



Rajasthan RVUNL 2021

Mechanical Engineering

Mini Mock Challenge

(April 4th - April 5th 2021)

Questions &
Solutions

1. In the following question, select the related word from the given alternatives.

Palaeontology : Fossil :: Phrenology : ?

- A. Skull
- B. Pancreas
- C. Thyroid
- D. Lungs

Ans. A

Sol. Palaeontology is the study of fossils. Similarly, Phrenology is the study of the size and shape of the skull.

Hence, option A is the correct response.

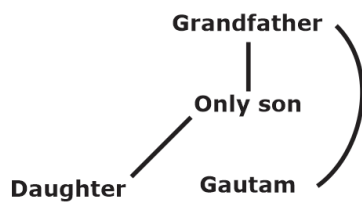
2. Pointing to Gautam, Nandani says, "I am the daughter of the only son of his grandfather."

How Nandani is related to Gautam?

- A. Niece
- B. Daughter
- C. Sister
- D. Cannot be determined.

Ans. C

Sol.



Nandani is the daughter of the only son of Gautam’s grandfather. Hence, it is clear that Nandani is the sister of Gautam.

3. P, Q, R and S are playing carrom. P and R are partners, S and Q are partners. S is sitting to the right of R who faces west, then Q faces which direction?

- A. South
- B. East
- C. West
- D. North

Ans. D

Sol.



Q is facing North.

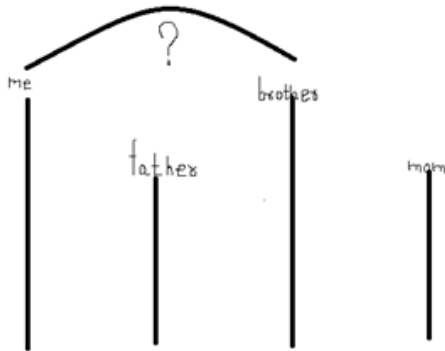
Hence, option D is correct.

4. I am taller than my father, my father is not taller than my brother and my mother is not taller than my brother. Who is the tallest?

- A. me
- B. brother
- C. mother
- D. data inadequate

Ans. D

Sol. Data is incomplete because heights of brother and me are not mentioned.



Hence, option D is the correct answer.

5. Janpad Panchayat works at which level?

- A. Village Level
- B. District Level
- C. Division Level
- D. Block Development Level

Ans. D

Sol. In Madhya Pradesh, **three-tier Panchayati Raj system** is implemented, where **gram panchayat** at **village level**, **janpad panchayat** at **development block level** and **district panchayat** is functioning at the **district level**. Hence the area comes under the **Janpad panchayat** is a **development block**.

6. Three crops that contribute maximum to global food grain production are _____

- A. wheat, rice, barley
- B. rice, maize, sorghum
- C. wheat, maize, sorghum
- D. wheat, rice, maize

Ans. D

Sol. Wheat, rice, maize contribute maximum to global food grain production.

7. Reverse Repo Rate and Base Rate are formulated by _____

- A. SBI
- B. SEBI
- C. RBI
- D. Government of India

Ans. C

Sol. Reverse Repo Rate and Base Rate are formulated by Reserve Bank of India.

Reverse repo rate is the rate of interest at which the RBI borrows funds from other banks in the short term.

Base rate is the minimum rate set by the Reserve Bank of India below which banks are not allowed to lend to its customers

8. Who was the first Indian to be elected as a Member of the British House of Commons?

- A. Jayaprakash Narayan
- B. Dada Bhai Naoroji
- C. Ram Manohar Lohia
- D. Sarojini Naidu

Ans. B

Sol. Dadabhai Naoroji (4 September 1825 – 30 June 1917), known as the Grand Old Man of India, was a Parsi intellectual, educator, cotton trader, and an early Indian political and social leader.

He was a Liberal Party member of parliament (MP) in the United Kingdom House of Commons between 1892 and 1895, and the first Asian to be a British MP.

9. Who was the founder of the Indian Reform Association in 1870?

- A. Debendranath Tagore
- B. Keshub Chandra Sen
- C. Rammohan Roy
- D. Dayanand Saraswati

Ans. B

Sol. The Indian Reform Association was formed on 29 October 1870 with Keshub Chunder Sen as president. It represented the secular side of the Brahmo Samaj and included many who did not belong to the Brahmo Samaj.

10. In respect of which type of bills, the President of India has no veto power?

- A. Money Bills
- B. Constitutional Amendment Bills
- C. Financial Bills
- D. Ordinary Bills

Ans. B

Sol. 1. The **President of India** has **no veto power** in respect of a **Constitutional Amendment Bill**. The **24th Constitutional Amendment Act of 1971** made it **obligatory** for the President to give his **assent** to a Constitutional Amendment Bill.

2. The power of **withholding** a bill sent for assent of the President is called **veto power** of the President. Different type of veto powers have been provided to the President of India by the Indian Constitution which are in the form of **Absolute**, **Suspensive** and **Pocket** veto.

11. The number of parliamentary seats (Lok Sabha) of Maharashtra is _____.

- A. 10
- B. 26
- C. 28
- D. 48

Ans. D

Sol. The number of parliamentary seats (Lok Sabha) of Maharashtra is **48**.

Maharashtra has a bicameral legislature.

The major contenders in the state are the United Progressive Alliance (UPA) and National Democratic Alliance (NDA).

12. Silvassa is the capital of which of the following Union Territory of India?

- A. Daman & Diu
- B. Lakshadweep
- C. Puducherry
- D. Dadra & Nagar Haveli

Ans. D

Sol. **Silvassa** is the capital of the Indian Union Territory of **Dadra and Nagar Haveli**. During Portuguese rule, Silvassa was also known as **Vila de Paço d'Arcos**, after the town of the same name near **Lisbon**.

The city has a large number of **factories** and **industries** providing significant government revenue, which allows the city to maintain a low level of **taxation**.

13. SHINYUU Maitri-18 is a bilateral exercise started in which of the following city?

- A. Noida
- B. Agra
- C. Varanasi
- D. Ghaziabad

Ans. B

Sol. SHINYUU Maitri-18 is a bilateral exercise between India and Japan from .from 03 Dec -07 Dec 18

It is started in **Agra**.

14. In which district of Uttar Pradesh Adani Group have set up a 50 MW solar photovoltaic plant?

- A. Mahoba
- B. RaeBareli
- C. Amethi
- D. Saharanpur

Ans. A

Sol. Infrastructure conglomerate Adani Group had set up **50 megawatts (MW) solar photovoltaic (PV) plant in Mahoba**, Uttar Pradesh.

The plant has been set up with an investment of Rs. 315 crore, under the National Solar Mission Scheme.

15. GEF, an international aid-giving agency has the full form:

- A. Global Economic Fund
- B. Global Educational Fund
- C. Global Environment Facility
- D. Global Energy Fund

Ans. C

Sol. The full form of GEF is **Global Environment Facility**.

The Global Environment Facility (GEF) was established on the eve of the 1992 Rio Earth Summit to help tackle our planet's most pressing environmental problems.

16. What was the theme of the International Women's Day 2019?

- A. Re-Thinking Women's Empowerment and Gender Equality
- B. Think Equal, Build Smart, Innovate for Change
- C. Press for Progress
- D. Equality for Women is Progress for All

Ans. B

Sol. The International Women's Day is celebrated on **8 March every year**.

"Think Equal, Build Smart, Innovate for Change" is the theme of International Women's Day.

17. Krivoy-Rog has rich resources of
- | | |
|--------------|-----------|
| A. Manganese | B. Coal |
| C. Iron-ore | D. Copper |

Ans. C

Sol. Krivoy-Rog has rich resources of Iron ore.
The city is a large industrial center, the center of the Kryvyi Rih iron ore basin.
The total explored reserves of iron ore are over 32 billion tons.

18. Which animal has three eyes in the world?
- | | |
|--------------|---------------|
| A. Octopus | B. Tuatara |
| C. Cockroach | D. Crocodiles |

Ans. B

Sol. **Tuatara animal has three eyes in the world.**

The lizard-like reptile tuatara has a "well-developed parietal eye, with a small lens and retina".

Parietal eyes are also found in lizards, frogs and lampreys, as well as some species of fish, such as tuna and pelagic sharks, where it is visible as a light-sensitive spot on top of their head.

19. Which chemical compound is also known as Pearl Ash?
- | | |
|------------------------|-------------------|
| A. Chromium Trioxide | B. Zinc Phosphide |
| C. Potassium Carbonate | D. None of these |

Ans. C

Sol. **Potassium Carbonate (K_2CO_3)** is known as **pearl ash**.

It is used in making glass, dyes, soap.

It is also used in fire extinguisher and to soften water.

Zinc Phosphide (Zn_3P_2) is used for killing rats.

Chromium Trioxide (CrO_3) is mainly used in chrome plating.

20. Which one of the following catalyst is used for hydrogenation of vegetable oils?
- | | |
|--------------|-----------|
| A. Zinc dust | B. Nickel |
| C. Platinum | D. Copper |

Ans. B

Sol.

21. The ratio of relative velocity of separation after collision to the velocity of approach before collision is called_____.

- | | |
|--|----------------------|
| A. Inelastic collision | B. Elastic collision |
| C. Coefficient of Restitution resilience | D. None of these |

Ans. C

Sol. The **coefficient of restitution** (e) is defined as the ratio of the relative velocity of collision after separation to the relative velocity of approach before collision. The **coefficient of restitution** depends to a large extent on the nature of the two materials of which the colliding objects are made.

It is also affected by the impact velocity, the shape and size of the colliding objects, the location on the colliding objects at which the collision occurs, and their temperatures.

22. If the mass of an object is 60 kgs, what will be its weight on the moon? (N=Newton)

- A. 60N
B. 600N
C. 98N
D. 10N

Ans. C

Sol. Given mass = 60 kg

As we know,

Weight = mass \times acceleration due to gravity

Weight on the earth = $60 \times 9.8 = 588$

On moon the gravity is approx $1/6$ as compared to earth that is $9.8/6 \text{ m/s}^2$

Weight of that object on moon = $588 \times 1/6 = 98 \text{ N}$

23. Which is the primitive gharana of Kathak style of dance?

- A. Lucknow
B. Banaras
C. Jaipur
D. Alwar

Ans. C

Sol. Kathak dance is the classical dance of Rajasthan. This dance originated from Jaipur city of Rajasthan; hence, the Jaipur Gharana is called the primitive / old Gharana of this dance. The originator of this dance was Bhanuji Maharaj. The second / new gharana of this dance is Lucknow. Due to the tradition of performing this dance on auspicious occasion, it is also called Mangal Mukhi dance.

24. Which of the following statements is not correct regarding Mahatma Gandhi Adarsh Gram Yojana?

- A. The scheme was launched on 27 November 2019 to mark the 100th birth anniversary of Mahatma Gandhi.
B. Under this scheme, 1 village in each district is to be selected and developed according to Gandhian values.
C. The objective of this scheme is to develop an atmosphere of goodwill.
D. The main activities of this scheme are population control, child health, establishment of de-addiction society, education and skill training programs, etc.

Ans. A

Sol. The scheme launched on 27 November 2019 to mark the 150th birth anniversary of Mahatma Gandhi. Under this scheme, 1 village in each district to be selected and developed according to Gandhian values. The objective of this scheme is to develop an atmosphere of goodwill. The main activities of this scheme are population control, child health, establishment of de-addiction society, education and skill training programs, etc.

25. Which of the following is not a breed of buffalo?

- A. Murrah
- B. Badawari
- C. Jaffarabadi
- D. Kankarej

Ans. D

Sol. Rajasthan hold the second place in the country in terms of buffalo dynasty. The main breeds of buffalo are Murrah, Badawari, Surti, and Jaffarabadi. Murrah is the best breed of buffalo. The buffalo-breeding center is located in Vallabh Nagar. Kankarej is breed of cow.

26. Who started the publication of a weekly magazine called Naveen Rajasthan?

- A. Vijay Singh Pathik
- B. Hiralal Shastri
- C. Jaynarayan vyas
- D. Pratap Singh Barhat

Ans. A

Sol. The Rajasthan Seva Sangh started a weekly publication from Ajmer called Naveen Rajasthan, whose publisher was Vijay Singh Pathik. Vijay Singh Pathik led the Bijolia and Bengu peasant movement. He is called the father of the peasant movement in India. He founded the Veer Bharat Samaj and edited newspapers like Rajasthan Kesari, Naveen Rajasthan / Tarun Rajasthan, etc.

27. Who was the first ruler of Gurjar-Pratihara dynasty?

- A. Nagabhatta I
- B. Banbhatta
- C. Vasudev
- D. Mihir Bhoj

Ans. A

Sol. Nagabhatta was the first ruler of the first Gurjara Pratihara dynasty and the de facto founder of the Gurjara Pratihara Empire. We get this information from the Aihole inscription of the Chalukya king Pulakeshian II and Harshacharit composed by Banabhatta.

28. Which of the following is not the work and responsibility of Rajasthan Public Service Commission?

- A. Recruitment on vacant posts and newly created posts of all services like administrative, police, accounts, cooperative of the state
- B. Conducting examinations for appointment to state services
- C. To advise the State Government regarding disciplinary action taken against an employee
- D. Recruitment in selected services by promotion

Ans. D

Sol. **Functions and responsibilities of Rajasthan Public Service Commission:**

- i. Recruitment on vacant posts and newly created posts of all services like administrative, police, accounts, cooperative of the state
- ii. Recruitment by promotion in **all services**
- iii. To advise the State Government regarding the policy of transfer, posting, compensation, expenses, etc., for the judicial matter
- iv. The Commission annually sends to the Governor all the details of its various activities, such as recruitment, promotion, seniority, determination, disciplinary proceedings, acceptance of temporary services and other consultancy related works
- v. Conducting examinations for appointment to state services
- vi. To advise the State Government regarding disciplinary action taken against an employee

29. Find the mean of the positive factors of 32

- A. 10.2
- B. 11.2
- C. 10.5
- D. 11.5

Ans. C

Sol. Number of these factors 1, 2, 4, 8, 16, 32 = 6

Sum of these factors = 1 + 2 + 4 + 8 + 16 + 32 = 63

$$\text{Mean} = \frac{\text{sum of factors}}{\text{number of factors}} = \frac{63}{6}$$

Mean = 10.5

30. Raju and Hemu are friends they were both born in 1995, what is the probability that they have same birthday?

- A. $\frac{1}{365}$
- B. $\frac{2}{365}$
- C. $\frac{1}{366}$
- D. $\frac{2}{366}$

Ans. A

Sol. The year 1995 is a non-leap year out of two friends say Raju's birthday can be any day of 365 days in a non-leap year also Hamu's birthday can be any day of 365 days of the same year so the total number of outcomes is = 365, we assume all those 365 outcomes are equally likely.

Let E be the event (Raju and Hemu have the same birthday)

Then the number of favorable outcomes to the event

$$n(E) = 1$$

$$P(E) = \frac{n(E)}{n(S)}$$

$$= \frac{1}{365}$$

31. If $\frac{x^4 + 1}{x^2} = 62$, then what is the value of $x^2 - \frac{1}{x^2}$?
- A. $6\sqrt{35}$ B. $16\sqrt{15}$
C. $36\sqrt{5}$ D. $26\sqrt{45}$

Ans. B

Sol.

$$\frac{x^4 + 1}{x^2} = 62$$

$$x^4 + 1 = 62x^2$$

$$x^2 + \frac{1}{x^2} = 62$$

$$\left(x + \frac{1}{x}\right)^2 = x^2 + \frac{1}{x^2} + 2$$

$$\left(x + \frac{1}{x}\right)^2 = 62 + 2 = 64$$

$$\left(x + \frac{1}{x}\right) = \sqrt{64} = 8$$

$$\left(x - \frac{1}{x}\right)^2 = x^2 + \frac{1}{x^2} - 2$$

$$\left(x - \frac{1}{x}\right)^2 = 62 - 2 = 60$$

$$\left(x - \frac{1}{x}\right) = \sqrt{60} = 2\sqrt{15}$$

Now,

$$x^2 - \frac{1}{x^2}$$

$$= \left(x + \frac{1}{x}\right)\left(x - \frac{1}{x}\right)$$

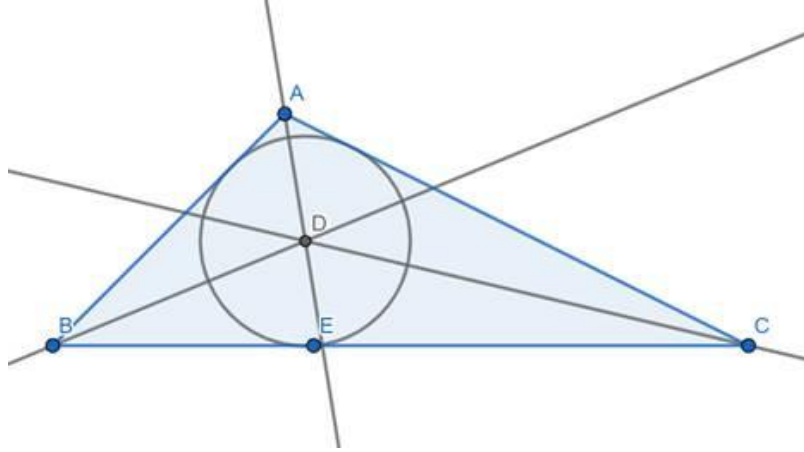
$$= 8 \times 2\sqrt{15}$$

$$= 16\sqrt{15}$$

32. The incenter of a triangle is determined by
- A. altitudes B. angle bisectors
C. medians D. perpendicular bisectors of the sides

Ans. B

Sol. The incenter of a triangle is intersection point of the angle bisector of a triangle.



33. 'खूँटी' शब्द का बहुवचन बताइए?

- | | |
|-------------|------------|
| A. खूँटियाँ | B. खूँटिया |
| C. खूँटियों | D. खूँटिया |

Ans. A

Sol. 'खूँटी' शब्द का बहुवचन खूँटियाँ है

34. उच्च की उत्तरावस्था क्या होगी?

- | | |
|-----------|-----------|
| A. उच्चतम | B. उच्चतर |
| C. ऊँचा | D. उच्चम |

Ans. B

Sol. मूलावस्था - उत्तरावस्था - उत्तमावस्था

उच्च - उच्चतर - उच्चतम

35. भूषण की कविता का प्रधान स्वर है-

- | | |
|-----------------|----------------|
| A. व्यंग्यात्मक | B. प्रशस्तिपरक |
| C. श्रृंगारिक | D. कारुणिक |

Ans. B

Sol. भूषण शिवाजी और छत्रसाल के दरबारी कवि थे। भूषण की कविता का प्रधान स्वर प्रशस्तिपरक था।

36. मगरमच्छ का स्त्रीलिंग है?

- | | |
|-----------------|---------------|
| A. मगरमच्छी | B. मगरमच्छवी |
| C. मादा मगरमच्छ | D. मगरमच्छानी |

Ans. C

Sol. 'मगरमच्छ' का स्त्रीलिंग होता है 'मादा मगरमच्छ'। अन्य सभी विकल्प सही नहीं हैं। अतः इस आधार पर सही विकल्प मादा मगरमच्छ है।

37. **Choose the sentence with correct usage of pronoun:**

- A. These are nice shoes, but they look uncomfortable.
- B. This are nice shoes, but they look uncomfortable.
- C. It are nice shoes, but they look uncomfortable.
- D. Them are nice shoes, but they look uncomfortable.

Ans. A

Sol. Option A is the sentence which uses the correct form of pronoun.

38. **Choose the most appropriate option to change the narration (direct/indirect) of the given sentence.**

- The teacher said, "Be quiet, boys."A. The teacher said that the boys should be quiet.
B. The teacher called the boys and ordered them to be quiet.
C. The teacher urged the boys to be quiet.
D. The teacher commanded the boys that they be quiet.

Ans. C

Sol. Statement A and D are incorrect due to inappropriate usage of connecting verb. In statement B 'called the boys' doesn't make much sense. Hence, statement C is the correct answer.

39. **Identify the best way to improve the underlined part of the given sentence. If there is no improvement required, select 'no Improvement'.**

I ordered tasty two large pizzas for the game.

- A. tasty large two
- B. large tasty two
- C. two tasty large
- D. No improvement

Ans. C

40. **Select the most appropriate option to fill in the blank.**

The show devoted two or three episodes to each novel, while short stories were _____ in a single episode.

- A. made up
- B. concealed
- C. narrated
- D. elucidate

Ans. C

Sol. Made up = invented; not true

Concealed = hidden

Narrated = give a spoken or written account of

Elucidate = explain

The context of the sentence is related to novels and short stories that were aired in a show. With respect to this, 'narrated' is the most suitable word to make the sentence contextually correct.

Hence, option C is the correct answer.

41. Which of the following casting method is used for ornaments and toys of non-ferrous alloys?
- | | |
|----------------------------|------------------------|
| A. Slush casting | B. Die casting |
| C. Permanent mould casting | D. Centrifugal casting |

Ans. A

Sol. The slush casting is a special application involving the used of permanent mould. It is used for casting low melting temperature alloys. This method is only adopted for ornaments and toys of non-ferrous alloys.

42. In PERT, the span of time between the optimistic and pessimistic time estimates of an activity is _____.
- | | |
|--------------|---------------|
| A. σ | B. 3σ |
| C. 6σ | D. 12σ |

Ans. C

Sol. In PERT, for each activity, time estimated are based on β -distribution by which the variance (v), standard deviation (σ).

$$\sigma = \sqrt{\text{variance}} = \frac{t_p - t_o}{6}$$

Thus, Span $t_p - t_o = 6\sigma$

Where: t_p = Pessimistic time

t_o = Optimistic time

43. A bar of 5 m length and area of 1.4 cm^2 is subjected to axial compressive load of 20 kN. The bar is heated to 100°C from 25°C and material has coefficient of expansion $17 \times 10^{-6}/^\circ\text{C}$ and Young's modulus $E = 210 \text{ GPa}$. Find the net change in length of Bar:
- | | |
|----------|----------|
| A. - 3mm | B. 3mm |
| C. 5mm | D. - 5mm |

Ans. B

Sol. Given: axial load (P) = 20 kN (compressive)

Length (L) = 5 m

$\Delta T = 100 - 25 = 75 \text{ }^\circ\text{C}$

$\alpha = 17 \times 10^{-6} /^\circ\text{C}$

$$(\Delta l)_{\text{axial}} = \frac{PL}{AE} = \frac{-20 \times 10^3 \times 5}{1.4 \times 10^{-4} \times 210 \times 10^9} = -3.40136 \text{ mm}$$

$$(\Delta l)_{\text{thermal}} = L \alpha \Delta T = 5 \times 17 \times 10^{-6} \times (100 - 25)$$

$$(\Delta l)_{\text{thermal}} = 6.375 \text{ mm}$$

$$(\Delta l)_{\text{net}} = (\Delta l)_{\text{axial}} + (\Delta l)_{\text{thermal}}$$

$$(\Delta l)_{\text{net}} = -3.40136 + 6.375$$

$$(\Delta l)_{\text{net}} = 2.973 \text{ mm}$$

44. Sensible heat factor is given by _____. (Where S.H. - Sensible Heat, L.H. - Latent Heat).

A. $\frac{S.H.}{S.H. + L.H.}$

B. $\frac{S.H. + L.H.}{S.H.}$

C. $\frac{S.H.}{L.H. - S.H.}$

D. $\frac{L.H. - S.H.}{S.H.}$

Ans. A

Sol. Sensible heat factor = $\frac{\text{Sensible Heat}}{\text{Total Heat}} = \frac{S.H.}{S.H. + L.H.}$

SHF will be 1 for Sensible heating.

45. The fouling factor in heat exchanger is defined as _____.

A. $R_f = U_{\text{dirty}} - U_{\text{clean}}$

B. $R_f = \frac{1}{U_{\text{dirty}}} - \frac{1}{U_{\text{clean}}}$

C. $\frac{1}{R_f} = \frac{1}{U_{\text{dirty}}} - \frac{1}{U_{\text{clean}}}$

D. $\frac{1}{R_f} = U_{\text{dirty}} - U_{\text{clean}}$

Ans. B

Sol. The resistance due to fouling = R_f

$$\therefore \frac{1}{U_{\text{dirty}}} = \frac{1}{U_{\text{clean}}} + \frac{1}{R_f}$$

$$\therefore R_f = \frac{1}{U_{\text{dirty}}} - \frac{1}{U_{\text{clean}}}$$

46. A cylindrical tank with closed ends is filled with compressed air at a pressure of 500 kPa. The inner radius of the tank is 2 m. and it has wall thickness of 10 mm. The magnitude of maximum in-plane shear stress (in MPa) is _____.

A. 12.5

B. 25

C. 30

D. 50

Ans. B

Sol. Given:

radius of the cylinder: $r = 2\text{m}$ i.e. $d = 4\text{m}$

Pressure: $P = 500\text{ kPa}$

Thickness of the cylinder: $t = 10\text{mm}$

Major Principal Stress = hoop stress:

$$\sigma_1 = \sigma_h = \frac{Pd}{2t}$$

Minor Principal Stress = longitudinal stress:

$$\sigma_2 = \sigma_l = \frac{Pd}{4t}$$

Maximum in-plane shear stress:

$$\tau = \frac{\sigma_1 - \sigma_2}{2} = \frac{Pd}{8t} = \frac{500 \times 10^3 \times 4}{8 \times .01}$$

$$\tau = 25\text{MPa}$$

47. Cochran boiler is a _____.
- A. horizontal fire-tube boiler
 - B. horizontal water-tube boiler
 - C. vertical water-tube boiler
 - D. vertical fire tube boiler

Ans. D

Sol. Cochran Boiler is a vertical drum axis, natural circulation, solid fuel fired and fire tube boiler with internally fired furnace.

48. Consider the following statements regarding CI engine:
- (1). CI engine knock can be reduced by increasing compression ratio.
 - (2). Thermal efficiency of a CI engine is lower relative to a SI engine.
 - (3). CI engine has a higher specific output relative to SI engine.
 - (4). CI engines use leaner mixtures relative to SI engines.

Which of following statements is/are correct _____?

- A. 1 and 3 only
- B. 2 and 4 only
- C. 1 and 4 only
- D. 1, 2, 3 and 4

Ans. C

Sol. Increase in compression ratio in CI engine results in increases air temperature and pressure and reduces the delay period hence the knocking phenomenon will get reduced.

A CI engine with a leaner air-fuel ratio always gives a better thermal efficiency, thus these are operated at leaner A/F ratios.

CI engines are heavier than the SI engines, thus they have lower specific power output, while efficiency of CI engines is more.

49. A two-dimensional flow field has velocities along x and y direction given by $u = x^2$ and $v = -2xy$, then equation of streamline is _____.
- A. $x^2y = \text{constant}$
 - B. $xy^2 = \text{constant}$
 - C. $xy = \text{constant}$
 - D. None of the above

Ans. A

Sol. Equation of streamline is given by:

$$\frac{dx}{u} = \frac{dy}{v} = \frac{dz}{w}$$

$$\text{Thus, } \frac{dx}{x^2} = \frac{dy}{-2xy}$$

$$2 \times \frac{dx}{x} = \frac{dy}{-y}$$

Now, on integrating on both the sides:

$$2 \ln x = -\ln y + \ln c$$

$$\ln x^2 y = \ln c$$

On comparison:

$$x^2 y = \text{constant}$$

50. In a single pass hot rolling operation a 400 mm width steel strip having a thickness of 12 mm is reduced to 9 mm by using a roll of 600 mm diameter, then the arm length is ____ mm.

- A. 5mm
B. 12 mm
C. 15mm
D. 20 mm

Ans. C

Sol. Given:

$$\text{Width: } w = 400 \text{ mm}$$

$$h_0 = 12 \text{ mm, } h_f = 9 \text{ mm}$$

$$R = 300 \text{ mm}$$

$$\text{Maximum draft: } \Delta h = h_0 - h_f = 3 \text{ mm}$$

$$\text{Project length: } L_p = \sqrt{R\Delta h} = \sqrt{300 \times 3} = \sqrt{900}$$

$$L_p = 30 \text{ mm}$$

$$\text{Arm length: } a = 0.5 L_p \text{ (for hot rolling)}$$

$$a = 0.5 \times 30$$

$$a = 15 \text{ mm}$$

51. 11 m wide, 31.2 m long and 5.4 m high rectangular barge (weighs 250 kN in air) is immersed in water. If a uniformly distributed load of 1000 kN is applied vertically on the barge, then depth of the barge below the water surface will be _____.

- A. 2.2 m
B. 3.6 m
C. 4.5 m
D. 0.37 m

Ans. D

Sol. Given:

$$W = 250 \text{ kN}$$

$$F_v = 1000 \text{ kN}$$

$$\text{Dimension} = 31.2 \times 11 \times 5.4 \text{ m}^3$$

According to the principle of floatation:

Buoyant force = total downward force

$$\rho_w \times 31.2 \times 11 \times h \times g = 1250 \times 1000$$

$$h = 0.37 \text{ m}$$

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A Technical Course for AEN & JEN (Mechanical)

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52. For arc welding current $I=500$ amp is drawn for 6 min duration. Then calculate, for how much duration current $I=1000$ amp can be drawn safely by the machine_____.
- A. 1.5 sec
 - B. 3 sec
 - C. 1.5 min
 - D. 3 min

Ans. C

Sol. Since, the current drawn (I) and duty cycle (t) relation is given by:

$$I^2t = \text{Const.}$$

$$t_1 = 6 \text{ min and } I_1 = 500 \text{ amp}$$

$$\text{and } I_2 = 1000 \text{ amp}$$

$$\text{Thus, } 500^2 \times 6 = 1000^2 \times t_2$$

$$t_2 = 1.5 \text{ min}$$

53. A stopwatch time study on an operator with a performance rating of 120 yielded a time of 2 min. If allowances of 10% of the total available time are to be given, the standard time of the operation is _____.
- A. 2 min
 - B. 2.4 min
 - C. 2.64 min
 - D. 2.67 min

Ans. C

Sol. Given:

Performance rating: $R = 1.2$

Actual time = 2 minutes

allowance = 10%.

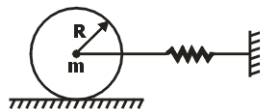
The normal time (NT) = OT \times RF

$$NT = 2 \times 1.2 = 2.4 \text{ min.}$$

Standard time (ST) = NT + allowances

$$ST = 2.4 \times 1.1 = 2.64 \text{ min.}$$

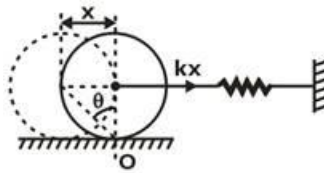
54. A solid sphere of mass m and radius r is connected by a spring of modulus K as shown in figure. If it is free to roll on the rough horizontal surface without slipping. What will be the natural frequency?



- A. $\sqrt{\frac{2k}{3m}}$ rad/s
- B. $\sqrt{\frac{3k}{2m}}$ rad/s
- C. $\sqrt{\frac{5k}{2m}}$ rad/s
- D. $\sqrt{\frac{5k}{7m}}$ rad/s

Ans. D

Sol.



Now apply restoring torque equation

$$(\Sigma M_o = 0):$$

$$T + I\alpha = 0$$

$$\left\{ \frac{2}{5} mR^2 + mR^2 \right\} \ddot{\theta} + kx \times R = 0$$

$$\frac{7}{5} mR^2 \ddot{\theta} + KR^2\theta = 0$$

$$\ddot{\theta} + \frac{5k}{7m} \theta = 0$$

$$\omega_n = \sqrt{\frac{5k}{7m}} \text{ rad/s}$$

55. Austempering is employed to obtain _____.

- A. 100% martensitic structure
- B. 100% bainitic structure
- C. 50% martensitic and 50% bainitic structure
- D. 100% pearlitic structure

Ans. B

Sol. Austempering is rapid cooling below the nose of TTT but above M_s (martensitic transformation line) and then held isothermally to have 100% bainitic structure.

56. The velocity ratio for flat belt is up to _____.

- A. 2:1
- B. 3:1
- C. 3:2
- D. 4:1

Ans. D

Sol. Flat belts have a narrow rectangular cross-section.

The velocity ratio for flat belt is up to 4:1.

57. The back work ratio in Rankine cycle is _____, if W_p and W_T are pump work and turbine work respectively.

- A. $\frac{W_T - W_p}{W_T}$
- B. $\frac{W_T}{W_p}$
- C. $\frac{W_p}{W_T}$
- D. $\frac{W_p}{W_T - W_p}$

Ans. C

Sol. Work ratio is given by:

$$r_w = \frac{W_T - W_p}{W_T}$$

Back work ratio (r_{bw}) is given by:

$$r_{bw} = \frac{W_p}{W_T}$$

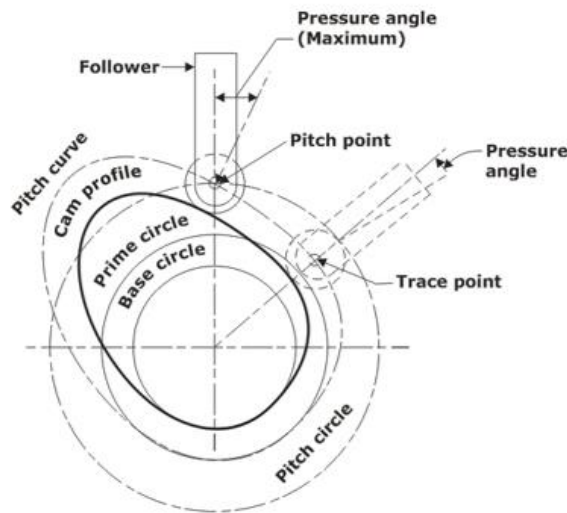
58. Which of the following is true about the base circle of cam?

- A. It is the circle passing through the pitch point.
- B. It is the smallest circle drawn tangent to the pitch curve.
- C. It is the smallest circle tangent to the cam profile
- D. It is the smallest circle drawn tangent to the prime circle.

Ans. C

Sol. It is the smallest circle that can be drawn tangential to the cam profile (contour) from the centre of rotation of a radial cam.

The base circle decides the overall size of a cam and is, therefore, a fundamental feature of the cam.



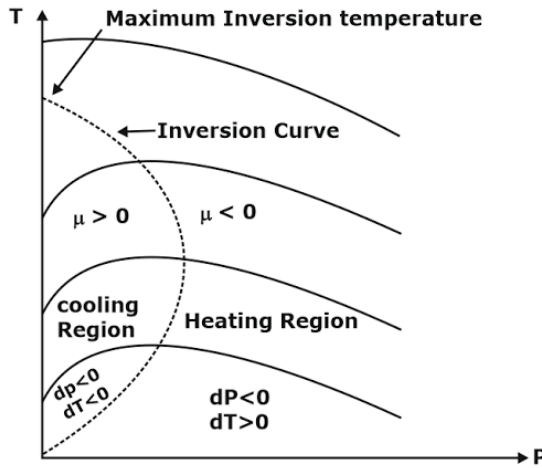
59. Joule-Thomson coefficient is the ratio of _____.

- A. pressure change to temperature change occurring when a gas undergoes the process of adiabatic throttling
- B. temperature change to pressure change occurring when a gas undergoes the process of adiabatic throttling
- C. temperature change to pressure change occurring when a gas undergoes the process of adiabatic compression
- D. pressure change to temperature change occurring when a gas undergoes the process of adiabatic compression

Ans. B

Sol. Joule-Thomson coefficient is given by $\mu_j = \left(\frac{dT}{dP}\right)_h$.

Thus it is ratio of temperature change to pressure change occurring when a gas undergoes the process of adiabatic throttling.



60. For an open channel at critical depth the flow becomes _____.

- A. constant
- B. Zero
- C. Half
- D. Maximum

Ans. D

Sol. Critical flow is the transition or control flow that possesses the **minimum possible energy** for that flow rate.

Critical flow has a **Froude number equal to one**.

For a given value of specific energy, the critical depth gives the **greatest discharge**.

61. A mass m_1 with velocity v_1 impacts with a mass m_2 at rest. After the impact if the mass m_1 comes to rest, then the coefficient of restitution 'e' should be _____?

- A. $e = \frac{m_1}{m_1 + m_2}$
- B. $e = \frac{m_2}{m_1 + m_2}$
- C. $e = \frac{m_1}{m_2}$
- D. $e = \frac{m_2}{m_1}$

Ans. C

Sol.



Initial speed: u_1 Initial speed: $u_2 = 0$

Given: $u_1 =$ initial speed of m_1

After collision speed of m_1 is 0 and let the speed of m_2 becomes v_2 .

By conservation of linear momentum:

$$(m_1u_1 + m_2u_2)_{\text{initial}} = (m_1v_1 + m_2v_2)_{\text{final}}$$

$$(m_1u_1 + m_2 \times 0)_{\text{initial}} = (m_1 \times 0 + m_2v_2)_{\text{final}}$$

$$m_1u_1 = m_2v_2$$

Coefficient of restitution (e) is given by:

$$e = -\frac{v_2 - v_1}{u_2 - u_1}$$

$$e = -\frac{v_2 - 0}{0 - u_1} = \frac{v_2}{u_1} = \frac{m_1}{m_2}$$

62. According to Gay-Lussac law for a perfect gas, the absolute pressure of given mass varies directly as _____.
- A. temperature
 - B. absolute temperature, if volume is kept constant
 - C. volume, if temperature is kept constant
 - D. remains constant, if volume and temperature are kept constant

Ans. B

Sol. Gay-Lussac's Law states that the pressure of a given mass of gas varies directly with the absolute temperature of the gas, when the volume is kept constant.

Since $PV = mRT$. Now, for a fixed quantity of mass at constant volume

$$V: P \propto T \Rightarrow \frac{P_1}{T_1} = \frac{P_2}{T_2}$$

63. Addition of magnesium to cast iron increase its _____.
- A. hardness
 - B. corrosion resistance
 - C. creep strength
 - D. ductility and strength in tension

Ans. D

Sol. Magnesium addition in cast iron promotes nodularity, thus the tensile strength and tensile elongation increases.

Excess Mg levels can lead to intercellular carbides resulting a reduction in tensile elongation.

64. Find natural frequency for spring which has stiffness of 1000 N/m and mass of 10 kg. Where mass of spring is mentioned as 1500 grams.
- A. 9.32 rad/s
 - B. 1.4 rad/s
 - C. 9.75 rad/s
 - D. 2.8 rad/s

Ans. C

Sol. When mass of spring is given. Natural frequency (ω_n) is given by:

$$\omega_n = \sqrt{\frac{K}{m + \frac{m_s}{3}}}$$

$$\omega_n = \sqrt{\frac{1000}{\left(10 + \frac{1.5}{3}\right)}} = 9.75 \text{ rad / sec}$$

65. Steam coal is a _____.

- A. Pulverised coal
- B. Brown coal
- C. Coking bituminous coal
- D. Non coking bituminous coal

Ans. D

Sol. Non-Coking bituminous Coal does not have any caking properties and it is mainly used as thermal coal for power generation in steam plants.

It has a higher ash content and also used in industries like cement, fertilizer, glass, ceramic, paper, chemical and brick manufacturing.

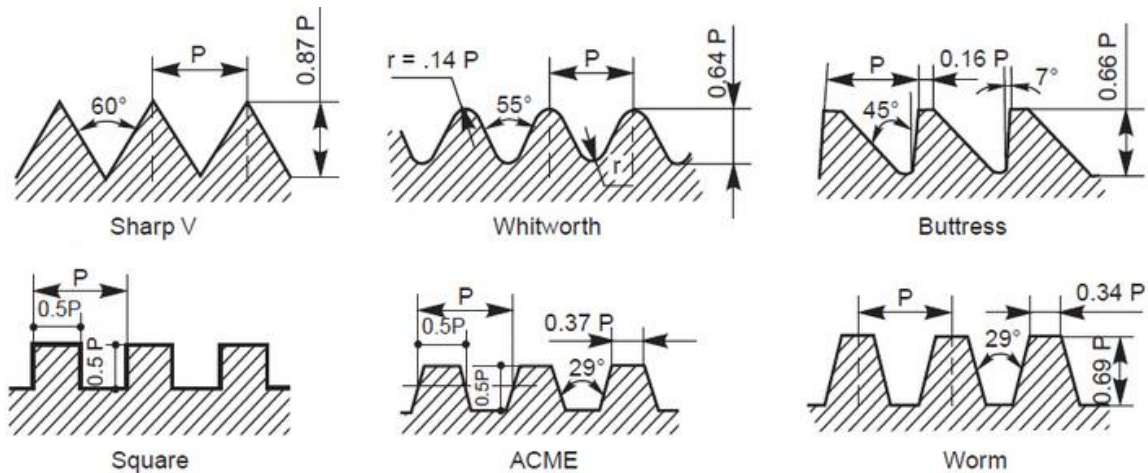
$$\text{UHV(kcal/kg)} = 8900 - 138(\% \text{Ash} + \% \text{Moisture})$$

66. Which of the following threads have highest thread angle _____?

- A. V - threads
- B. Buttress threads
- C. Square threads
- D. Acme threads

Ans. A

Sol. Different threads and their included angle are given below in the diagram:



67. The non-traditional machining process that essentially requires vacuum is _____.
- A. electron beam machining
 - B. electro chemical machining
 - C. electro chemical discharge machining
 - D. electro discharge machining

Ans. A

Sol. In electron- beam machining, vacuum conditions are created/required for material removal, because electrons move efficiently in vacuum.

68. A clamp – clamp supported column of length $L = n$ unit, and flexural rigidity of column is EI , then the critical buckling load (P_{cr}) is given by _____.
- A. $4EI$
 - B. EI
 - C. $2EI$
 - D. $EI/4$

Ans. A

Sol. Column length: $L = n$

For Clamp - clamp type column:

Equivalent length: $L_e = L/2 = n/2$

Critical buckling load is given by:

$$P_{cr} = \frac{\pi^2 EI}{(L_e)^2}$$

$$P_{cr} = \frac{\pi^2 EI}{(\pi / 2)^2} = 4EI$$

69. The only selective approach suitable for spare parts inventory is _____.
- A. ABC analysis
 - B. VED analysis
 - C. FSN analysis
 - D. SOS analysis

Ans. B

Sol. In inventory, VED stands for vital, essential and desirable.

VED analysis is related to maintenance spare parts and shows the essentiality of stocking spares.

70. A bucket contains water filled upto a height = 15 cm. The bucket is tied to a rope which is passed over a frictionless light pulley and the other end of the rope is tied to a weight of mass which is half of that of the (bucket + water). The water pressure above atmosphere pressure at the bottom is

A. 0.5 kPa

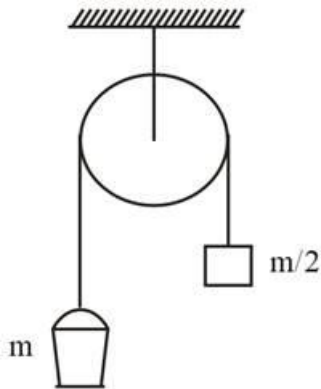
B. 1 kPa

C. 5 kPa

D. None

Ans. B

Sol.



Let the acceleration of bucket is a $mg - \frac{m}{2}g = \left(m + \frac{m}{2}\right)a$

$$a = \frac{g}{3}$$

Now, for pressure difference

$$P = \rho h (g - a)$$

$$P = 1000 \times 0.15 \times \left(g - \frac{g}{3}\right)$$

$$P = 1000 \times 0.15 \times 10 \times \frac{2}{3}$$

$$P = 1 \text{ kPa}$$
