

## Sample Question

TEST CODE: GEA

**GEA/Test  
1**

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Part I – ten questions	10 x 4 = 40
Part II – twenty questions	20 x 4 = 80
<b>Total marks</b>	<b>120</b>

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### Part I

1. The equation  $(x - 2)^2 + (y - 3)^2 + (x - 2)(y - 3) = 0$  represents a

- |                           |              |
|---------------------------|--------------|
| A) Circle                 | B) Hyperbola |
| C) Pair of straight lines | D) Point     |

2. The equation of the parabola, having focus at  $(3, -4)$  and the line  $3x - 4y + 5 = 0$  as directrix, is

- A)  $16x^2 + 9y^2 + 24xy - 180x + 240y + 600 = 0$
- B)  $16x^2 + 9y^2 - 180x + 240y + 600 = 0$
- C)  $16x^2 = 240y + 600$
- D)  $9y^2 = -180x + 600$

3. Suppose X, Y and Z are three commodities. A packet containing 5, 3 and 7 pieces of X, Y and Z respectively costs ₹ 24.50. Another packet, containing 2, 1 and 3 pieces of X, Y and Z respectively, costs ₹ 17.00. The cost of a packet containing 16, 9 and 23 pieces of X, Y and Z respectively

- A) is ₹ 55.00                      B) is ₹ 75.50                      C) is ₹ 100.00  
D) cannot be determined

4. Let  $A = \begin{pmatrix} 1 & 0 \\ -1 & 1 \end{pmatrix}$  and  $A^2 - 2A + I_2 = 0$ . Then the value of  $A^{50}$  is

- A)  $\begin{pmatrix} 50 & 0 \\ -1 & 1 \end{pmatrix}$                       B)  $\begin{pmatrix} 1 & 0 \\ -1 & 50 \end{pmatrix}$                       C)  $\begin{pmatrix} 1 & 0 \\ -50 & 1 \end{pmatrix}$                       D)  $\begin{pmatrix} 1 & 0 \\ -50 & 0 \end{pmatrix}$

5. The sum of the infinite series  $1 + \frac{1+2}{2!} + \frac{1+2+3}{3!} + \frac{1+2+3+4}{4!} + \dots$  is

- A)  $\frac{3e}{2}$                       B)  $\frac{3e}{4}$                       C)  $\frac{3(e+e^{-1})}{2}$                       D)  $e^2 - e$

6. The value of  $\lim_{x \rightarrow 0} \frac{\sin(\sin x)}{x}$  is

- A) 0                      B) 1                      C) 2                      D)  $\infty$

7. Consider the function  $f(x) = \frac{e^{-|x|}}{\max\{e^x, e^{-x}\}}$ ,  $x \in \mathbb{R}$ , then

- A)  $f$  is not continuous at some points
- B)  $f$  is continuous everywhere, but not differentiable anywhere
- C)  $f$  is continuous everywhere, but not differentiable at exactly one point
- D)  $f$  is differentiable everywhere

8. A curve is drawn such that the slope at a point  $P(x, y)$  is equal to  $x$ . Then the curve represents a family of

- |             |               |
|-------------|---------------|
| A) Circles  | B) Parabolas  |
| C) Ellipses | D) Hyperbolas |

9. Which of the following is the general solution of the differential equation

$$\log_e \left( \frac{dx}{dy} \right) = x + y?$$

- |                       |                          |
|-----------------------|--------------------------|
| A) $e^x + e^{-y} = c$ | B) $e^y + e^{-x} = c$    |
| C) $e^x + e^y = c$    | D) $e^{-x} + e^{-y} = c$ |

10. An integrating factor for the linear differential equation

$$x \cos x \frac{dy}{dx} + y(x \sin x + \cos x) = 1 \text{ is}$$

A)  $x + \sec x$

B)  $x \cos x$

C)  $x \sec x$

D)  $\frac{\sec x}{x}$

### Part II

11. Applying the linear drag force, the equation of vertical projectile motion can be represented as  $dw/dt = -g - kw$ . Assuming,  $w = w_0$  at  $t = 0$ ; vertical motion ( $w$ ) can be expressed as

A)  $w = -(g/k) + [w_0 + (g/k)] \exp(-kt)$

B)  $w = (g/k) + [w_0 + (g/k)] \exp(-kt)$

C)  $w = -(g/k) - [w_0 + (g/k)] \exp(-kt)$

D)  $w = -(g/k) + [w_0 + (g/k)] \exp(kt)$

where,  $g$  = acceleration due to gravity,  $k$  = proportionality constant and  $t$  = time.

12. Suppose a mass  $m$ , begins to slide down a slope of angle  $\alpha$  at a speed  $v$  in the direction  $s$  of the local slope. If the drop of elevation is  $h$ , then the coefficient of friction  $f$  for the avalanche can be expressed as

A)  $f = h/x_{max}$

B)  $f = m/x_{max}$

C)  $f = \alpha/x_{max}$

D)  $f = v/x_{max}$

Assumptions are: Total distance of travel  $x = 0$  to  $x = x_{max}$ ; and  $v = 0$  at  $x = 0$ .

13. Seawater density at near surface (i.e. at  $z = 0$ ,  $\rho = \rho_0$ ) is  $1025 \text{ kg m}^{-3}$ . If the near surface seawater is transferred to a depth ( $z$ ) of 5000 m (without change in temperature) then its density will be

- A)  $1049 \text{ kg m}^{-3}$       B)  $1000 \text{ kg m}^{-3}$       C)  $1500 \text{ kg m}^{-3}$       D)  $1200 \text{ kg m}^{-3}$

Use,  $d\rho/dz = (\rho/k)\rho g$ , where,  $g = 9.81 \text{ m s}^{-2}$ , bulk modulus  $k = 2200000000 \text{ kg m}^{-1}\text{s}^{-2}$  ( $= 2.2 \text{ GPa}$ ).

14. From the data given below the calculated Gibbs free energy of the following reaction  $\text{NH}_3(\text{g}) = \text{NH}_3(\text{aq})$  at  $T = 298.16\text{K}$  will be

- A)  $\Delta G^\circ = - 10.04 \text{ kJ mol}^{-1}$       B)  $\Delta G^\circ = + 10.04 \text{ kJ mol}^{-1}$   
C)  $\Delta G^\circ = - 00.00 \text{ kJ mol}^{-1}$       D)  $\Delta G^\circ = - 11.04 \text{ kJ mol}^{-1}$ .

$\overline{H}_f^\circ$  values for  $\text{NH}_3(\text{g})$  and  $\text{NH}_3(\text{aq})$  is  $- 46.19 \text{ kJ mol}^{-1}$  and  $- 80.83 \text{ kJ mol}^{-1}$  and  $\overline{S}_f^\circ$  values for  $\text{NH}_3(\text{g})$  and  $\text{NH}_3(\text{aq})$  is  $192.5 \text{ kJ mol}^{-1}$  and  $110.0 \text{ kJ mol}^{-1}$ .

15.  $B_{ij}$  is a symmetric strain tensor satisfying the relationship  $A_{ij} + A_{ji} = 2B_{ij}$ . If the

displacement gradient tensor  $A_{ij} = \begin{pmatrix} 5 & 3 & 1 \\ 3 & 7 & 2 \\ 3 & 4 & 3 \end{pmatrix}$ , then  $B_{ij}$  is

A)  $\begin{pmatrix} 5 & 3 & 2 \\ 3 & 7 & 3 \\ 2 & 3 & 3 \end{pmatrix}$

B)  $\begin{pmatrix} 5 & 3 & 2 \\ 3 & 0 & 3 \\ 2 & 3 & 3 \end{pmatrix}$

C)  $\begin{pmatrix} 5 & 3 & 2 \\ 3 & 7 & 3 \\ 2 & 3 & 0 \end{pmatrix}$

D)  $\begin{pmatrix} 0 & 3 & 2 \\ 3 & 7 & 3 \\ 2 & 3 & 3 \end{pmatrix}$

16. Consider the following equation  $k \frac{d^2T}{dy^2} + \rho H = 0$ . Where T is the temperature, k is coefficient of thermal conductivity, y is depth,  $\rho$  is density and H is internal heat production rate per unit mass. At surface  $y = 0$ ,  $T = T_0$  and heat flux  $q = -q_0$ . The temperature distribution profile will be

A)  $T = T_0 + \frac{q_0}{k} y - \frac{\rho H}{2k} y^2$

B)  $T = T_0 + \frac{q_0}{k} - \frac{\rho H}{2k} y^2$

C)  $T = T_0 + \frac{q_0}{k} y - \frac{\rho H}{2k}$

D)  $T = T_0 + \frac{q_0}{k} y$

17. For mean grain diameter  $d = 5 \times 10^{-4}$  m, water density  $\rho = 1000 \text{ kg m}^{-3}$ , fluid viscosity  $\mu = 10^{-3} \text{ kg m}^{-1} \text{ s}^{-1}$ , the Darcy velocity  $q$  in  $\text{m yr}^{-1}$  will be

- A)  $6.3 \times 10^4 \text{ m yr}^{-1}$     B)  $6.3 \times 10^5 \text{ m yr}^{-1}$     C)  $6.3 \times 10^3 \text{ m yr}^{-1}$     D)  $6.3 \times 10^2 \text{ m yr}^{-1}$

The Reynolds number ( $R_e$ ) is specified here as  $R_e = 1$ .

18. Your neighbor drills a well 1000 m away from your well and starts pumping out water from the same aquifer that you rely upon. How long will it be before the disturbance affects your well?

- A) 53 days                      B) 50 days                      C) 60 days                      D) Immediately

Hydraulic diffusivity  $D = 5.44 \times 10^{-2} \text{ m}^2 \text{ s}^{-1}$ .

19. An undeformed sedimentary succession with cyclic deposition of beds having older to younger beds in the sequence A-B-C-D is drilled by several bore holes. Measured core from a bore hole shows at best two omissions in a given cycle with following counts.

Total number of cycles	50
One bed missing	20
Two successive beds missing	05

The joint probability of getting bed D immediately above bed A, and bed A immediately above bed D in a core from an adjacent drill hole is

- A) 0.05                      B) 0.5                      C) 0.25                      D) 0.04

20. Measurement of attitude of hingelines associated with a tight fold is as follows.

4-043; 5-045, 8-041, 7-045, 6-044

The strike of the fold limbs should be in the range

- A) 045 to 090                      B) 038 to 048                      C) 045 to 046                      D) 040 to 043

21. Consider the rock forming minerals quartz, nepheline, feldspar and hornblende. Quartz and nepheline cannot occur together in a rock. How many different rock types with at least two of the above minerals can be formed?

- A)  ${}^4C_2 - 1$                       B)  ${}^4P_2 - 1$                       C)  ${}^4C_2 + {}^4C_3 - 3$                       D)  ${}^4P_2 + {}^4C_3 - 2$

22. Displacement (D) across a symmetric ductile shear zone with uniform shear strain ( $\gamma$ ) and thickness (T) is given by  $\gamma T$ . For a shear zone with continuously varying  $\gamma$ , with  $F(\gamma) = e^t$ ,  $T/2 < t < 0$ , where t is the distance from the shear zone margin, the D value is

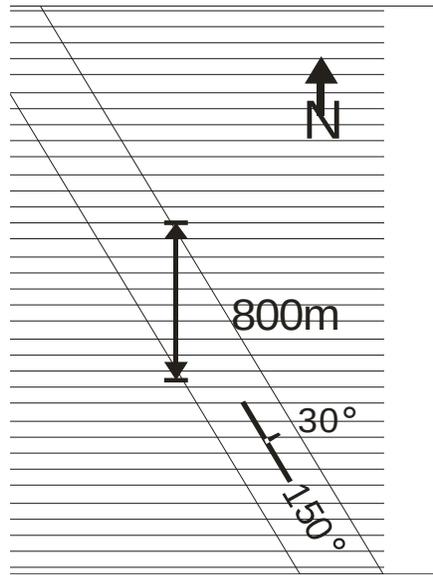
- A)  $(T \cdot e^{T/2}) / 2$                       B)  $T \cdot e^{T/2}$                       C)  $2 (T \cdot e^{T/2})$                       D)  $4 (T \cdot e^{T/2})$

[Assume  $\gamma$  reaches maximum value at the centre of the shear zone]

23. In the  $Al_2SiO_5$  system with coexisting kyanite and sillimanite the degree of freedom is

- A) 0                      B) 1                      C) 2                      D) 3

24. True thickness of a bed shown by hatch symbol in the map view is



- A) 200 m                      B) 300 m                      C) 800 m                      D) 1600 m

25. If the average value for the measurements of length of some unionid shells is 20 cm and the mode of the same is 23 cm, the median value is

- A) 20cm                      B) 21.5cm                      C) 23cm                      D) 63cm

26. If satellite A fitted with a 30deg FOV camera has the same ground swath that of satellite B operating at 200km and fitted with a 60deg FOV camera then at what altitude satellite A is located?

- A) 100km                      B) 400km                      C) 600km                      D) 800km

27. A spherical clastic grain is abraded to a grain of ellipsoidal shape having axial ratios 1:0.5:0.33. if the initial volume of the grain is V, then the volume of the largest possible ellipsoid representing the abraded grain is

- A)  $\frac{1}{2} V$                       B)  $\frac{1}{3} V$                       C)  $\frac{1}{6} V$                       D)  $\frac{1}{36} V$

28. The direction cosines of a paleovector is given by cosines of the respective angle(s) between the vector and the cartesian co-ordinate axes (X,Y,Z), represented by (i,j,k).

Distribution of paleovectors are described by Orientation Tensor Matrix (OTM) whose

elements are defined as follows  $\begin{pmatrix} \sum i^2 & \sum ij & \sum ik \\ \sum ji & \sum j^2 & \sum jk \\ \sum ki & \sum kj & \sum k^2 \end{pmatrix}$ . If all measured vectors lie on the

XY co-ordinate plane then the correct OTM is given by

- A)  $\begin{pmatrix} \sum i^2 & 0 & \sum ik \\ \sum ji & 0 & \sum jk \\ \sum ki & 0 & \sum k^2 \end{pmatrix}$                       B)  $\begin{pmatrix} 0 & 0 & 0 \\ 0 & \sum j^2 & \sum jk \\ 0 & \sum kj & \sum k^2 \end{pmatrix}$
- C)  $\begin{pmatrix} \sum i^2 & 0 & 0 \\ \sum ji & \sum j^2 & 0 \\ \sum ki & \sum kj & 0 \end{pmatrix}$                       D)  $\begin{pmatrix} \sum i^2 & \sum ij & 0 \\ \sum ji & \sum j^2 & 0 \\ 0 & 0 & 0 \end{pmatrix}$

29. Ship A travels along prime meridian from 45° N latitude to the North pole. Another ship B travels along the same meridian from 45° N latitude to the equator. If the distance travelled by ship A is X km and that by ship B is Y km and the polar radius of the earth is shorter than the equatorial radius then

A)  $X = Y$

B)  $X < Y$

C)  $X > Y$

D)  $X = 0.5 Y$

30. If the cross sectional area ( $A$ ) of a productive aquifer is  $1000 \text{ m} \times 50 \text{ m}$ , hydraulic conductivity ( $K$ ) is  $75 \text{ m/day}$  and hydraulic gradient ( $i$ ) is  $0.01$ , then the flow velocity ( $v$ ) and total flux ( $Q$ ) of the groundwater movement will respectively be

A)  $0.75 \text{ m/day}$  and  $37500 \text{ m}^3/\text{day}$

B)  $7.5 \text{ m/day}$  and  $3750 \text{ m}^3/\text{day}$

C)  $75 \text{ m/day}$  and  $375 \text{ m}^3/\text{day}$

D)  $750 \text{ m/day}$  and  $37 \text{ m}^3/\text{day}$