

Indian Institute of Technology Madras Zanzibar Screening Test (IITM ZST)

Total Marks: 60 Time: 3 hours

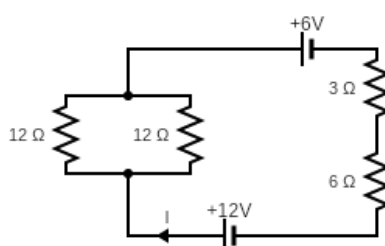
There is no negative marking.

Chemistry

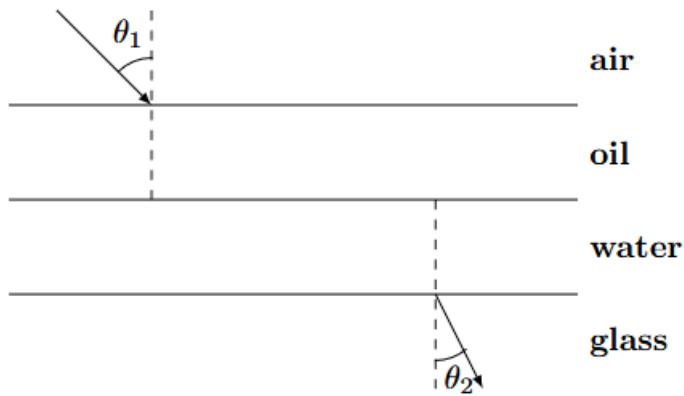
- [1 Mark]** Which of the following electronic configurations represents an atom in an excited state?
 - $1s^2 2s^2 2p^1$
 - $1s^2 2s^2 2p^2 3s^1$
 - $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^{10}$
 - $1s^1$
- [1 Mark]** Which among the following is the most acidic hydrocarbon?
 - C_3H_4
 - C_2H_2
 - C_4H_6
 - C_2H_4
- [1 Mark]** First ionization enthalpy for an element X is defined as the enthalpy associated with the reaction $X(g) \rightarrow X^+(g) + e^-$. The correct order of first ionization enthalpy for the given elements is:
 - $Li > Ne > Na > K$
 - $Ne > Li > Na > K$
 - $K > Na > Ne > Li$
 - $K > Na > Li > Ne$
- [1 Mark]** Density of an ideal gas at 300 K and 1 atm pressure is 1.1 g/L. The density of the same gas at 450 K and 2 atm pressure is
 - 0.68 g/L
 - 1.1 g/L
 - 1.47 g/L
 - 1.63 g/L
- [1 Mark]** The hybridization and geometry in SF_6 are
 - sp^3d^2 , Square Pyramidal
 - d^2sp^3 , Octahedral
 - sp^3d^2 , Octahedral
 - d^2sp^3 , Square Pyramidal

Physics

6. **[1 mark]**: A 2 kg object moving at 10 m/s collides with a stationary 3 kg object. After the collision, the two stick together and slide 4 m across a rough surface (coefficient of kinetic friction is 0.3). Their speed immediately after the collision and the total work done by the friction, respectively, are: Ignore air resistance and use $g = 10 \text{ m/s}^2$.
- 4 m/s, 60
 - 6 m/s, 90 J
 - 8 m/s, 115.5 J
 - 10 m/s, 150 J
7. **[1 mark]**: An electric circuit consists of four resistors and two emf sources. The electric current flows in the circuit, as shown in the figure below is _____



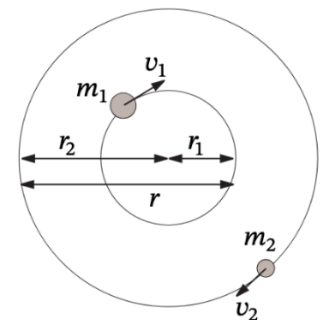
8. **[1 mark]**: In a measurement system, time t is measured using angular momentum L , speed v and mass m . Which of the following expressions can be used to measure the t . Here, a is a dimensionless constant.
- $t = a \sqrt{\frac{LG}{v^5}}$
 - $t = a \sqrt{\frac{Lv^5}{G}}$
 - $t = a \sqrt{\frac{LG}{v^3}}$
 - $t = a \sqrt{\frac{Lv}{G}}$
9. **[1 mark]**: A person of mass m is sitting inside a satellite. The satellite is revolving the earth at a height h from the surface of the Earth. Then, which of the following statement(s) is (are) correct?
- The person feels his/her weight to be $\frac{GMm}{(R+h)^2}$, where R is the radius of the Earth and M is the mass of the Earth.
 - A person feels heavier than on Earth.
 - A person feels no weight inside the satellite.
 - A person on Earth sees zero acceleration for the person inside the satellite.
10. **[1 mark]**: A monochromatic (single wavelength) light passing through air is incident on an oil surface at an angle θ_1 . Thereafter, it passed through water and emerged at an angle θ_2 in a glass medium, as shown in the figure. Given the refractive indices of oil, water and glass are 1.2, 1.3, 1.5 respectively what is the value of angle θ_2 ?



- $\sin^{-1} \left[\frac{\sin \theta_1}{2.34} \right]$
- $\sin^{-1} \left[\frac{\sin \theta_1}{1.50} \right]$
- $\sin^{-1} \left[\frac{1}{0.615} \right]$
- $\sin^{-1} \left[\frac{\sin \theta_1}{4} \right]$

11. [1 mark]: An object is placed in front of a lens such that a real inverted image of half the size is formed at a distance 15 cm away from the lens. The focal length of the lens (in cms) is _____

12. [2 marks]: Consider that two masses m_1 and m_2 are orbiting in circular paths about a common centre. The radii of the circular paths are r_1 and r_2 , respectively, as shown in the figure. The distance between the masses remains constant at all times. If $m_1 = 2m_2$ then which of the following is(are) true:



- $v_1 = v_2$
- $v_1 = \frac{v_2}{2}$
- For an outside observer, the center of mass is at rest.
- If the time period of m_1 and m_2 is T_1 and T_2 respectively then $T_2 = 2T_1$.

13. [2 marks]: In a simple harmonic oscillation (S. H. M.) which of the following statement(s) is (are) correct?

- Position and acceleration are in phase.
- The phase difference between the velocity and the position is $\frac{\pi}{2}$.
- The frequency of the kinetic energy is twice that of the frequency of the S. H. M.
- The phenomenon "kinetic energy = potential energy" happens twice in one cycle of the S. H. M.

Mathematics

14. [1 Mark] $\lim_{x \rightarrow a} \log(x - a) / \log(e^x - e^a) = \underline{\hspace{2cm}}$.
15. [1 mark] A circle touches the x-axis at (3,0) and passes through (0,5). Its radius is:
a. 5
b. $17/5$
c. 6
d. $17/3$
16. [1 Mark] The value of $\sin(\tan^{-1}(\frac{3}{4}))$ is
a. $4/5$
b. $3/5$
c. $3/4$
d. $5/3$
17. [1 Mark] The value of $\int_0^1 \frac{x}{(1+x^2)^2} dx$ is
a. 1
b. $1/2$
c. $1/3$
d. $1/4$
18. [1 Mark] The value of $\int_{-1}^1 \frac{\cos^{-1}x}{\sqrt{1-x^2}} dx$ is
a. π^2
b. $\frac{\pi^2}{2}$
c. $\frac{\pi^2}{3}$
d. $\frac{\pi^2}{4}$
19. [1 Mark] Which of the following are the mean, median, and mode of the dataset given by : {4, 7, 7, 10, 12}.
a. Mean = 8, Median = 7, Mode = 7
b. Mean = 8, Median = 8, Mode = 7
c. Mean = 7, Median = 7, Mode = 10
d. Mean = 8, Median = 8, Mode = 10
20. [1 Mark] Two independent events A and B have probabilities 0.3 and 0.4, respectively. What is the probability that both events occur?
a. 0.07
b. 0.12
c. 0.15
d. 0.20
21. [2 Marks] A motor boat takes the same amount of time to travel 36 km upstream as it does to travel 60 km downstream. If the speed of river's current is 4km/h, then the speed of the boat (in km/h) in still water is _____.

22. **[2 Marks]** A point P in the plane divides the line segment joining $A = (2,3)$ and $B = (8,7)$ in the ratio 2:3. The coordinates of P are
- (4,5)
 - (5, 4)
 - (22/5, 23/5)
 - (19/5, 21/5)
23. **[2 Marks]** Three Vectors $2i - j + dk$, $i + dj - k$, and $di + j + 2k$ are coplanar if d equals:
- 0
 - $1 + \sqrt{3}$
 - $1 - \sqrt{3}$
 - 2
24. **[2 Marks]** If X, Y, Z are three points in the three dimensional space, with coordinates $(1,0,1)$, $(1,1,2), (-1, -2,1)$ respectively, and if θ is the angle between XY and XZ , then $\cos \theta$ equals:
- 0
 - 1
 - 1/2
 - 1/3
25. **[2 Marks]** Let X, Y be propositions given by: $X: p \wedge q \rightarrow p$, $Y: p \vee q \rightarrow p \wedge q$. Then, which of the following is true?
- X is not a tautology and Y is a contradiction.
 - X is not a tautology and Y is not a contradiction.
 - X is a tautology and Y is not a contradiction.
 - X is a tautology and Y is a contradiction.
26. **[2 Marks]** In a group of 40 students, 24 play football and 18 play basketball, with 10 playing both. What is the probability that a student who plays basketball also plays football?
- $\frac{1}{2}$
 - $\frac{5}{9}$
 - $\frac{2}{3}$
 - $\frac{3}{4}$
27. **[2 Marks]** How many ways can 6 distinct students be seated in a row if two particular students must not sit next to each other?
- 240

- b. 480
- c. 360
- d. 600

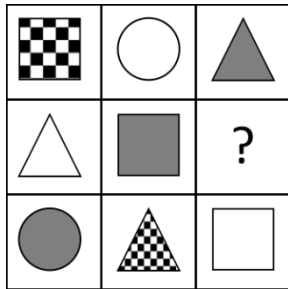
28. **[2 Marks]** Consider the function $f(x) = \max\{1 - x, x + 1, 2\}$ for all x in the real line R . Which of the following statement(s) is/ are true?
- a. f is continuous at all points in R .
 - b. f is continuous at all points except at $x = -1$ and $x = 1$.
 - c. f is differentiable at all points in R .
 - d. f is differentiable at all points in R except at $x = -1$ and $x = 1$.

29. **[2 Marks]** The limit: $\lim_{n \rightarrow \infty} \left(\frac{1}{n+1} + \frac{1}{n+2} + \dots + \frac{1}{2n} \right)$ equals

- a. $\log 2$
- b. $\log \sqrt{2}$
- c. $\log 3$
- d. $\log \sqrt{3}$

Analytical Ability

30. [1 Mark] Choose the appropriate figure from the options to replace the question mark (?).



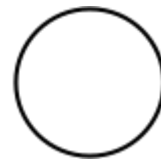
(A)



(B)



(C)



(D)

31. [1 Mark] A man spends 30% of his income on rent, 20% on food, and 10% on transportation. If he saves \$400, what is his total income?

- a. \$1000
- b. \$1200
- c. \$1500
- d. \$2000

32. [1 Mark] Two types of oils one costs \$ 9 per litre and another at \$ 15 per liter. In what ratio the two kinds of oils must be mixed so that mixture may cost \$ 10.2 per liter?

- a. 2:1
- b. 3:1
- c. 4:1
- d. 5:1

33. [1 Mark] In the sequence 6, 9, 14, x, 30, 41, a possible value of x is

- a. 25
- b. 21
- c. 18
- d. 20

34. **[1 Mark]** The following table gives the percentage distribution of population of five states, A,B,C,D and E on the basis of poverty line and also on the basis of sex.

State	Percentage of Population below the Poverty Line	Proportion of Males (M) and Females(F)	
		Below Poverty Line	Above Poverty Line
		M : F	M : F
A	35	5 : 6	6 : 7
B	25	3 : 5	4 : 5
C	24	1 : 2	2 : 3
D	20	3 : 2	4 : 3
E	15	5 : 3	3 : 2

If the male population above poverty line for State A is 2.1 million, then the total population of State A in million is?

- 4.0
 - 7.5
 - 7.0
 - 6.7
35. **[1 Mark]** A train leaves station A at 60 km/h and another leaves station B at 40 km/h towards station A. The distance between the two stations is 300 km. How far from station A will they meet?
- 120 km
 - 150 km
 - 180 km
 - 200 km
36. **[1 Mark]** A number is increased by 20% and then decreased by 20%. What is the net change in the number?
- 4% increase
 - 4% decrease
 - No change
 - 2% decrease
37. **[1 Mark]** Five people (A, B, C, D, E) are at a party. Each is wearing a dress of a different color: red, blue, green, yellow, and purple. Use the following clues to determine who is wearing the green dress:
- A is not wearing red or blue.
 - B is not wearing yellow or purple.
 - C is wearing either green or yellow.
 - D is wearing either blue or purple.

- a. A
- b. B
- c. C
- d. D

38. **[1 Mark]** What is the next letter in the sequence: O, T, T, F, F, S, S, ?

- a. E
- b. N
- c. T
- d. S

39. **[1 Mark]** A rectangular paper sheet of dimensions 54cm x 4cm is taken. The two longer edges of the sheet are joined together to create a cylindrical tube. A cube whose surface area is equal to the area of the sheet is also taken. Then, the ratio of the volume of the cylindrical tube to the volume of the cube is

- a. $1/\pi$
- b. $2/\pi$
- c. $3/\pi$
- d. $4/\pi$

Verbal Aptitude

Q 40-41 To answer the following questions, select the one word that has most likely the same meaning as the italicized word in the context of the sentence.

40. [1 Mark] The newspapers continue to fill their columns with *salacious* gossip.
- Saleable
 - Profound
 - Lecherous
 - Reasonable
41. [1 Mark] We have all been forced to guess about the future plans of the corporation as the CEO has refused to divulge any *germane* insights.
- Relevant
 - Complicated
 - Reticent
 - Immaterial

Q42-43: To answer the following questions, choose the word when substituted for the blank space, best completes the meaning of the sentence.

42. Spycraft insists on meetings to ensure the sanctity of operations.
- Personal
 - Indecorous
 - Clandestine
 - Unsolicited
43. I found him to be an man without adequate cause.
- Pathetic
 - Jealous
 - Irritable
 - Energetic

Common text for Q44-46

Read the below passage and answer the questions that follow:

From Yuval Harari's *Sapiens: A Brief History of Humankind*

During the first half of the twentieth century, scholars taught that every culture was complete and harmonious, possessing an unchanging essence that defined it for all time. Each human group had its own world view and system of social, legal and political arrangements that ran as smoothly as the planets going around the sun. In this view, cultures left to their own devices did not change. They just kept going at the same pace and in the same direction. Only a force applied from outside could change them. Anthropologists, historians and politicians thus referred to 'Samoan Culture' or 'Tasmanian Culture' as if the same beliefs, norms and values had characterised Samoans and Tasmanians from time immemorial.

Today, most scholars of culture have concluded that the opposite is true. Every culture has its typical beliefs, norms and values, but these are in constant flux. The culture may transform itself in response to changes in its environment or through interaction with neighbouring cultures. But cultures also undergo transitions due to their own internal dynamics. Even a completely isolated culture existing in an ecologically stable environment cannot avoid change. Unlike the laws of physics, which are free of

inconsistencies, every man-made order is packed with internal contradictions. Cultures are constantly trying to reconcile these contradictions, and this process fuels change.

44. **[2 Marks]** How would you characterise the scholars' point of view on culture in the first half of the twentieth century, as described in the first paragraph?
- Essentialist
 - Constructionist
 - Primitive
 - Relative
45. **[2 Marks]** According to the author, which is not a true statement about contemporary understanding of culture?
- Cultures try to reconcile internal contradictions.
 - Cultures are constantly mutating.
 - Cultures are attentive to internal and external processes of change.
 - Culture needs to be understood and studied according to scientific principles.
46. **[2 Marks]** Which of the following means the same as *Flux*?
- Exodus
 - Convergence
 - Fluidity
 - Emigration