

**ENTRANCE EXAMINATION-2018**  
**B.Sc. (Aeronautics)**

## SET B

ROLL NO. 

B	3	9	2	7	0	6	
---	---	---	---	---	---	---	--

Signature of Invigilator

**Time: 2 Hours****Total Marks: 120**

### Instructions to Candidates

1. Do not write your name or put any other mark of identification anywhere in the OMR Response Sheet. **IF ANY MARK OF IDENTIFICATIONS IS DISCOVERED ANYWHERE IN OMR RESPONSE SHEET, the OMR sheet will be cancelled, and will not be evaluated.**
2. This Question Booklet contains this cover page and a total of **120 Multiple Choice Questions of 1mark each.**
3. Space for rough work has been provided at the beginning and end. Available space on each page may also be used for rough work.
4. There is negative marking in Multiple Choice Questions. For each wrong answer, 0.25 marks will be deducted.
5. **USE OF CALCULATOR IS NOT PERMITTED.**
6. **USE/POSSESSION OF ELECTRONIC GADGETS LIKE MOBILE PHONE, iPhone, iPad, pager ETC. is strictly PROHIBITED.**
7. Candidate should check the serial order of questions at the beginning of the test. If any question is found missing in the serial order, it should be immediately brought to the notice of the Invigilator. No pages should be torn out from this question booklet.
8. Answers must be marked in the OMR response sheet which is provided separately. OMR Response sheet must be handed over to the invigilator before you leave the seat.
9. The OMR response sheet should not be folded or wrinkled. The folded or wrinkled OMR/response Sheet will not be evaluated.
10. Write your Roll Number in the appropriate space (above) and on the OMR Response Sheet. Any other details, if asked for, should be written only in the space provided.
11. There are four options to each question marked A, B, C and D. Select one of the most appropriate option and fill up the corresponding oval/circle in the OMR Response Sheet provided to you. The correct procedure for filling up the OMR Response Sheet is mentioned below.
12. **Use Black or Blue Ball Pen** only for filling the ovals/circles in OMR Response Sheet. Darken the selected oval/circle completely. If the correct answer is 'B', the corresponding oval/circle should be completely filled and darkened as shown below.

**CORRECT METHOD**

Ⓐ ● Ⓒ Ⓓ

### WRONG METHOD

WRONG METHOD																			
(A)	X	(C)	(D)	(A)	B	(C)	(D)	A		(C)	(D)	A		(C)	D	A		(C)	

1. A siren emits sound of 1100 Hz. Find the approximate frequency heard by an observer, moving towards the siren, with a velocity of 10 m/s. Assume a temperature of 20° C.

(A) 1130 Hz  
(B) 1170 Hz  
(C) 1200 Hz  
(D) 1220 Hz

2. Particles of air vibrate, as a sound wave of frequency 800 Hz passes by. Temperature of air is 30° C. If the maximum particle velocity is 20 percent of the wave velocity, calculate approximately, the amplitude of particle vibration.

(A) 10 mm  
(B) 14 mm  
(C) 18 mm  
(D) 22 mm

3. A rocket is moving away from Earth, at a speed of 9 km per sec. A 100 kg massive missile is fired from the rocket, parallel to rocket's motion. The velocity of the missile, measured by an observer on Earth, is 34000 km per hour. Find the approximate velocity of the missile, with respect to the rocket observer; (in meter per second).

(A) 240  
(B) 340  
(C) 440  
(D) 540

FLW

4. An ac circuit carries a current, given by  $I = A \sin(wt) + B \cos(wt)$ ;  $A = 1$  milli amp,  $B = 2$  milli amp,  $w = 471$  rad/s,  $t$  is in sec. Find (in mA) the approximate peak value of the current, in the circuit.

(A) 0.3  
(B) 0.4  
(C) 0.5

(D) None of the above

5. In an L R C circuit, the SI values of L, R and C are 2 units each. The circuit is subjected to sinusoidal voltage, of frequency 70 Hz, with peak voltage of 300 volt. Calculate approximately the peak value of current in the circuit.

(A) 0.35 mA  
(B) 0.45 mA  
(C) 0.55 mA  
(D) None of the above

$$V = IR$$

$$I = \frac{V}{R} = \frac{300}{2} = 150$$

0.15 A = 150 mA

6. Consider an L C circuit subject to sinusoidal voltage of frequency  $f = 50$  Hz. Let SI values of L, C be 10 units each. For 2 percent increase in  $f$ , the impedance in the circuit will

(A) Not change  
(B) Increase by nearly 2 percent  
(C) Decrease by about 2 percent  
(D) Increase by about 1 percent

$$1 \times \sin \pi/4 + 2 \cos \pi/4$$

$$1 \times \frac{1}{\sqrt{2}}$$

$$\frac{1}{\sqrt{2}} + \frac{2}{\sqrt{2}}$$

$$\frac{3}{\sqrt{2}}$$

$$17 \frac{1}{1.7} = 10$$

7. Ratio of electrostatic to gravitational force between an electron and a proton, 1 mm apart, is denoted by  $\alpha$ . Then  $\log_{10} \alpha$ , is about

(A) 37  
(B) 39  
(C) 42  
(D) 45

$$1 \text{ mm} = 1000000$$

5

8. Speed of red light and blue light are same

(A) In glass but not in vacuum  
(B) Neither in glass nor in vacuum  
(C) Both in glass and vacuum  
☒ (D) In vacuum but not in glass

9. A distance of 1 mm is equal to 1 million nano meter. Focal length of a normal eye is about

(A) 1 nano meter  
(B) 10 nano meter  
(C) 100 nano meter  
☒ (D) None of the above

10. Rays of different colour, after going through a convex lens, do not exactly converge at a single point. This phenomenon is called

(A) Spherical aberration  
☒ (B) Chromatic aberration  
(C) Coma  
(D) None of the above

$$\beta = \frac{\lambda d}{D}$$

11. Inverse square law for intensity of light is valid for

(A) Point source only  
(B) Line source only  
(C) Plane source only  
(D) All sources

12. Young double slit arrangement is immersed in water.

(A) Fringe width will remain same  
☒ (B) Fringe width will increase  
(C) Fringe width will decrease  
(D) There will be no fringes

13. The wavelength span of visible light, in air is an interval of 300 nm (i.e. 400 nm to 700 nm). In water, the corresponding interval will be about

(A) 225 nm  
(B) 250 nm  
(C) 270 nm  
(D) 280 nm

14. Find the minimum thickness of a film (held in air), which will strongly reflect, light of wavelength 589 nm. The refractive index of the film is 1.25.

- (A) 110 nm
- (B) 114 nm
- (C) 118 nm
- (D) 122 nm

$$\frac{E}{\lambda \mu t}$$

15. Phenomenon of beats may take place for

- (A) Longitudinal waves only
- ☒ (B) Transverse waves only
- (C) Only ultrasonic waves
- (D) None of the above

$$\begin{array}{r} 7.1 \\ 7 \overline{) 50} \\ \underline{49} \\ 10 \end{array}$$

$$\frac{50}{0.7 \times 10}$$

16. A microphone of cross sectional area of 0.7 sq cm is placed in front of a small speaker, emitting 5 watt of sound output. If the distance between the speaker and the microphone is 2.5 meter, approximately calculate the energy falling on the microphone, in 10 sec.

- (A) 400 erg
- (B) 440 erg
- (C) 480 erg
- (D) 520 erg

17. Excess pressure inside soap bubble A is twice the excess pressure inside another soap bubble B. The ratio of volumes of bubble A and B is

- (A) 0.115
- (B) 0.125
- (C) 0.135
- (D) 0.145

$$P_1 = 2\sqrt{2} \quad P_2 = \sqrt{2}$$

$$P = \frac{4\pi}{R_1} \quad 2 \frac{4\pi}{R_2}$$

2

18. Rain drops falling to earth acquire uniform velocity, due to

- (A) Their negligible weight
- (B) Surface tension
- ☒ (C) Viscosity of air
- (D) None of the above

19. Tangent galvanometer is governed by the equation;  $I = K \tan x$ . In a particular measurement, it is found that  $x = 44^\circ$ , with a possible error of  $0.2^\circ$ . The corresponding value of  $I$  is known to be 2 mA; with a possible error of 0.1 mA. calculate approximately the expected percentage error in the calculated value of the parameter  $K$ .

- (A) 6
- (B) 9
- (C) 12
- (D) 15

20. The following is not a unit of electric flux

- (A) V m
- (B) J m / C
- (C) W m / A
- (D) A m / W

21. Isotopes of copper are found with atomic masses 63 and 65; their respective abundances being 69 and 31 percent. Approximately calculate the average atomic mass of copper.

(A) 63.6  
(B) 63.7  
(C) 63.8  
(D) 63.9

$$\frac{63 \times 69 + 65 \times 31}{100}$$

$$\begin{array}{r} 4 \overline{) 6.4611} \\ \underline{4} \phantom{00} \\ 2.46 \end{array}$$

22. Approximately calculate the number of moles in 6.46 gm of helium gas.

(A) 1.5  
(B) 1.6  
(C) 1.7  
(D) 1.8

23. Atomic mass of Lithium is 7. Lithium reacts with water to produce LiOH. In the reaction, hydrogen gas is also produced. Approximately calculate the amount of Li required to produce 9.9 gm of hydrogen.

(A) 64 gm  
(B) 66 gm  
(C) 68 gm  
(D) 70 gm

22509

2200

24. What is the oxidation number of nitrogen in nitric acid?

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

N

HNO<sub>3</sub>, NOOH

3  
94  
8  
592

25. To neutralize one mole of sulfuric acid; how many moles of sodium hydroxide are required?

(A) 1  
(B) 2  
(C) 0.5  
(D) None of the above

$$\begin{array}{r} 0.8 \\ 74 \overline{) 640} \end{array}$$

$$\begin{array}{r} 69 \\ 74 \end{array}$$

$$1 \text{ atm} = 74 \text{ cm}$$

$$\frac{1}{74} \times 69$$

26. Pressure of a gas sample is measured by a mercury barometer. The barometer shows a pressure reading of 69 cm of mercury. This pressure is about

(A) 70 % of atmospheric pressure  
(B) 80 % of atmospheric pressure  
(C) 90 % of atmospheric pressure  
(D) 1.1 times of atmospheric pressure

27. An inflated helium gas balloon of volume 0.55 litre at 1 atm pressure rises to a height of 6 km above sea level. Where the pressure is reduced to 0.4 atm. If temperature is assumed to be same (as that at sea level), approximately calculate (in litre), the new volume of the balloon.

(A) 0.75  
(B) 0.95  
(C) 1.15  
(D) None of the above

$$V_2 = \frac{0.55}{0.4} = 1.375$$

$$\frac{V_1}{V_2} = \frac{P_2}{P_1}$$

$$\frac{0.55}{V_2} = \frac{1}{0.4}$$

$$V_2 = \frac{0.55 \times 0.4}{1} = 0.22$$

$$V = \frac{1}{P}$$

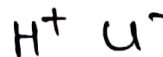
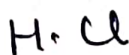
$$4 \overline{) 5.5} \\ \underline{4} \\ 1.50$$

28. Approximately calculate the density (in gm / litre), of carbon dioxide at 0.99 atm, at a temperature of 55°C.  
 (A) 1.6  
 (B) 1.5  
 (C) 1.4  
 (D) 1.3
29. Approximately calculate the rms speed (in km / sec ), of helium gas atoms at room temperature  
 (A) 1.1  
 (B) 1.4  
 (C) 1.7  
 (D) 2.1
30. A certain gas isothermally expands from an initial volume of 2 L, to a volume of 6 L; against a constant pressure of 1.2 atm. Approximately calculate the work done by the gas.  
 (A) 410 J  
 (B) 450 J  
 (C) 490 J  
 (D) 520 J
31. Sulfur has atomic mass 32. Its dioxide reacts with oxygen to become sulfur trioxide. Heat released in the reaction is 99 kJ, for each mole of dioxide consumed. Approximately calculate the amount of heat evolved, if 75 gm of sulfur dioxide is consumed in a particular reaction.  
 (A) 85 kJ  
 (B) 95 kJ  
 (C) 105 kJ  
 (D) 115 kJ
32. One mm distance is equal to a million nm. Use Bohr theory to approximately calculate (in nm), the wavelength of a photon, emitted in the transition in H atom, from  $n = 5$  to  $n = 2$  level.  
 (A) 430  
 (B) 480  
 (C) 520  
 (D) 540
33. What is the total number of orbitals associated with the principal quantum number  $n = 3$ ?  
 (A) 6  
 (B) 9  
 (C) 12  
 (D) 18
34. The bond in HCl is  
 (A) Ionic  
 (B) Covalent  
 (C) Polar covalent  
 (D) Metallic

$$1.2 \times 3 \quad (3.6)$$

$$n=3$$

$$\begin{matrix} s & p & d \\ \textcircled{1} & \textcircled{3} & \textcircled{5} \end{matrix}$$



35. x rays of wavelength  $\lambda$  strike an ionic crystal; the rays are reflected at an angle of  $30^\circ$  with the crystal plane. Let  $n = 1$  (order of x ray diffraction). If interplanar spacing in the crystal is denoted by  $R$ , calculate the value of

a.

- (A)  $0.25 R$
- (B)  $0.5 R$
- (C)  $0.75 R$
- (D)  $R$

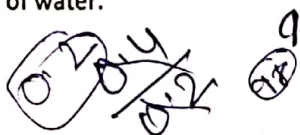
36. A sample of 1.5 gm of common salt is dissolved in 48.5 gm of water, at room temperature. Calculate the percent by mass, of the salt in the solution.

- (A) 0.5
- (B) 1
- (C) 2
- (D) 3

$$\frac{1.5}{50} \quad \frac{1.5}{50} \quad \frac{1.5}{50} \quad \frac{1.5}{50} \quad 800 \overline{) 150} \quad 0.0$$

37. Atomic mass of sulfur is 32. Approximately calculate the molality of a sulfuric acid solution, containing 25 gm of sulfuric acid in 200 gm of water.

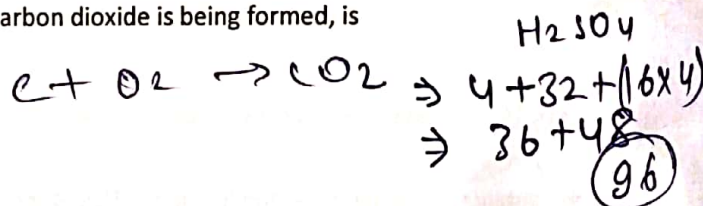
- (A) 1.1
- (B) 1.3
- (C) 1.6
- (D) 1.7



$$\frac{1.5}{10} \times 100 \quad 800 \overline{) 150} \quad 0.3$$

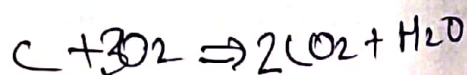
38. Carbon reacts with oxygen gas to form carbon dioxide. At a particular moment, during the reaction, oxygen is disappearing at the rate  $R$ . The rate, at which carbon dioxide is being formed, is

- (A)  $R$
- (B)  $2 R$
- (C)  $R/2$
- (D)  $0.25 R$



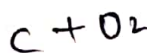
39. The decomposition of ethane to methyl radicals is a first order reaction, with a rate constant of  $0.032 / \text{minute}$ , at  $700^\circ \text{C}$ . Approximately calculate (in minutes), the half life of the reaction.

- (A) 14
- (B) 18
- (C) 22
- (D) 25



40. In the decomposition of calcium carbonate, the gas evolved is

- (A)  $\text{CO}$
- (B) Oxygen
- (C) Carbon di oxide
- (D) None of the above



41. For spontaneous process, free energy change

- (A) Is zero
- (B) Is necessarily negative
- (C) Is necessarily positive
- (D) May be positive or negative

$$16 \times 96500 \text{ C} = 1 \text{ F}$$

42. Corrosion means deterioration of a metal by

- (A) Heating
- (B) Cooling
- (C) Bending
- (D) ~~Electrochemical process~~

43. The magnitude of one faraday (in kilo coulomb) is about

- ~~(A) 96~~
- (B) 98
- (C) 99
- (D) 90

44. As atomic mass increases, the reactivity of halogens

- (A) Remains same
- ~~(B) Decreases steadily~~
- ~~(C) Increases steadily~~
- (D) First decreases then increases

45. The number of transition elements is about

- (A) 10
- ~~(B) 20~~
- (C) 30
- (D) 50

46. In a particular alkane molecule, the number of H atoms is 114. Then the number of C atoms in that molecule is

- (A) 52
- (B) 54
- ~~(C) 56~~
- (D) 58

$$\frac{112}{2} = 56$$

47. How many structural isomers may be identified for pentane?

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



48. Functional group in alcohol is

- (A) O
- (B) CO
- (C) COOH
- ~~(D) None of the above~~

49. Polymers are large molecules made up of small repeating units, called

- ~~(A) Monomers~~
- (B) Isomers
- (C) Functional groups
- (D) None of the above

50. Aqua regia refers to a mixture of nitric acid and

- (A) Sulfuric acid
- (B) HCl
- (C) Common salt
- (D) None of the above

51. Chemical name of laughing gas is

- (A) Nitric oxide
- (B) Sulfur di oxide
- (C) Nitrous oxide
- (D) Methane

52. In a particular solution (at STP), the ratio of  $H^+$  ion concentration to  $OH^-$  ion concentration is 100. What is the pH of the solution?

- (A) 3
- (B) 4
- (C) 5
- (D) 6

53. On dissolution of 114 gm of sucrose (at STP) in 1 kg of water, the vapour pressure of water is found to reduce by 5.6 %, from its initial value. Approximately calculate the molecular weight of sucrose.

- (A) 305
- (B) 320
- (C) 345
- (D) 370

54. Nernst equation relates cell voltage to

- (A) Reagent concentration
- (B) Atmospheric pressure
- (C) Humidity of surroundings
- (D) None of the above

55. Copper sulfate solution is electrolyzed for 7 minutes, with a steady current of 0.6 ampere (at STP). The amount of copper deposited is about

- (A) 1.1 milli mole
- (B) 1.3 milli mole
- (C) 1.5 milli mole
- (D) 1.6 milli mole

56. If concentration ( of reactants and products ) in a chemical reaction , is measured in mole / L and time in sec , what are the units of rate constant of a first order chemical reaction ?

- (A) Inverse of sec
- (B) L / ( mole sec)
- (C) Mole sec / L
- (D) Sec

$$-10 \log 100 \quad 10 \log 10$$

$$Cu^{2+} \\ 2F \rightarrow 1 \text{ mol} \\ 2 \times 96500 \rightarrow 1 \text{ mol} \\ \frac{1}{2 \times 96500} \times 4.2 \text{ mol} \\ \frac{4.2}{2 \times 96500} \text{ mol}$$

$$\frac{\text{mol}}{\text{lit} \times \text{sec}} \Rightarrow \frac{1}{\text{sec}} \left( \frac{\text{mol}}{\text{L}} \right) \frac{\text{mol}}{\text{L}} \times \text{sec}$$

57. Usually near room temperature, rate of a chemical reaction doubles when temperature is

- (A) Increased by 5 degree
- ~~(B) Increased by 10 degree~~
- (C) Decreased by 5 degree
- (D) Decreased by 10 degree

58. One mm is equal to a million nm. Energy of 118.5 kcal / mole is required to ionize Na atoms. Calculate approximately the maximum wavelength of electromagnetic radiation, which may ionize Na atoms.

- (A) 400 nm
- (B) 320 nm
- (C) 240 nm
- (D) 200 nm

59. In the periodic table, as one moves from left to right (in a period), electron affinity will

- (A) Remain same
- ~~(B) Randomly fluctuate~~
- (C) Decrease
- (D) Increase

60. As reducing agent, action of copper is

- (A) As strong as Zn
- (B) Stronger than Zn but weaker than Ni
- ~~(C) Weaker than Zn and Ni both~~
- (D) Stronger than Zn and Ni both

61. The range of the function  $f(x) = 1 + 3 \cos 2x$  is

- (A) All real numbers
- (B) The interval  $[0, 3]$
- (C) The interval  $[1, 3]$
- ~~(D) None of the above~~

62. Let  $f(x) = \sin x$  and  $g(x) = \cos x$ . What is the value of  $f(g(x))$ , for  $x = \text{zero}$ .

- (A) Zero
- (B) 1
- (C) 0.5
- (D) None of the above

63. Limit of  $(\sin x) / x$ , as  $x$  approaches infinity, is

- (A) 1
- ~~(B) Zero~~
- (C) 3.14
- (D) Does not exist

64. How many two digit (positive) integers are divisible by 3?

- ~~(A) 30~~
- (B) 28
- (C) 26
- (D) 24

Handwritten notes for question 60:  
 $1 + 3 \cos 2x$   
 $(1, 4)$   
 Red agent  
 oxid agent

$f(x)$

$\sin(\cos x)$

$\sin(1)$

$\sin(\cos x)$

$\sin(1)$

Handwritten calculations for question 62:  
 $f(0) =$   
 $f(g(0)) = \sin \cos 0$   
 $\frac{\sin x}{x}$

30

Handwritten numbers in circles:  
 93  
 96  
 99

$$\Rightarrow 11^3 + 12^3 + 13^3 \dots 20^3$$

65. Sum of cubes of integers from 11 to 20 (both inclusive) is

- (A) 40025  
(B) 40525  
(C) 41075  
(D) 42225

$$\frac{2+x}{2} = \frac{y+x}{2}$$

$$2+x = \frac{30+x}{1}$$

66. Arithmetic mean of 2 and x is equal to harmonic mean of y and x. If  $y = 30/7$ , find x.

- (A) 12  
(B) 10  
(C) 9  
(D) 8

$${}^{12}C_3$$

$$\frac{12!}{3!9!}$$

$$\frac{2 \times 11 \times 10}{3 \times 2}$$

$${}^{12}C_n = 495$$

$${}^{11}C_n =$$

$$220$$

67. Number of combinations of 12 items, n at a time is 495. Number of combinations of 11 items, n at a time is 165 less. Find n.

- (A) 4  
(B) 3  
(C) 2  
(D) 6

$$\frac{12 \times 11 \times 10 \times 9}{4 \times 3 \times 2}$$

$${}^{12}C_n = 495$$

$${}^{11}C_n = 495 - 165$$

$$\frac{12!}{8!4!}$$

68. The function  $f(x) = \ln(1+x)$ , may be approximated by x, if x is small. If this approximation is used to calculate the value of f(1.06), find approximately the percent error made (in comparison with the exact value of the function).

- (A) 1  
(B) 2  
(C) 3  
(D) 4

$$\frac{12!}{2!10!}$$

$$12 \times 10$$

$${}^{12}C_n - {}^{11}C_n = 165$$

$$\frac{12!}{n!(12-n)!} - \frac{11!}{n!(11-n)!} = 165$$

69. The fifth term of the series of  $\exp(x)$  is 105 times its ninth term. Find x.

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

$$\frac{12 \times 11 \times 10 \times 9}{5 \times 4 \times 3 \times 2}$$

$$\frac{12!}{8!4!}$$

$$\frac{12 \times 11 \times 10}{3 \times 2}$$

$${}^{12}C_3 = \frac{12!}{9!3!}$$

$$22 \times 10 = 220$$

70. Consider the binomial expansion of  $(1+x)$  raised to the fractional power  $1/2$ . The fifth term of the expansion is  $5/64$  times the third term. Find x.

- (A)  $1/4$   
(B)  $1/2$   
(C)  $1/8$   
(D)  $1/16$

$$\frac{12 \times 11 \times 10}{3 \times 2}$$

$$\frac{12!}{9!3!}$$

$$\frac{12!}{6!6!}$$

71. The function  $f(x)$  is defined as the product of  $(x+1)$ ,  $(x+3)$ ,  $(x-2)$  and  $(x-4)$ . The function  $f(x)$  is divided by  $(x-a)$  to yield a remainder equal to 144. The value of a is

- (A) 1  
(B) 3  
(C) 5  
(D) 6

$$\frac{12 \times 11 \times 10 \times 9}{2 \times 3 \times 2}$$

$$\frac{12 \times 11}{2}$$

$${}^{12}C_2$$

$$\frac{12!}{10!2!}$$

$${}^{12}C_n$$

$$\frac{12!}{8!4!}$$

72. The function  $f(x)$  is defined as  $g(x) - 1$ ; where  $g(x)$  is the sum of the first 3 terms of the series expansion of  $\exp(x)$ . The function  $f(x)$  is divided by  $(x + a)$  and the remainder is found to be zero. Find  $a$ .

- (A)  $1/2$
- (B) 1
- (C)  $3/2$
- (D) 2

73. The function  $f(x)$  is square of  $\sin x$ . The period of  $\sin x$  is  $T$ . Then the period of  $f(x)$  is

- (A)  $2T$
- (B)  $3T/2$
- (C)  $T$
- (D)  $T/2$

74. The value of  $\sinh(x)$  is  $3/4$ . Approximately calculate the value of  $x$ .

- (A) 0.9
- (B) 0.7
- (C) 0.4
- (D) 0.3

$$\sinh(x) = 3/4$$

$$\frac{22}{7} \times \frac{142}{180} \approx \frac{11}{450}$$

$$2\pi = 360$$

75. Calculate approximately the number of degrees in an angle of 1.4 radian.

- (A) 65
- (B) 75
- (C) 80
- (D) 95

$$\frac{2\pi \times 1.4}{360} \approx \frac{180}{180}$$

76. Greatest integer function is usually denoted by square brackets  $[ ]$ . Define a function  $f(x)$  such that  $f(x) = [3.5 \cos x] + 1$ . Calculate the value of  $f(x)$  at  $x = \text{zero}$ .

- (A) 4
- (B) 4.5
- (C) 1
- (D) -2.5

77. Let  $i, j, k$  be unit vectors in the usual notation. Define vectors  $a = 2i - 5j$  and  $b = i + j$ . Calculate the magnitude of vector  $c = 2a - 3b$ .

- (A) 5
- (B) 7
- (C) 10
- (D) None of the above

78. Let  $i, j, k$  be unit vectors in the usual notation. Consider vectors  $a = 0.5i + 0.7k$ ,  $b = 4j + k$ ,  $c = i + pj + qk$  where  $p, q$  are real numbers. Find  $p$  such that  $c$  is perpendicular to  $a$  and  $b$  both.

- (A)  $3/28$
- (B)  $4/28$
- (C)  $5/28$
- (D)  $6/28$

$$\frac{12 \times 11 \times 10 \times 9 \times 8 \times 7}{6 \times 5 \times 4 \times 3 \times 2}$$

79. The equation  $n \ln y = \ln x + k$ ; in variables  $x$  and  $y$  ( $n$  and  $k$  being positive constants), represents a parabola for  $n$  equal to

- (A) 1  
(B) 2  
(C) 3  
(D) 4

80. Area of an ellipse is equal to that of a unit circle. Major axis of the ellipse is larger than its minor axis by 25 %. Eccentricity of the ellipse is

- (A) 0.6  
(B) 0.5  
(C) 0.4  
(D) 0.3

81. Let  $a$  denote the positive square root of 2. Write the equation of tangent to a unit circle (with centre at origin), inclined at  $45^\circ$  with positive  $x$  axis.

- (A)  $Y = X$   
(B)  $Y = X + a$   
(C)  $Y = X - a$   
(D)  $Y = -X$

$$a = \sqrt{2}$$

82. The equation  $(y - x + 1)(2y + 2x - 3) = 0$  represents a pair of straight lines

- (A) Parallel to each other  
(B) Intersecting at 30 degree  
(C) Intersecting at 60 degree  
(D) Mutually Perpendicular

$$2 + 2 - 10 + 15 = 0 \\ k = 8$$

83. The planes  $x + 2y + z = 12$  and  $2x - 5y + kz + 5 = 0$ , intersect at angle of  $90^\circ$ . Calculate  $k$ .

- (A) 4  
(B) 6  
(C) 8  
(D) 9

84. Unit sphere centered at the origin is cut by the plane  $2x - 3y + 4z = 1$ . Radius of the circle of intersection is denoted by  $a$ . Then square of  $a$  is equal to

- (A)  $28/29$   
(B)  $27/29$   
(C)  $26/29$   
(D)  $25/29$

85. Let  $f(x)$  denote the square of  $\cos x$  and let  $g(x)$  denote the square of  $f(x)$ . Then  $8g(x)$  may be represented as

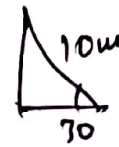
- (A)  $3 + 2 \cos 2x + \cos 4x$   
(B)  $2 - 4 \cos 2x + 2 \cos 4x$   
(C)  $3 - \cos 2x + \cos 4x$   
(D)  $3 + 4 \cos 2x + \cos 4x$

$$f(x) = \cos^2 x \\ g(x) = f(x)^2 \\ \Rightarrow 8(1 - \sin^2 x)(1 - \sin^2 x) \\ 8(1 + \sin^4 x) \\ 8 \times \cos^4 x \\ 8(\cos^2 x)(\cos^2 x)$$

86. A right angled triangle has one of its angles equal to 30 degree. Length of the hypotenuse is 10 cm. The area of the triangle (in square cm) is approximately equal to

(A) 22  
(B) 24  
(C) 26  
(D) 28

$$5 \times 5\sqrt{3}$$



$$\cos 30^\circ = \frac{6}{10}$$

$$\frac{\sqrt{3}}{2} = \frac{6}{10}$$

$$\boxed{5\sqrt{3}}$$

87. A complex number  $z$  is represented in the complex plane by the vector  $OP$  (where  $O$  is origin in the complex plane). The angle between real axis and vector  $OP$  is  $10^\circ$ . Another vector  $OQ$  represents the square of  $z$ . Angle between  $OQ$  and real axis (in degrees) is

(A) 10  
(B) 20  
(C) 90  
(D) 100



$$\cos 30^\circ = \frac{6}{10}$$

$$\frac{\sqrt{3}}{2} = \frac{6}{10}$$

$$\boxed{5\sqrt{3}}$$

88. Matrix multiplication is

(A) Commutative but not associative  
(B) Neither commutative nor associative  
(C) Associative but not commutative  
(D) Commutative as well as associative

89. The system of equations  $3x - 2y + 3z = 8$ ,  $2x + y - z = 1$  and  $5x - y + 2z = 10$  has

(A) A unique solution  
(B) Two possible solutions  
(C) Infinitely many solutions  
(D) No solution

$$\sin 30^\circ = \frac{x}{10}$$

$$\frac{1}{2} = \frac{x}{10}$$

$$\boxed{5\sqrt{3}}$$

$$x = 5$$

90. Let  $I$  denote identity matrix of order 3. Let square of  $I$  be called  $S$  and let the cube of  $I$  be called  $C$ . Then

(A)  $C = I + S$   
(B)  $C = 3I$   
(C)  $2C = 3S$   
(D)  $C = I$

$$5 \times 5\sqrt{3}$$

$$25\sqrt{3}$$

$$25 \times 1.7$$

$$3 \times 25$$

$$75$$

$$1.7$$

$$117.5$$

$$25 \times$$

$$214.25$$

$$2$$

91. Continuity of a function is

(A) Necessary but not sufficient for its differentiability  
(B) Sufficient but not necessary for differentiability  
(C) Neither necessary nor sufficient for differentiability  
(D) Necessary as well as sufficient for differentiability

92. Derivatives of a function  $f(x)$ , of first and second order, both exist in a given interval. They are respectively denoted by  $p$  and  $q$ . Let  $p$  be positive and  $q$  be negative, in the interval mentioned. Then, in that interval

(A) Function is increasing and graph is concave  
(B) Function is decreasing and graph is concave  
(C) Function is increasing and graph is convex  
(D) None of the above



93. Consider the graph of  $\sin x$ . The area under the first half cycle of the curve is

- (A) 1 unit
- ~~(B) 2 unit~~
- (C) 0.5 unit
- (D) 1.5 unit

94. Normal to the plane  $2x - 3y + z = 33$  from origin, may be represented as

- (A)  $3x = -2y = 6z$
- (B)  $3x = 2y = -6z$
- (C)  $-3x = -2y = 6z$
- (D)  $3x = 2y = 6z$

95. Use L Hospital rule to evaluate the limit  $y \exp(-x)$ , as  $x$  tends to zero and  $y$  denotes the cube of  $x$ .

- (A) 3
- (B) 4
- (C) 6
- (D) 9

96. Let cube of  $\sin x$  be called  $f(x)$  and let the cube of  $\cos x$  be called  $g(x)$ . The product  $fg$  is integrated with respect to  $x$ , from zero to  $a$ , where  $a$  is one fourth of the period of  $\cos x$ . What is the value of the definite integral?

- (A) 1
- (B)  $1/2$
- (C)  $2/3$
- (D)  $1/4$

97. Consider the function  $f(x) = p + 5x - 10$ , where  $p$  denotes the square of  $x$ . Calculate the average value of this function in the interval  $x = 2$  to  $x = 3$ .

- (A)  $53/6$
- (B)  $52/6$
- (C)  $51/6$
- (D)  $50/6$

98. The differential equation

$3y dx + kx dy = 0$ , is exact if  $k$  is

- (A) 1
- (B) 2
- ~~(C) 3~~
- (D) 4

$$\begin{aligned}
 3y dx + kx dy &= 0 \\
 3y dx &= -kx dy \\
 \frac{dy}{3y} &= \frac{-kx}{-kx} dx \\
 \frac{1}{3} \log y &= -\frac{1}{k} \log x
 \end{aligned}$$

99. Two normal distribution curves are compared. The two peaks occur at the same value of frequency, but curve 1 is broader than curve 2. Let the two standard deviations be called  $s_1$  and  $s_2$  respectively. Then

- (A) The value  $s_2$  is greater than  $s_1$
- (B) The value  $s_1$  is greater than  $s_2$
- (C) The values  $s_1$  and  $s_2$  are equal
- (D) Either value may be greater, depending on circumstances

100. Regression equations (of  $y$  on  $x$  and also of  $x$  on  $y$ ) are found using a given set of values of  $x$  and  $y$  variables. The regression equations are  $2x - 3y + 11 = 0$  and  $4x - 5y + k = 0$ . From the set of given values of  $x$  and  $y$ , the average value of  $y$  is found to be 12. Find the average value of  $x$ .

(A)  $31/2$   
 (B)  $29/2$   
 (C)  $27/2$   
 (D)  $25/2$

101. Let  $a, b, c$  be mutually perpendicular displacement vectors. Then  $(a \times b) \cdot (b \times c)$  has magnitude equal to

(A) That of  $a$   
 (B) That of  $b$   
 (C) That of  $c$   
 (D) Zero

102. Let  $e$  be charge of electron and  $q$  be the charge of proton. The magnitude of  $(eq/2hc)$ , using S.I units, is

(A)  $0.7 \text{ eV}$   
 (B)  $0.07 \text{ eV}$   
 (C)  $0.007 \text{ eV}$   
 (D) None of the above

103. Define "light hour" similar to "light year". The magnitude of "light hour" (in million km) is about

(A) One thousand  
 (B) Ten thousand  
 (C) One million  
 (D) Ten million

$$3 \times 10^8 \times 60 \times 60 \Rightarrow$$

$$108 \times 10^{10}$$

$$10^{12} \times 10^6$$

104. A rectangular plot of land is measured. The sides are found to be of lengths 105 and 76 meters respectively. The expected error in each measurement is one percent. The expected error in area of the plot is

(A) 120 square meter  
 (B) 140 square meter  
 (C) 160 square meter  
 (D) 200 square meter

105. A tiny golden spherical ball of relative density 19 and radius 1 mm is priced at Rs 25. Another spherical ball of gold (of same quality), of radius 2 mm; may be reasonably priced at Rs

(A) 100  
 (B) 200  
 (C) 300  
 (D) 400

$$25\sqrt{2}$$

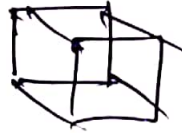
$$\begin{array}{r} 13^3 \\ 105 \\ 26 \\ \hline 630 \\ 805 \\ \hline 8680 \end{array}$$

106. The following is not a unit of electric field

(A) Newton/coulomb  
 (B) Volt/meter  
 (C) Joule / (coulomb meter)  
 (D) (ohm meter)/ coulomb

107. The potential energy function of a particle is  $U(x) = a + bx$ ; where  $a$  and  $b$  are positive constants and  $f$  is square of  $x$ . The graph of  $U$  as a function of  $x$  is

(A) A parabola  
(B) Straight line  
(C) Circle  
(D) None of the above



$$\frac{V}{V} = 1 - \frac{0.5}{1}$$

$$\frac{1}{2} = \frac{V}{V}$$

108. Bernoulli theorem is based on

(A) Conservation of charge  
(B) Conservation of energy  
(C) Hooke's law  
(D) None of the above

109. A wooden cube of volume 100 ml, floats on the surface of water. The relative density of wood is known to be 0.5. The volume of wood outside water is about

(A) 10 ml  
(B) 20 ml  
(C) 40 ml  
(D) 50 ml

110. A particle of mass 1 gm executes SHM, with equation of motion as  $x = a + b \cos(\omega t)$ ; where  $a = 0.7$  meter,  $b = 0.3$  meter,  $\omega = 1.57$  rad/sec,  $t$  is in sec,  $x$  is in meter. Maximum kinetic energy of the particle (in mJ) is about

(A) 0.1  
(B) 0.2  
(C) 0.3  
(D) 0.4

$$x = 0.7 + 0.3 \cos(1.57t)$$

$$0.7 = 0.3 \cos(1.57t)$$

111. A planet has average density equal to that of the Earth, but the value of  $g$  on its surface is 14 SI. Assume that the planet has approximately spherical shape. Its mass is about

(A) Half of mass of Earth  
(B) Double of mass of Earth  
(C) Thrice the mass of Earth  
(D) None of the above

$$G \frac{M}{r^2} = \frac{GM}{r^2}$$

112. The eccentricity of a planet's elliptical orbit is 0.1. The length of major axis of the orbit is  $x$  percent greater than that of minor axis. Approximate value of  $x$  is

(A) 0.3  
(B) 0.5  
(C) 0.7  
(D) 0.9

113.  $\cos(\omega t)$  may be approximated as 1, if  $\omega t$  is small. Let the exact value of  $\cos(\omega t)$  be 0.5. The error made in using the above approximation is about

(A) 1 percent  
(B) 3 percent  
(C) 30 percent  
(D) None of the above

$$v = \frac{d}{t}$$

114. A car travels on a straight road for 10 km, at uniform velocity of 20 km/h. The car then halts for 15 minutes. It then travels a further distance of 45 km; at a uniform velocity of 30 km/h. find the average velocity during the whole journey, in km/h.

(A) 12  
(B) 24  
(C) 36  
(D) 48

$$\frac{10 \text{ km}}{20 \text{ km/h}} = 0.5 \text{ h}$$

$$\frac{45 \text{ km}}{30 \text{ km/h}} = 1.5 \text{ h}$$

$$\frac{55 \text{ km}}{1.5 \text{ h}} = 36.67 \text{ km/h}$$

$$\frac{10 + 45}{30 + 15 + 90} = 36.67$$

115. A block is accelerating down an inclined plane. The plane makes an angle of  $45^\circ$ , with the horizontal. The downward acceleration of the block has magnitude of  $0.6 \text{ g}$ . Approximately calculate the coefficient of friction, between the block and the incline.

(A) 0.15  
(B) 0.25  
(C) 0.35  
(D) 0.45

$$\frac{55}{2 + 1 + 6} = 5.5$$

$$\frac{10 + 45}{\frac{1}{2} + \frac{1}{4} + \frac{3}{2}} = 55 \times 4 = 220$$

$$\frac{10 + 45}{0.5 + 0.25 + 1.5} = 36.67$$

116. A simple pendulum has amplitude of  $5^\circ$ . The approximate angular displacement, of the pendulum bob (from its mean position) where its speed is 80 percent of its maximum speed; is about

(A) 2 degree  
(B) 3 degree  
(C) 5 degree  
(D) 7 degree

$$\sqrt{\frac{2}{1.8}} = 1.05$$

$$\frac{55 \times 4}{9} = 24.4$$

$$n \sin \theta = \frac{v}{m}$$

117. A metal sample is heated from  $50^\circ \text{C}$  to  $70^\circ \text{C}$ . Its resistance will

(A) Not change  
(B) Increase by 100 percent  
(C) Decrease by 10 percent  
(D) None of the above

118. A sound wave of frequency 400 Hz and speed 360 m/s is travelling in air. Approximately how far apart are two points of the medium, differing in phase by  $45^\circ$ ?

(A) 44 cm  
(B) 22 cm  
(C) 11 cm  
(D) 6 cm

119. A string fixed at both ends is 12 meter long and has a mass of 15 gm. It is subjected to a tension of 60 N and set vibrating. What is the approximate speed of a wave, travelling along the string, with the longest possible wavelength?

(A) 80 m/s  
(B) 100 m/s  
(C) 120 m/s  
(D) 220 m/s

$$v = \sqrt{\frac{T}{\mu}}$$

120. Spherical sound waves are emitted in all directions uniformly, by a point source radiating 250 watt. What is the approximate magnitude of intensity (in SI), at 20 meter from the source?

(A) 0.05  
(B) 0.10  
(C) 0.15  
(D) 0.20