



RVUNL 2021

Mechanical Engineering

Mini Mock Challenge

(April 30th - May 1st 2021)

Questions &
Solutions

10. As per National Sports Awards 2020, who amongst the following was awarded Rajiv Gandhi Khel Ratna Award?

- A. Mariyannapn Thangavelu
- B. Dharmendra Tiwary
- C. Kuldip Singh Bhullar
- D. Karan Avtar Singh

Ans. A

Sol. Of the above, Rajiv Gandhi Khel Ratna was awarded to Mariyannapn Thangavelu (para-athlete). He was awardee the honour along with Rohit Sharma (cricketer), Vinesh Phogat (wrestler), and Rani Rampal (women hockey captain). Apart from them, Dharmendra Tiwary was awarded Arjuna Award for Archery and Kuldip Singh Bhullar (with Jincy Philips) was awarded with Dhyan Chand award for Athletics.

11. The headquarter of National Bank for Agriculture and Rural Development (NABARD) is situated at

- A. New Delhi
- B. Bangalore
- C. Kolkata
- D. Mumbai

Ans. D

Sol. The headquarter of National Bank for Agriculture and Rural Development (NABARD) is situated at Mumbai. Founded in 1982 as a statutory body and has been entrusted with "matters concerning policy, planning, and operations in the field of credit for agriculture and other economic activities in rural areas in India". Its basic function is to look after rural finance via refinancing RRBs (Regional Rural Banks).

12. Which amongst the following ecosystem types has the lowest annual net primary productivity?

- A. Tropical deciduous forests
- B. Salt marsh
- C. Open ocean
- D. Temperate evergreen forests

Ans. C

Sol. Amongst the following, Open ocean has the least annual net primary productivity. Primary productivity is a term used to describe the rate at which plants and other photosynthetic organisms produce organic compounds in an ecosystem. Ecosystems, apart from open ocean with least primary productivity, include deserts, tundra region, lakes and streams biomes.

13. What is programme *GOAL*?

- A. It is a joint initiative of Facebook India with Ministry of Tribal affairs to provide mentorship to tribal youth through digital mode.
- B. It is an initiative of a Manipur-based NGO to create India's first transgender football team.
- C. It is launched by Indian Navy as a part of national effort to repatriate Indian citizens from overseas.
- D. It is a public-private partnership, launched by U.S., to facilitate and accelerate development of COVID-19 vaccines, therapeutics, and diagnostics.

Ans. A

Sol. **Welspun Energy** has commissioned **Asia's largest solar power project** in **Jodhpur**. The company had earlier started a **15 MW solar generation unit** at the site and now plans to install two more units of **15 MW** and **20 MW**. The entire **50 MW solar project** will be developed in three phases and the project will generate total electricity of **90 million kWh** annually.

18. In which of the following year Jaipur was conferred the title of the World Craft City?

- A. 2014
- B. 2015
- C. 2016
- D. 2013

Ans. B

Sol. In **2015, Jaipur** was conferred the title of the **World Craft City** by the World Crafts Council, becoming the only city in the world to have received the title for **multiple crafts**. Jaipur, in particular, and Rajasthan, in general, has seen some successful crafts based businesses and startups reach scale in the last few decades, notably – **Jaipur Rugs, Rangсутra, Anokhi, Kilol, Sadhna** and **Soma**.

19. Who was the first Chief Minister of Rajasthan?

- A. C S Venkatachari
- B. Manikya Lal Verma
- C. Pandit Hiralal Shastri
- D. Tika Ram Paliwal

Ans. C

Sol. Pandit Hiralal Shastri (24 November 1899 – 28 December 1974) was an Indian politician and the first chief minister of Rajasthan state in northern India. He was in office from 7 April 1949 to 5 January 1951. Hiralal Shastri was born at Jobner in Jaipur District in a peasant family. He completed his early education in Jobner. Hiralal passed the degree of Sahitya Shastri in 1920. In 1921, he stood first in the B.A. examination from Maharaja's College, Jaipur.

20. Who was the famous ruler of Mewar who repaired the fort of Achalgarh?

- A. Rana Ratan Singh
- B. Maharana Kumbha
- C. Rana Sanga
- D. Maharana Raj Singh

Ans. B

Sol. Achalgarh is a fort situated about 11 kilometres (6.8 mi) north of Mount Abu, a hill station in Rajasthan, India. The fort was originally built by the Paramara dynasty rulers and later reconstructed, renovated and named as Achalgarh by Maharana Kumbha in 1452 CE, one of the several forts built during his reign.

21. Rajasthan has the shortest inter-state border with which state?

- A. Gujarat
- B. Madhya Pradesh
- C. Punjab
- D. Haryana

Ans. C

Sol. Rajasthan has the shortest 89-km inter-state border with Punjab and the longest 1600-km distance with Madhya Pradesh. 5 states share boundaries with Rajasthan.

22. What are the districts of Rajasthan in which no river flows?

- A. Bikaner and Churu
- B. Sriganaganagar and Hanumangarh
- C. Jodhpur and Jaisalmer
- D. Nagaur and Pali

Ans. A

Sol. Bikaner and Churu are the two districts in Rajasthan in which no river flows, but the Kantali River originating from Khandela, Sikar disappears in an area called Sahaba in Churu district.

23. What is the length of Rajasthan from north to south?

- A. 828 km
- B. 848 km
- C. 836 km
- D. 826 km

Ans. D

Sol. Rajasthan is located in the western part of the map of India. The shape of Rajasthan is like a rhombus. Rajasthan is 869 kilometers from east to west, while 826 kilometers from north to south. The latitudinal extension of Rajasthan is $23^{\circ} 03'$ North to $30^{\circ} 12'$ North with a difference of $7^{\circ} 09'$ minutes. The longitudinal extension of Rajasthan is $78^{\circ} 17'$ E longitude from $69^{\circ} 30'$ East longitude. The difference is $8^{\circ} 47'$ minutes.

The Tropic of Cancer cuts Rajasthan in Banswara and Dungarpur districts. Because of this, the sun shines right here on 22 June.

24. Which river was also known as Charmanavati river in ancient times?

- A. Chambal
- B. Banas
- C. Ghaggar
- D. Sabarmati

Ans. A

Sol.

The Chambal river was known as Charmanavati in ancient times. The Chambal river originated from the Janapav hill near Manpur near Mhow in Madhya Pradesh. It enters Kota near Chaurasigarh (Chittorgarh district) in Rajasthan, forming the border of Kota, Bundi districts, and meets the river Yamuna at the end via Sawai Madhopur, Karauli and Dhaulpur. The principal tributaries of Chambal are Banas, Kalisindh and Parvati.

25. The first plasma bank of Rajasthan will be established at which place?

- A. Udaipur
- B. Ajmer
- C. Jaipur
- D. Kota

Ans. C

Sol. The government of Rajasthan is to set up the first plasma bank of the state in Jaipur. India's first plasma bank was established in Delhi. Under plasma therapy, blood plasma is collected from a COVID-19 recovered patient. This is then transfused into a COVID-19 patient. Blood

plasma is the fluid released after removing the components of blood. The components of blood are RBC, WBC, and platelets. RBC is Red Blood Corpus and WBC is White Blood Corpus. RBCs carry oxygen to the blood.

26. Which Air Force helicopter has been deployed by the Indian Air Force in Rajasthan for Locust control?

- A. Rudra
- B. Mig
- C. Apache
- D. MI 17

Ans. D

Sol. The versatile Mi-17 helicopter was used for spraying in Jodhpur district, making it the first-of-its-kind activity in the history of locust control in India, according to the Agriculture Ministry.

Aerial spraying capacity has been strengthened for anti-locust operations with the deployment of a Bell helicopter in Rajasthan for use in Scheduled Desert Area as per the need and the Indian Air Force has also conducted trials in anti-locust operation by using Mi-17 helicopter.

27. When did Rajasthan government announced ban on pan masala and tobacco?

- A. 8 March 2020
- B. 2 October 2019
- C. 26 January 2020
- D. 30 November 2019

Ans. B

Sol. Rajasthan government has announced ban on pan masala and tobacco on 02 October 2019 on Mahatma Gandhi Jayanti. The government has announced a ban on the production, storage, distribution and sale of pan masala and flavored tobacco containing magnesium carbonate, nicotine, tobacco or mineral oil.

After Maharashtra and Bihar, Rajasthan is the third state to impose this ban. According to the Medical Department of Rajasthan, this important step has been taken to prevent drug addiction among the youth. The government has banned these items under the Food Security Act.

28. Identify the wrong pair related to wildlife mascots district wise.

- A. Sirohi - Wild Fowl
- B. Hanumangarh - Chhota Kilkila
- C. Dhaulpur - Ghonsiga
- D. Sikar - Shahin

Ans. C

Sol.

- i. Ajmer Khadmore
- ii. Bundi Sukarbh
- iii. Chittorgarh Chausinga
- iv. Churu Krishna Deer

- v. Dosa rabbit
- vi. Dholpur Pachira (Indian Screamer)
- vii. Hanumangarh Chhota Kilkila
- viii. Jaisalmer Godavan
- ix. Jalore bear
- x. Sikar - Shaheen
- xi. Sirohi - Wild Fowl

29. One of the factors of $x^3 - 3x^2 + 3x - 2$ is:
- | | |
|------------------|------------------|
| A. $x^2 + x + 1$ | B. $x^2 - x + 1$ |
| C. $x^2 - x - 1$ | D. $x^2 + x - 1$ |

Ans. B

Sol. Putting $x = 2$ in equation $x^3 - 3x^2 + 3x - 2$

We get

$$2^3 - 3(2)^2 + 3(2) - 2 = 0$$

i.e. $x - 2$ is the factor of $x^3 - 3x^2 + 3x - 2$

Dividing $(x^3 - 3x^2 + 3x - 2)$ by $(x - 2)$ we get Quotient $(x^2 - x + 1)$

30. A certain sum is distributed among A, B, C and D in the ratio 3: 4 : 8 : 6 respectively. If the share of C is Rs 2,820, more than that of B, then what is the sum of shares of A and D?
- | | |
|-------------|-------------|
| A. Rs 5,460 | B. Rs 5,640 |
| C. Rs 3,564 | D. Rs 6,345 |

Ans. D

Sol. Let total sum be x

According to question

$$\left(\frac{8}{3+4+8+6} - \frac{4}{3+4+8+6} \right) \times x = 2820$$

$$\Rightarrow \frac{4x}{21} = 2820$$

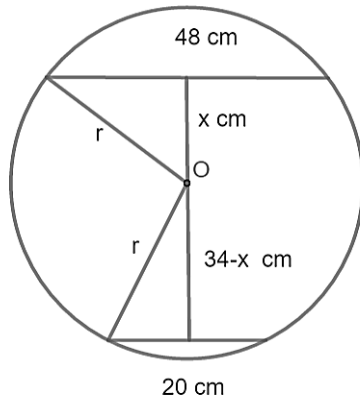
$$\Rightarrow x = 14805$$

$$\text{Required sum} = \frac{3+6}{21} \times 14805 = 6345$$

31. In a circle with centre O. chords AB and CD are parallel chords on opposite side of O. If $AB = 20$ cm. $CD = 48$ cm and the distance between the chords is 34 cm. then the diameter (in cm) of the circle is:
- | | |
|-------|-------|
| A. 26 | B. 39 |
| C. 42 | D. 52 |

Ans. D

Sol.



$$r^2 = x^2 + 24^2 \text{ and } r^2 = (34 - x)^2 + 10^2$$

equating the value of r^2 we have

$$x^2 = (34 - x)^2 + 100 + (24 \times 24)$$

$$\Rightarrow x^2 = 34^2 + x^2 - 68x - 576 + 100$$

$$\Rightarrow 68x = 680$$

$$\Rightarrow x = 10 \text{ cm}$$

Now

$$r^2 = 10^2 + 24^2 = 676 = 26^2$$

$$r = 26 \text{ cm}$$

$$D = 52 \text{ cm}$$

32. If $\sqrt{24} = 4.899$, then the value of $\sqrt{\frac{8}{3}}$ is—

A. 0.544

B. 2.666

C. 1.633

D. 1.333

Ans. C

Sol.

$$\because \sqrt{24} = 4.899$$

$$\therefore \sqrt{\frac{8}{3}} = \sqrt{\frac{24}{3^2}}$$

$$= \frac{1}{3} \sqrt{24}$$

$$= \frac{1}{3} \times 4.899$$

$$= 1.633$$

33. |||Common||| निर्देश: प्रत्येक प्रश्न में एक वाक्य दिया हुआ है। वाक्य के जिस भाग में गलती हो, (A), (B) या (C) तो वही भाग आपका उत्तर होगा। यदि कोई गलती न हो, तो आपका उत्तर (D) होगा। |||End|||
(A) सज्जनों से मित्रता / (B) रखने से / (C) सुखशान्ति मिलती है / (D) कोई गलती नहीं।

- A. A
B. B
C. C
D. D

Ans. A

Sol. 'सज्जनों' के स्थान पर 'सज्जन' होगा।

34. निम्न में से किस शब्द में "नि" उपसर्ग का प्रयोग किया गया है?

- A. निर्वास
B. निपात
C. निर्भय
D. निर्दोष

Ans. B

Sol. उपसर्ग = उप (समीप) + सर्ग (सृष्टि करना) का अर्थ है- किसी शब्द के समीप आ कर नया शब्द बनाना।
उपसर्ग कहलाते हैं।

यहाँ केवल निपात शब्द में 'नि' उपसर्ग है, अन्य शब्दों में 'निर्' उपसर्ग का प्रयोग किया गया है।

निपात = नि + पात

निर्वास = निर् + वास

निर्भय = निर् + भय

निर्दोष = निर् + दोष

35. दिए गए विकल्पों में तत्सम शब्द के लिए सही विकल्प कौन सा है ?

- A. तमोली
B. औधर
C. आभीर
D. तुरन्त

Ans. C

Sol. तत्सम - तद्भव

आभीर - अहीर

अन्धक - औधर

त्वरित - तुरन्त

तम्बोली - तमोली

इतिहास या उत्पत्ति के आधार पर शब्द पाँच प्रकार के होते हैं।

तत्सम , तद्भव , देशज , विदेशज , संकर

तद्भव - संस्कृत के शब्दों से उत्पन्न हुए तद्भव शब्द कहते हैं।

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तत्सम - वे शब्द जो संस्कृत की तरह ही प्रयोग में लाए जाते हैं तत्सम शब्द कहलाते हैं।

36. निम्नलिखित में से "सुदामाचरित" का काव्य रूप क्या माना जाता है ?

- A. महाकाव्य
B. खंडकाव्य
C. एकार्थकाव्य
D. चरितकाव्य

Ans. B

Sol. खंडकाव्य - खण्डकाव्य साहित्य में प्रबंध काव्य का एक रूप है। जीवन की किसी घटना विशेष को लेकर लिखा गया काव्य खण्डकाव्य है।

सुदामाचरित - कवि नरोत्तमदास (सम्बत 1602) कृत 'सुदामाचरित' इस परम्परा की सर्वाधिक महत्त्वपूर्ण रचना है। यह एक संक्षिप्त खण्ड काव्य है, जो दोहा, कवित्त और सवैया छन्दों में रचा गया है।

37. |||Common||| **Direction:** Fill in the blank with appropriate verb to make the sentence past perfect tense: |||End|||

The guest _____ when I reached the club.

- A. were leaving
B. left
C. have been leaving
D. had left

Ans. D

Sol.

The correct sentence with the appropriate verb is: The guest had left when I reached the club. The formula to identify past perfect tense is: had + third form of verb. This type of verb is used to express an action completed before a certain moment in the past.

38. Choose the correct order of the sentences to rearrange them in a suitable manner.

- P. the next
Q. supposed to be
R. cricket legend
S. He is

OPTIONS:

- A. SRPQ
B. SQPR
C. QSPR
D. SRQP

Ans. B

Sol. The correct order of the sentence is "He is supposed to be the next cricket legend".

39. Which of the following prefix is suitable for the word "mature"?

- A. im-
B. a-
C. dis-
D. in-

Ans. A

Sol. The correct prefix for the word mature is "im", i.e., immature.

40. |||Common||| **Direction:** Fill in the blank with the most appropriate modal from the given options: |||End|||
My office is two hours away from my home so, I _____ leave early every day. A. can
B. may
C. shall
D. would

Ans. C

Sol. The correct sentence with the most appropriate modal is: My office is two hours away from my home so I shall leave early every day. The modal 'shall' is used to express offers, suggestions and is used with only 'I' and 'We'.

41. Two composite bars of copper and steel, heated up to a certain temperature, then thermal stress developed in Copper and Steel bar respectively is?
A. Compressive and tensile B. Tensile and compressive
C. Both compressive D. Both tensile

Ans. A

Sol. Thermal expansion coefficient of Copper bar is more than steel bar, thus on heating, Copper bar will try to expand more compared to the steel bar. Since both are joined rigidly, expansion in both must be the same. Hence, the actual expansion in copper will be somewhat lesser than its free expansion. So compressive thermal stresses will be developed in Copper and tensile thermal stress will be developed in Steel bar.

42. In a refrigeration cycle the heat is absorbed by refrigerant at:
A. Evaporator B. Condenser
C. Expansion valve D. Compressor

Ans. A

Sol. The evaporator is the space in the refrigerator where the heat is absorbed from the objects by the refrigerant. Hence, Evaporator is the place where is heat is absorbed by the refrigerant and and heat is rejected by the objects.

In condenser, heat is rejected by the refrigerant and it then returns to the evaporator, in the initial state, ready to absorb more heat.

43. The three dimensional flow field described by $V = (y^2 + z^2)i + (x^2 + z^2)j + (x^2 + y^2)k$ at $(1, 2, 3)$, the Ratio of angular velocity of x to y component is _____.
A. - 2 B. - 0.5
C. 2 D. 0.5

Ans. B

Sol.

$$u = y^2 + z^2, v = x^2 + z^2, \omega = x^2 + y^2.$$

$$\frac{\partial u}{\partial x} = 0 \quad \frac{\partial v}{\partial x} = 2x \quad \frac{\partial \omega}{\partial x} = 2x$$

$$\frac{\partial u}{\partial y} = 2y \quad \frac{\partial v}{\partial y} = 0 \quad \frac{\partial \omega}{\partial y} = 2y$$

$$\frac{\partial u}{\partial z} = 2z \quad \frac{\partial v}{\partial z} = 2z \quad \frac{\partial \omega}{\partial z} = 0$$

$$\omega_x = \frac{1}{2} \left[\frac{\partial \omega}{\partial y} - \frac{\partial v}{\partial z} \right] = \frac{1}{2} [2y - 2z]$$

$$\omega_x = \frac{1}{2} [2(2) - 2(3)] = -1 \text{ rad / s}$$

$$\omega_y = \frac{1}{2} \left[\frac{\partial u}{\partial z} - \frac{\partial \omega}{\partial x} \right]$$

$$\omega_y = \frac{1}{2} [2z - 2x] = \frac{1}{2} [6 - 2] = 2 \text{ rad / s}$$

$$\frac{\omega_x}{\omega_y} = -0.5$$

44. Why offset is provided in a cam follower mechanism?

- | | |
|------------------|----------------------------|
| A. To avoid jerk | B. To accelerate |
| C. To decelerate | D. To minimize side thrust |

Ans. D

Sol.

- When the motion of the follower is along an axis away from the axis of the cam center, it is called off-set follower.
- Offset reduces stroke length also reduces side thrust thus, tear and wear also diminishes.

45. In arc welding, arc is created between the electrode and work by _____.

- | | |
|-----------------------|-----------------------|
| A. flow of current | B. voltage |
| C. material thickness | D. contact resistance |

Ans. B

Sol.

- An arc is generated between two conductors of electricity, when they are touched to establish the flow of current and then separated by a small distance.
- In order to produce the arc, the **potential difference (voltage)** between the two electrodes should be sufficient to allow them to move across the air gap.

46. One ton of refrigerator is equal to the refrigeration effect corresponding to melting of 1000 kg of ice:

- | | |
|----------------|----------------|
| A. In 1 hour | B. In 1 minute |
| C. In 24 hours | D. In 12 hours |

Ans. C

Sol. 1 Ton of Refrigeration is the rate of heat removal required to freeze 1 ton (1000Kg) of water at 0°C in 24 Hrs.

47. A horizontal jet of water 100 mm diameter having a velocity of 15m/s strikes a fixed plate. Work done by the jet on fixed vertical plate (in Nm) is ?

- A. 20
- B. 10
- C. 15
- D. None of the above

Ans. D

Sol. Given,

diameter of jet (d)= 100mm,

Velocity of jet (V) = 15m/s

velocity of plate, u = 0m/s(fixed)

thus,

$$W = \rho A(V-u)^2 \cdot u$$

$$W = \rho A(V-u)^2 \cdot 0$$

$$W = 0$$

For fixed plate work done is equal to zero.

48. The transformation in which one liquid phase and one solid phase transforms into a solid phase is

- A. Peritectic
- B. Eutectic
- C. Eutectoid
- D. None of the above

Ans. A

Sol. The transformation in which one liquid phase and one solid phase transforms into a solid phase is Peritectic transformation. In iron carbon diagram, peritectic transformation takes place at 1492°C and 0.18% of carbon.

49. The value of Gr/Re² is approximately 1. Gr = grashof's number, Re = Reynolds number.

The flow type is

- A. Free Convection
- B. Forced convection
- C. Mixed convection
- D. Can not be decided

Ans. C

Sol.

The deciding Parameter for type of flow is Gr/Re²

$$\frac{Gr}{Re^2} \gggg 1 \Rightarrow \text{free convection}$$

$$\frac{Gr}{Re^2} \lllll 1 \Rightarrow \text{forced convection}$$

$$\frac{Gr}{Re^2} \approx 1 \Rightarrow \text{Mixed flow}$$

50. The minimum ratio of diameter to thickness above which spherical shell is called thin spherical cell is
- A. 5
B. 10
C. 15
D. 20

Ans. D

Sol. The minimum ratio of diameter to thickness above which spherical shell is called thin spherical cell is 20. If the ratio is less than 20, then it is considered as thick cylinder.

51. Which of the following statements is correct regarding laminar flow
- (i) Fluid moves in thin sheets or layer
(ii) Occurs at lower fluid velocity
(iii) Inertia forces are more significant than viscous force
(iv) Absence of Bulk mixing of fluid
- A. (i), (ii) (iii) only
B. (i), (ii) (iv) only
C. (i), (iii) (iv) only
D. All of the above

Ans. B

Sol.

Laminar flow is the flow in which the fluid flows in the form of laminar or layer sliding over one another when the fluid velocity is very low.

Reynold's number is the ratio of inertial force to the viscous force. When the value of Reynold's number is low (less than 2000 for pipe flow), laminar flow occurs. For low Reynold's number, viscous force is dominant. not the inertial force.

52. In a four-bar mechanism, two adjacent links are rotating at angular velocities of 5 rad/s (clockwise) and 10 rad/s (anti-clockwise). If the radius of the pin joining the links is 3 cm, then what is the value of rubbing velocity:
- A. 15 cm/s
B. 30 cm/s
C. 40 cm/s
D. 45 cm/s

Ans. D

Sol.

We know rubbing velocity is given by,

$$v = (\omega_1 \pm \omega_2) \times r$$

Plus (+) sign is used when the links move in opposite direction

Minus (-) sign is used when the links move in same direction

$$\text{Here } v = (5 + 10) \times 0.03 = 0.45 \text{ m/s} = 45 \text{ cm/s}$$

53. Light impurities in centrifugal castings are
- A. collected at outer surface
B. collected at inner surface
C. mixed uniformly throughout the casting
D. thrown away as slug

Ans. B

Sol. Centrifugal casting method uses inertia forces caused by rotation to distribute the molten metal into the mold cavity. Light impurities due to their light mass are collected at inner surface.

54. The Benson boiler has

- A. two drums - one for water and another for steam
- B. a horizontal steam drum
- C. a vertical steam drum
- D. no steam drum

Ans. D

Sol. **Salient features of Benson Boiler**

- As there are no drums, the total weight of Benson boiler is 20% less than other boilers. This also reduces the cost of the boilers.
- As no drums are required, the transfer of the Benson parts is easy. Majority of the parts may be carried to the site without pre-assembly.
- Since no drum is used, this is an once-through boiler and the feed water entering at one end is discharged as superheated steam at the other end.
- Circulating pump and downcomers are dispensed with.

55. An engineering material property is defined as "the capacity of retaining the deformation produced with the application of load permanently". The property described is _____.

- A. Ductility
- B. Toughness
- C. Brittleness
- D. Plasticity

Ans. D

Sol. • the capacity of retaining the deformation produced with the application of load permanently is called plasticity

- plasticity is used in forging application as well in stampings operation

56. Consider the following statements regarding fins effectiveness

- 1) It is the ratio of heat transfer rate from the surface with fin to the heat transfer rate from surface without fin
- 2) It is ratio of actual heat transfer rate from fin to the ideal heat transfer rate from fin having entire surface temperature as base temp.
- 3) Addition of extended surfaces will always increase the heat transfer rates.

Which of the following statements is/are correct?

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

Ans. C

Sol.

$$\text{Effectiveness}(\epsilon_{fin}) = \frac{\dot{Q}_{fin}}{\dot{Q}_{without\ fin}}$$

$$\text{Efficiency of fin}(\eta) = \frac{\dot{Q}_{fin}}{\dot{Q}_{fin,max}}$$

$\dot{Q}_{fin,max}$ is maximum possible heat transfer rate which is obtained if entire fin surface has same temperature as base temperature.

Addition of extended surfaces will not always increase in the heat transfer rate. For effective heat transfer rate $h < mk$.

57. The key will fail in which of the following manner?
- | | |
|-------------------------------|------------------|
| A. Shearing | B. Crushing |
| C. Both crushing and shearing | D. None of these |

Ans. C

Sol. Shear failure: Actually, during rotation the shaft and the machine element, say hub, each element exerts equal and opposite force on the key.

Crushing: During rotation the shaft and the hub impose compressive force on the key causing its deformation. The key is then permanently deformed under this force and finally crushing occurs.

Hence the answer is C

58. A uniform circular ring of mass M and radius r is rotating with an angular speed ω about an axis passing through its centre and perpendicular to the plane of the ring. Two identical beads, each of mass m, somehow gets attached at two diametrically opposite points. The rotational speed of the ring will become ____.

- | | |
|-----------------------------|-------------------------------|
| A. $\frac{\omega M}{M + m}$ | B. $\frac{2\omega M}{M + 2m}$ |
| C. $\frac{\omega M}{m}$ | D. $\frac{\omega M}{M + 2m}$ |

Ans. D

Sol. Mass of the circular ring = M

Radius of the ring = r

Initial angular velocity = ω

Initial angular momentum = $Mr^2\omega$

When the two identical beads of mass m are connected, the new angular momentum is given by

New angular momentum = $(M + 2m)r^2\omega'$

Since there is no external torque, the angular momentum is conserved.

Initial angular momentum = Final angular momentum

$$\omega = \frac{\omega M}{M + 2m}$$

59. The enthalpy of saturated water at triple point in a steam table is

- A. zero
- B. slightly negative
- C. slightly positive
- D. can't say

Ans. C

Sol. In steam table, the internal energy and entropy of saturated water at triple point (0.01°C) are chosen to be zero.

Enthalpy, $h = u + pv$

Due to "pv" term, the enthalpy of saturated water at triple point will be slightly positive.

60. 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:

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

61. In a multi-disk clutch, if there are 6 and 5 disks on driving and driven shafts respectively, the number of contact surfaces are

- A. 11
- B. 6
- C. 5
- D. 10

Ans. D

Sol. In a multi-disk clutch,

No. of active plates $n_1 + n_2 - 1 = 6 + 5 - 1 = 10$

n_1 = no of frictional surface on driving shaft,

n_2 = no. of contact surface on driven shaft.

62. Piezometric head from the basic Bernoulli's equation, i.e. $\frac{P}{\rho g} + \frac{V^2}{2g} + Z = C$ is ?

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A. $\frac{P}{\rho g}$

B. $\frac{V^2}{2g}$

C. $\frac{V^2}{2g} + Z$

D. $\frac{P}{\rho g} + Z$

Ans. D

Sol.

$$\frac{P}{\rho g} = \text{Pressure head, } \frac{V^2}{2g} = \text{Dynamic head}$$

$$\frac{P}{\rho g} + Z = \text{Piezometric head}$$

63. For an exponential smoothing method of forecasting, the value of number of demand is 12, Find the exponential smoothing coefficient α for such a forecasting model.

A. 0.36

B. 0.15

C. 0.54

D. 0.49

Ans. B

Sol. Given that

$$N = 12$$

We know that

$$\alpha = \frac{2}{N + 1}$$

$$\alpha = \frac{2}{12 + 1}$$

$$\therefore \alpha = 0.15$$

64. In brazing process the filler metal should have the melting point above

A. 50 °C

B. 150 °C

C. 250 °C

D. 450 °C

Ans. D

Sol. In soldering process the filler metal used have the melting point below 450°C and in brazing process it has above 450 °C but below the solidus of base metal.

65. A boy kicks a football such that it acquires a velocity of 10m/s at an angle of 45° with the ground. If the goal is 15m away from the boy's location, by how much distance did he miss his goal?

(take $g=10 \text{ m/s}^2$)

- A. 5 m
- B. 10m
- C. 7.5m
- D. 6m

Ans. A

Sol.

The ball will undergo projectile motion.

Neglecting the drag forces.

Range of projectile is given as,

$$R = \frac{u^2 \sin 2\theta}{g}$$

$$R = \frac{100 \times \sin 90}{10} = 10 \text{ m}$$

Distance left from goal = 15 - 10 = 5 m

66. Calculate the efficiency of engine for an engine working on air-standard Otto cycle has a clearance volume, 10% of swept volume.

- A. 55.4%
- B. 61.6%
- C. 39%
- D. 49.9%

Ans. B

Sol. Given $V_c = 10\% V_s$

$$\frac{V_c}{V_s} = 0.1 \Rightarrow \frac{V_s}{V_c} = 10$$

$$r = 1 + \frac{V_s}{V_c} = 1 + 10 = 11$$

$$\eta = 1 - \frac{1}{r^{\gamma-1}} = 1 - \frac{1}{11^{1.4-1}}$$

$$\eta = 0.6167$$

$$\eta = 61.67\%$$

67. A cylinder filled with 2 kg of oxygen ($\gamma=1.4$) is heated at constant pressure from 27°C to 127°C, the heat supplied is equal to

- A. 201 kJ
- B. 224 kJ
- C. 105 kJ
- D. 182 kJ

Ans. D

Sol. Given,

$m = 2 \text{ kg oxygen}$

$\gamma=1.4$

$T_1 = 27^\circ\text{C}$ $T_2 = 127^\circ\text{C}$

$Q = mC_p dT$

$$C_p = \frac{\gamma R}{(\gamma - 1)}$$

For oxygen,

$$R = \frac{R_o}{M} = \frac{8314}{32} = 259.8$$

$$C_p = \frac{259.81 \times 1.4}{0.4} = 909.34 \text{ J/kgK}$$

$$Q = 2 \times 909.34 \times (127 - 27) = 181868.75 \text{ J}$$

$$Q = 181.86 \text{ kJ} = 182 \text{ kJ}$$

68. In vibration isolation system, if $\frac{\omega}{\omega_n} = \sqrt{2}$ then transmissibility(ϵ) will be.

- A. greater than one
- B. equal to one
- C. less than one
- D. zero

Ans. B

Sol. In Vibration isolation system,

$$\frac{\omega}{\omega_n} = \sqrt{2}$$

then transmissibility

$$\epsilon = \frac{\sqrt{1 + \left(\frac{2\xi\omega}{\omega_n}\right)^2}}{\sqrt{\left(1 - \left(\frac{\omega}{\omega_n}\right)^2\right)^2 + \left(\frac{2\xi\omega}{\omega_n}\right)^2}}$$

$$\epsilon = 1, \text{ when } \frac{\omega}{\omega_n} = 0, \sqrt{2}$$

69. The deformation of a bar under its own weight as compared to that when subjected to a direct axial load equal to its own weight will be

- A. Remains same
- B. Double
- C. Half
- D. None of these

Ans. C

Sol.

$$\delta_{\text{due to load } W} = \frac{WL}{AE}$$

$$\delta_{\text{due to load self weight equal to } W} = \frac{WL}{2AE}$$

thus,

The deformation of a bar under its own weight as compared to that when subjected to a direct axial load equal to its own weight will be half.

70. Grinding wheel is specified as "A 46 K 10 V 27" . The grain size of a wheel will be
- A. Coarse
 - B. Medium
 - C. Fine
 - D. Very Fine

Ans. B

Sol. A 46 K 10 V 27

A represent the abrasive material which is Al_2O_3 .

46 represents grain size, which falls under medium size and is used for semi finishing operation.

K represent the hardness of the wheel which is medium hardness.

10 represent the structure which falls under open structure.

V represent the type of bond which here is vetrified.

27 represent manufacturer code.
