digits is

- (a) 444 (b) 442  
(c) 424 (d) 422

Answer (a)

24. ABC is a triangle, the bisector of angle A meets BC in D. The relation between AD, AB and AC is

- (a)  $AD > \sqrt{AB \cdot AC}$  (b)  $AD > AB \cdot AC$   
(c)  $AD = \sqrt{AB \cdot AC}$  (d)  $AD < \sqrt{AB \cdot AC}$

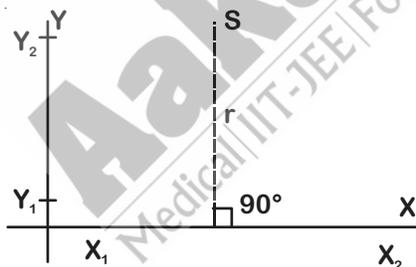
Answer (d)

**PART : A2**

**MORE THAN ONE CORRECT OPTIONS. BUBBLE ALL CORRECT OPTIONS ONLY.**

25. An infinitely long conductor when carrying current  $I$ , produces a magnetic field  $B$  around it. If such a conductor is placed along the X-axis, then the magnitude of  $B$  at a distance  $r$  is given by the relation

$B = \frac{\mu_0 2I}{4\pi r}$ , (where  $\frac{\mu_0}{4\pi} = 10^{-7} \text{ NA}^{-2}$  is a constant). The following figure shows such an infinitely long conductor placed along X-axis carrying current  $I$  and  $B$  at  $S$  is  $2 \times 10^{-4} \text{ T}$ , directed into the plane of the paper at  $S$ . Given  $r = 1 \text{ cm}$ . Then, the correct statements are



- (a)  $I = 10 \text{ A}$   
(b) The number of electrons transported across the cross section of the conductor during time  $1 \text{ s}$  is  $6.25 \times 10^{19}$   
(c) The direction of current  $I$  is from  $X_2$  to  $X_1$   
(d) The electrons will flow in the direction  $X_2$  to  $X_1$

Answer (a, b, c)

26. The ratio of the charge of an ion or subatomic particle to its mass ( $q/m$ ) is called specific charge. Then the correct options are

- (a) SI unit of specific charge can be written as  $\text{A}\cdot\text{s} / \text{kg}$ .  
(b) If all the isotopes of hydrogen are ionized then tritium will have least specific charge among them.  
(c) Specific charge of an  $\alpha$ -particle will be greater than that of an electron.  
(d) Specific charge ratio of an electron is  $1.75 \times 10^{11} \text{ C/kg}$ .

Answer (a, b, d)

27. Acetylene torches and burners used by glassblowers produce intense ultraviolet light. Glassblowers wear special glasses that contain which of the following elements to absorb the UV?
- (a) Neodymium (b) Praseodymium  
(c) Cerium (d) Didymium

Answer (a, b)

28. Equal lengths of magnesium ribbons are taken in four test tubes A, B, C and D. In test tube A, 1M acetic acid is added; in test tube B, 1M HCl is added; in test tube C, 1M HNO<sub>3</sub> is added; and in test tube D, 1M NaOH is added. The observed results will be:
- (a) The fizzing occurs more vigorously in A (b) The fizzing occurs more vigorously in B  
(c) The fizzing occurs more vigorously in C (d) The fizzing occurs more vigorously in D

Answer (b, c)

29. Choose the correct statements from following options.
- (a) A robust adaptive immune response is initiated using weakened forms of the bacterium known as live attenuated vaccines.  
(b) Administration of a killed or chemically inactivated virus can trigger a weaker adaptive immune response, but can be strengthened with booster doses.  
(c) A conjugate or multivalent component always reduces immunogenicity of the vaccine.  
(d) Inclusion of alum, cytokines, and/or lipids always reduces the immune response to a vaccine.

Answer (a, b)

30. The minimum energy required to exist that is the energy required to perform chemical reactions even when a person is at rest is called the *basal metabolic rate* (BMR), which accounts for about 50 to 70 percent of the daily energy expenditure in most sedentary individuals. It is influenced by many factors. Some statements are made about these factors. Choose the correct statements from the following options.
- (a) Thyroid hormone decreases metabolic rate  
(b) Growth hormone increases metabolic rate  
(c) Fever decreases metabolic rate  
(d) Malnutrition decreases metabolic rate

Answer (b, d)

31. If  $0 \leq x \leq \pi$  and  $81^{\sin^2 x} + 81^{\cos^2 x} = 30$ , then  $x =$

- (a)  $\frac{\pi}{6}$  (b)  $\frac{\pi}{3}$   
(c)  $\frac{5\pi}{6}$  (d)  $\frac{2\pi}{3}$

[Useful information :  $\pi^C = 180^\circ$ ,  $\sin(180 - \theta) = \sin \theta$ ,  $\sin \theta \geq 0$  when  $0 \leq \theta \leq 180^\circ$ ]

Answer (a, b, c, d)

32. Given  $(a - b)^2 + (a - c)^2 = (b - c)^2$ , then which of the following statements are true?
- (a) Equation is valid when  $b = c$  and  $a \neq c$   
(b) Equation is valid when  $a = b$   
(c) Equation is valid when  $a = c$   
(d) Given equation is not valid when  $a, b$  and  $c$  are distinct

Answer (b, c, d)

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