VIZAG STEEL
Pride of Steel

VIZAG
Steel Management Trainee 2020

Mechanical Engineering

Mega Mock Challenge
(August 21 - August 22 2020)

Questions & Solutions

1. In the following question, select the related word from the given alternatives.
    Bee : Honey :: Cow:?

    A. Animal   B. Grass

    C. Milk   D. Water

Ans. C

Sol. Honey is obtained from bees. Similarly, milk si obtained from cows.

    Hence, option C is the correct response.

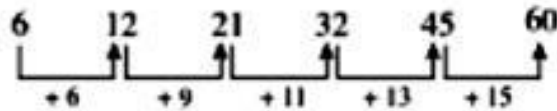2. Find the wrong number in the series.

    6, 12, 21, 32, 45, 60

    A. 6   B. 12

    C. 21   D. 32

Ans. A

Sol. **Given series:** 6, 12, 21, 32, 45, 60

    The pattern is:

    In the given series the odd numbers are added to get the next number in the series So,

    the order will be **(+5, +9, +11, +13, +15).** Therefore, **7 must replace 6 in the given**

    series.

    Clearly, 6 is the wrong number in the given series.

    New series will be: **7,** 12, 21, 32, 45, 60

    Hence, option A is correct.

3. **Direction:** In the question given below there is a statement followed by two conclusions
    numbered I and II. You have to assume everything in the statement to be true. Then
    consider the 2 conclusions together and decide which of them follows beyond a reasonable
    doubt from the information given in the statement.

    Statement:

    One can master the English language only through extensive reading and constant use of
    the language through writing and conversing.

    Conclusions:

    I. People who do not read English books cannot master the language fully.
    II. Only reading is not enough, one needs to practise speaking and writing in the language
    to master it.

    A. Only conclusion I follows

    B. Only conclusion II follows

    C. Both conclusion I and II follows

    D. Neither conclusion I nor II follows

    E. Either conclusion I nor II follows

Ans. C

Sol. One cannot learn complete command over the language without reading books or articles in that language. His/her knowledge regarding the usage will be incomplete. So I conclusion follows. Conclusion II also follows as the practice makes a man perfect. Without using the language accumulated by reading by conversing and writing one will not master the language.

4.   Equations given below are solved on the basis, of a certain system. On the same basis, find out the correct answer for the unsolved equation.

2 × 3 =49, 5 × 6 = 2536, 1 × 9 = 181, 4 × 7 = ?

A. 1628	B. 1649
C. 2549	D. 1219

Ans. B

Sol.

Hence, option B is the right answer.

5.   Arrange the given words in the sequence in which they occur in the dictionary.

1). Manifest

2). Meticulous

3). Meridian

4). Merchant

A. 1,4,3,2	B. 2,1,4,3
C. 1,3,2,4	D. 2,3,4,1

Ans. A

Sol. The correct order of the words is,

1). Manifest

4). Merchant

3). Meridian

2). Meticulous

→ 1, 4, 3, 2

6. **Direction**: If LUXOR is coded as 30, then GUILDS will be coded as?

   A. 36
   B. 38
   C. 24
   D. 40

Ans. C

Sol. LUXOR : 12, 21, 24, 15, 18 = 90 (sum) 90/3 =30)

   Similarly

   GUILDS : 7, 21, 9, 12, 4, 19 = 72 sum hence 72/3= 24

7. In the following question, select the odd word from the given alternatives.

   A. Japanese
   B. Italian
   C. French
   D. German

Ans. A

Sol. Japanese is an Asian country language, while Italian, French and German are European country languages.

   Hene, option A is different from others.

8. Choose the correctly spelt word.

   A. Rhapsody
   B. Rhapsoady
   C. Rapcody
   D. Rapsody

Ans. A

Sol. Option A has the correctly spelt word. Rhapsody means an effusively enthusiastic or ecstatic expression of feeling.

9. **Direction:** In the following question, some part of the sentence have error and some have none. Find out which part of the sentence has an error. If the sentence is correct as it is, your answer is 'No error'.

   Travel agents around the world have to rely on computers (A)/ to book seats in air flights or rooms in hotels (B)/ either now or a year from now. (C)/ No error

   A. (A)
   B. (B)
   C. (C)
   D. No error

Ans. B

Sol. The error is in part (B) of the sentence. The preposition should be "on" instead of "in".

10. Select the correct option to fill in the blank. |||End|||

   He agreed _____ my business proposal.

   A. at
   B. on
   C. to
   D. for

Ans. C

Sol. The correct preposition to be used in the given sentence is "to". Hence, option C is the correct answer.

Explanation:

When you agree with someone/something, it means you accept the point of someone/something.

I agree with you.

She does not agree with my answer.

You agree on some issue or point of debate.

We agreed on this issue.

You agree to demands/queries, or you agree to do something.

He agreed to my demands.

He agreed to join me for the movie.

11. Select the word which means the same as the group of words given.

   A written declaration of government or a political party. A. Manifesto

   B. Affidavit

   C. Dossier

   D. Document

Ans. A

Sol. Manifesto = a public declaration of policy and aims, especially one issued before an election by a political party or candidate.

   Affidavit = a written statement confirmed by oath or affirmation, for use as evidence in court.

   Dossier = a collection of documents about a particular person, event, or subject.

   Hence, the correct word is "manifesto".

12. Select the most appropriate antonym of the given word. |||End|||

   Permit

   A. endorse   B. approve

   C. certify   D. forbid

Ans. D

Sol. Permit means to allow someone to do something. The word which is opposite in meaning is "forbid" as it means to refuse to allow.

   Endorse means declare one's public approval or support of.

13. First time in India which state announced cow cess?

   A. Madhya Pradesh   B. Uttar Pradesh

   C. Haryana   D. Rajasthan

   E. Uttarakhand

Ans. D

Sol.   First time in India Rajasthan announced cow cess. Rajasthan is the only state in India which has a dedicated Cow Ministry. Rajasthan government has imposed a 10% cow cess as surcharge on stamp duty for protection and propagation of cows in the state.

14.   International boundary between India and Pakistan is demarcated by

A. McMahon Line   B. Durand Line

C. Radcliffe Line   D. Maginot Line

Ans.   C

Sol.   McMahon Line - India China

Durand Line - Pakistan Afghanistan

Radcliffe Line - India Pakistan

Maginot Line - France Germany

15.   Who was the first Indian awarded the Oscar for lifetime achievements in Cinema?

A. Amitabh Bachchan   B. Satyajit Ray

C. Bhanu Athaiya   D. Shivaji Ganeshan

Ans.   B

Sol.

• Satyajit Ray is one of the world's finest directors, producers, screenwriters, composers, writers, and graphic designers.

• **Satyajit Ray was the first Indian awarded the Oscar for lifetime achievements in Cinema.**

• Oscars are awards for artistic and technical merit in the film industry.

16.   Where is Lomas rishi caves situated?

A. Barabar and Nagarjuni hills   B. Garo hills

C. Aravalli range   D. Baba budan hills

E. khasi hills

Ans.   A

Sol.

• The Lomas Rishi Cave, also called the Grotto of Lomas Rishi, is a sacred architectural feature located in the Barabar and Nagarjuni hills of Jehanabad district in the Indian state of Bihar.

• This rock-cut cave was carved out as a sanctuary. It was built during the Ashokan period of the Maurya Empire in the 3rd century BC, as part of the sacred architecture of the Ajivikas.

17.   NABARD was established on the recommendations of ____.

A. B. Sivaraman Committee   B. S. Wanchoo Committee

C. T. Rangarajan Committee   D. N. Tandon Committee

E. None of these

Ans. A

Sol. NABARD was established on the recommendations of **B. Sivaraman Committee**, (by Act 61, 1981 of Parliament) on 12 July 1982 to implement the National Bank for Agriculture and Rural Development Act 1981.

18. Successive discounts of 20% and 10% are equivalent to a single discount of :

A. 28%

B. 25%

C. 30%

D. 15%

Ans. A

Sol. We have two successive discount be x% and y%, then equivalent discount

$$= \left(x + y - \frac{xy}{100}\right)\%$$

$$= \left(20 + 10 - \frac{20 \times 10}{100}\right)\%$$

$$= (30 - 2)\%$$

$$= 28\%$$

19. **Direction:** What should come in place of question mark (?) in the following number series?

12, 7, 8, 13, ?, 68.5 A. 27

B. 19

C. 21

D. 24

E. 28

Ans. A

Sol. This series following this pattern,

×0.5+1, ×1+1, ×1.5+1, ×2+1, ×2.5+1

=13×2+1=**27**

7= 12×0.5+1

8= 7×1+1

13= 8×1.5+1

27=13×2+1------hence 27 is missing term

68.5= 27×2.5+1

20. A car goes one kilometer at 30 km per hour and then goes another kilometer at 40 km per hour. The average speed (in km/hour) of the car for 2 km is

A. 35

B. $34\frac{2}{7}$

C. $33\frac{3}{7}$

D. $33\frac{5}{7}$

Ans. B

Sol. Time taken by a car to cover 1 km at a speed of 30 km/hr = $\dfrac{1}{30} hr$

Time taken by a car to cover another 1 km at a speed of 40 km/hr = $\dfrac{1}{40} hr$

Now, total distance covered by the car = 1 + 1 = 2 km

$$Total\ time = \dfrac{1}{30} + \dfrac{1}{40} = \dfrac{7}{120} hr$$

Therefore, The average speed of the car =

$$\dfrac{total\ distance}{total\ time} = \dfrac{2}{\dfrac{7}{120}} = \dfrac{2 \times 120}{7} = \dfrac{240}{7} = 34\dfrac{2}{7} km/hr$$

Hence, option B is correct.

21. A tree increases annually by 1/8th of its height. By how much will it increase after 2 years, if it stands today 64 cm high?

A. 72 cm   B. 74 cm

C. 75 cm   D. 81 cm

Ans. D

Sol. In first year tree will increase by;

= 64 × 1/8 = 8 cm

Tree's Height at the end of I year = 64 + 8 = 72 cm

In second year tree will increase by;

= 72 × 1/8 = 9 cm

Tree's Height at the end of II year = 72 + 9 = 81 cm

Hence Option D is correct.

22. Ram and Shyam together can do a work in 8 days. Both of them began to work. After 3 days Ram fell ill. Shyam completed the remaining work in 15 days. In how many days can Ram complete the whole work?

A. 17   B. 12

C. 15   D. 13

Ans. B

Sol. Work of Ram and Shyam for

1 day = $\dfrac{1}{8}$

∴ Work of Ram and Shyam for 3 days $\dfrac{3}{8}$

$\therefore$ Remaining work = $1 - \dfrac{3}{8} = \dfrac{5}{8}$

$\because \dfrac{5}{8}$ work is done by Shyam in 15 days

$\therefore$ 1 work is done by Shyam

$= 15 \times \dfrac{8}{5} = 24$ days.

$\therefore$ work of Shyam for 1 day = $\dfrac{1}{24}$

$\therefore$ work of Ram for 1 day

$= \dfrac{1}{8} - \dfrac{1}{24} = \dfrac{1}{12}$

Hence Ram alone will complete the work in 12 days.

23. The ages of Puja and Rani were in the ratio 3 : 2 a year ago. Five year hence, the ratio of their ages become 7 : 5. Find the present age of Rani

A. 37   B. 28

C. 25   D. 32

E. 27

Ans. C

Sol. Let the present ages of Puja and Rani be 'a' and 'b'.

Given, ages of Puja and Rani were in the ratio 3 : 2 a year ago.

$\therefore \dfrac{a-1}{b-1} = \dfrac{3}{2}$

$\Rightarrow$2a − 2 = 3b − 3

$\Rightarrow$a = 1.5b − 0.5

Also, five year hence, the ratio of their ages become 7 : 5.

$\therefore \dfrac{a+5}{b+5} = \dfrac{7}{5}$

$\Rightarrow$5a + 25 = 7b + 35

$\Rightarrow$7.5b − 2.5 + 25 = 7b + 35

$\Rightarrow$0.5b = 12.5

$\Rightarrow$b = 25

$\therefore$Present age of rani = 25 years

24. When a number is divided by 24, the remainder is 16. The remainder when the same number is divided by 12 is

A. 3   B. 4

C. 6   D. 8

Ans. B

Sol. the number is of form

N = 24Q + 16

on dividing by 12

N/12 = 2Q + (16/12)

=2Q + 1 + (4/12)

Thus the remainder is 4

OR

Required remainder = 16 − 12 = 4 because 24 is the multiple of 12

Hence Option B is correct.

25. **Direction:** What approximate value should come in place of the question mark (?) in the following equation (Note: You are not expected to calculate the exact value)?

$9980 \div 49 \times (4.9)^2 - 1130 = ?$

A. 3870   B. 4500

C. 2600   D. 3000

E. 4080

Ans. A

Sol. Approximate value be calculated as

$9980 \div 49 \times (4.9)^2 - 1130 = ?$

$? \approx 10000 \div 50 \times 25 - 1130$

$= 200 \times 25 - 1130 = 3870$

26. Which of the following is more commonly used firing order for six-cylinder stroke engine _____?

A. 1 − 5 − 4 − 6 − 2 − 3.   B. 1 − 5 − 3 − 6 − 2 − 4

C. 1 − 5 − 6 − 4 − 2 − 3   D. 1 − 5 − 6 − 3 − 2 − 4.

Ans. B

Sol. Firing orders for 4-cylinders and 6-cylinder engines is as follows:

• The more commonly used firing order for 6-cylinders IC engine is 1 − 5 − 3 − 6 − 2 − 4.

• For 4-cylinders engine: 1 − 3 − 4 − 2.

27. The value of Biot number is very small (<0.01) when _____.

A. conductive resistance of the fluid is negligible

B. conductive resistance within the body is negligible

C. convective resistance of a fluid surface of the body is negligible

D. none of the these

Ans. B

Sol. Biot Number is given by:

$$\text{Biot Number}\,(Bi) = \frac{\text{Internal Conduction resistance}}{\text{Convective Resistance}}$$

If Biot Number(Bi)<0.01

Conduction resistance should be negligible and that takes place in special case of unsteady heat transfer that is lumped capacity heat transfer in which inside temperature gradients is negligible.

28. The chemical formula for the refrigerant R-1150 is _____.

    A. C_2H_4 B. CCl_2F_2

    C. CH_4 D. NH_3

Ans. A

Sol. Designation ⇒ R1150, which suggests that refrigerant is unsaturated.

Complete designation is written as:

R-1(m − 1)(n + 1)P and formula will be $C_mH_nF_pCl_q$

m − 1 = 1 ⇒ m = 2

n + 1 = 5 ⇒ n = 4

P = 0

Since 2m = n + p + q

4 = 4 + 0 + q

q = 0

Thus, formula will be ⇒ C_2H_4.

29. A small percentage of Boron is added to steel in order to _____.

    A. Increase endurance strength   B. Reduce machinability

    C. Increase wear resistance   D. Increase hardenability

Ans. D

Sol.

o   Boron (B) is useful as an alloying element in the steel because it enhances the hardenability of steel.

o   Addition of boron in a quantity of up to 0.01% to austenitic steels also improves their high-temperature strength.

o   Boron has a high neutron absorption capability thus it also alloyed to certain types of stainless steel which are used in the nuclear industry.

o   Chromium increases the wear resistant

o   Sulphur and manganese increases machinability.

30. The forecast for the monthly demand of a product is given in the table below.

Month	Forecast	Actual Sales
1	32.00	30.00
2	31.80	32.00
3	31.82	30.00

The forecast is made by using the exponential smoothing method. The exponential smoothing coefficient used in forecasting the demand is

A. 1.00   B. 0.10

C. 0.50   D. 0.40

Ans. B

Sol.

Month	Forecast	Actual Sales
1	32.00	30.00
2	31.80	32.00
3	31.82	30.00

Since $f_t = f_{t-1} + α (D_{t-1} - F_{t-1})$

$F_3 = F_2 + α (D_2 - F_2)$

$31.82 = 31.80 + α (32 - 31.80)$

$α = 0.10$

31. What is the percentage increase in cutting speed when tool life is reduced to 60% use $VT^n = C$ and $n = 0.5$ _____.

A. 21%   B. 23%

C. 77%   D. 29%

Ans. D

Sol. Taylor's tool life is given by:

$$V_1 T_1^n = V_2 \left(0.6 T_1\right)^n$$

$$\frac{V_2}{V_1} = \left(\frac{T_1}{0.6\, T_1}\right)^{0.5}$$

$$\frac{V_2}{V_1} = 1.29$$

$$\%\text{increase} = \frac{V_2 - V_1}{V_1} = \frac{1.29 V_1 - V_1}{V_1}$$

$$\%\text{increase} = 29\%$$

32. The figure below shows a symbolic representation of the surface texture in a perpendicular lay orientation with indicative values (I through VI) marking the various specifications whose definitions are listed below.

P: Maximum Waviness Height (mm); Q: Maximum Roughness Height (mm);

R: Minimum Roughness Height (mm); S: Maximum Waviness Width (mm); T: Maximum Roughness Width (mm); U: Roughness Width Cutoff (mm).
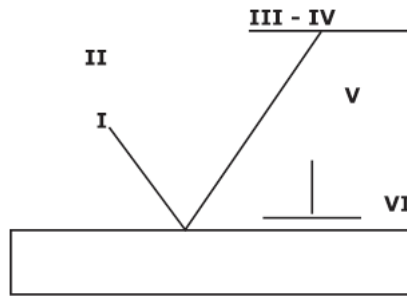
The correct match between the specifications and the symbols (I to VI) is

A. I-Q, II-U, III-R, IV-T, V-S, VI-P   B. I-R, II-Q, III-P, IV-S, V-U, VI-T

C. I-R, II-P, III-U, IV-S, V-T, VI-Q   D. I-U, II-S, III-Q, IV-T, V-R, VI-P

Ans. B

Sol.
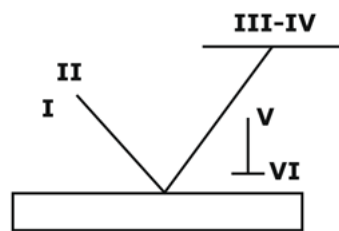
I = minimum roughness height (mm)

II = Maximum roughness height (mm)

III = Maximum waviness height (mm)

IV = Maximum waviness width (mm)

V = Roughness width cut off (mm)

VI = Maximum Roughness width (mm)

33. The radiative heat transfer rate per unit area (W/m^2) between two plane parallel grey surfaces (emissivity 0.9) maintained at 400 K and 300 K is (Stefan Boltzman constant σ= 5.67×10^{-8} W/m^{2}K^4) _____.

    A. 1020   B. 464

    C. 812   D. 567

Ans. C

Sol. Given:

   T_1 = 400 K,

   T_2 = 300 K

   ε = 0.9

   σ = 5.67×10^{-8} W/m^{2}K^4

Heat transfer rate is given by:

$$Q = \dfrac{\sigma\left(T_1^4 - T_2^4\right)}{\dfrac{1}{\varepsilon} + \dfrac{1}{\varepsilon_2} - 1}$$

$$Q = \dfrac{5.67 \times 10^{-8} \times \left(400^4 - 300^4\right)}{\dfrac{1}{0.9} + \dfrac{1}{0.9} - 1}$$

Q = 812 W/m²

34. Stress concentration factor for an elliptical hole is given by:
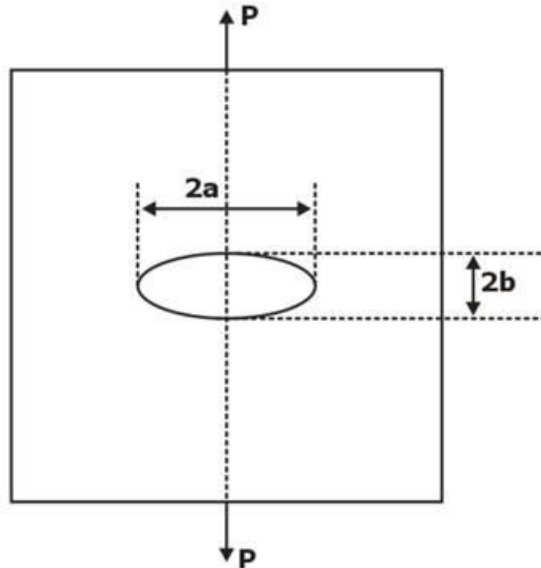
A. $K_t = 2\left(1 + \dfrac{a}{b}\right)$

B. $K_t = 1 + \left(\dfrac{2a}{b}\right)$

C. $K_t = \left(\dfrac{b}{a}\right)$

D. $K_t = 1 - \left(\dfrac{2a}{b}\right)$

Ans. B

Sol. Stress concentration factor for an elliptical hole is given by:

$$\boxed{K_t = 1 + \left(\dfrac{2a}{b}\right)}$$

35. The maximum efficiency of Parson's turbine for nozzle angle of 30° is _____.

A. 93.30%

B. 75%

C. 85.71%

D. 87.5 %

Ans. C

Sol. The maximum efficiency of Parson's turbine is given by:

$$\eta_{max} = \dfrac{2\cos^2 \alpha}{1 + \cos^2 \alpha}$$

Where α = Nozzle angle

$$\eta_{max} = \frac{2\cos^2 30°}{1 + \cos^2 30°}$$

$$= 0.8571$$

$$= 85.71 \%$$

36. If the velocity distribution in a turbulent boundary layer is given by $\frac{u}{u_\infty} = \left(\frac{y}{\delta}\right)^{\frac{1}{8}}$, then ratio of displacement thickness to nominal boundary layer thickness will be _____.

A. $\frac{1}{9}$　　　　　　　　　　　　　　　　B. $\frac{1}{8}$

C. $\frac{1}{7}$　　　　　　　　　　　　　　　　D. $\frac{1}{4}$

Ans. A

Sol. Displacement thickness (δ*) is given by:

$$\delta^* = \int_0^\delta \left(1 - \frac{u}{u_\infty}\right) dy$$

$$\delta^* = \int_0^\delta \left(1 - \left(\frac{y}{\delta}\right)^{\frac{1}{8}}\right) dy$$

$$= \left[y - \frac{y^{\frac{1}{8}+1}}{\frac{9}{8}\delta^{\frac{1}{8}}}\right]_0^\delta = \left[(\delta - 0) - \frac{8\delta^{\frac{9}{8}}}{9\delta^{\frac{1}{8}}} + 0\right]$$

$$= \delta - \frac{8}{9}\delta$$

$$\delta^* = \frac{\delta}{9} \Rightarrow \frac{\delta^*}{\delta} = \frac{1}{9}$$

37. For incompressible flow, a converging section acts as a diffuser for upstream flow which is:

A. Subsonic only　　　　　　　　　　B. Supersonic only

C. Both subsonic and supersonic　　　D. Sonic only

Ans. B

Sol. The relation between change in velocity, change is cross section area and Mach number (M) is given by:

Since $\frac{dA}{A} = \frac{dV}{V}(M^2 - 1)$

Where M = Mach number

For converging section:
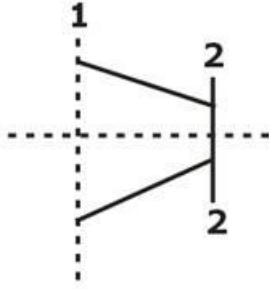
$$\frac{dA}{A} = \text{Negative}$$

When it acts as a diffuser i.e. velocity decreases at outlet section 2-2.

Thus, $\frac{dV}{V} = \text{Negative} \; (-\text{ve})$

Thus, M > 1 (always) i.e. the flow must be supersonic.

38. A small ball of mass 1 kg moving with a velocity of 8 m/s undergoes a direct central impact with a stationary ball of mass 2 kg. the impact is perfectly elastic. The speed of 2 kg mass ball after the impact is _____.

A. 8 m/s   B. 16 m/s

C. 4 m/s   D. 5.34 m/s

Ans. D

Sol. Conservation of linear Momentum:

$1 \times 8 = 1 \times V_1 + 2 \times V_2$

$V_1 + 2 V_2 = 8$ .... (1)

Since collision is perfectly elastic. Thus:

Velocity of approach = Velocity of separation

$8 - 0 = V_2 - V_1$

$V_2 - V_1 = 8$ .... (2)

By equation (1) and (2):

$3 V_2 = 16$

$V_2 = 5.33$ m/s

39. Joule-Thompson coefficient for an ideal gas is _____.

A. higher than zero   B. less than zero

C. zero   D. 1

Ans. C

Sol. Joule-Thompson coefficient of an ideal gas is zero as its enthalpy depends on only temperature.

$$\mu_J = \frac{1}{c_p}\left[T\left(\frac{\partial V}{\partial T}\right)_P - v \right] \qquad \dots \text{(a)}$$

For ideal gas: Pv = RT   … (1)

$$\left(\frac{\partial V}{\partial T}\right)_P = \frac{R}{P}$$ …(2)

On substituting values from (1) and (2):

Thus, $\mu_J = \frac{1}{c_p}\left[T\frac{R}{P} - v\right] = \frac{1}{c_p}[v - v] = 0$

40. The condition for the generation of discontinuous chips is _____.

   A. Machining of Ductile material at high cutting speed.

   B. Machining of Ductile material at low cutting speed.

   C. Machining of brittle material at high speed.

   D. Machining of brittle material at low speed

Ans. D

Sol. **Discontinuous Chips:** It means chips become broken pieces before it departs from the cutter. It is often happened in high brittle materials, such as cast iron or bronze.

   Cause of Discontinuous chips:

1. Highly brittle material of work piece

2. Smaller bevel of cut tools

3. Lower cutting speed, Large feed, thick chip

41. For the Cantilever beam as shown Below
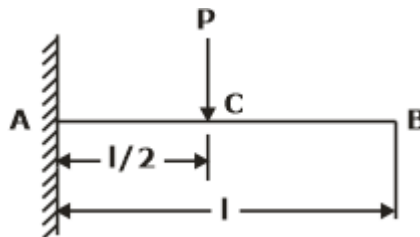
   Deflection At centre will be:

   A. $\dfrac{Pl^3}{3EI}$

   B. $\dfrac{Pl^3}{24EI}$

   C. $\dfrac{Pl^3}{8EI}$

   D. $\dfrac{Pl^3}{48EI}$

Ans. B

Sol. For cantilever Beam, deflection under point load P is given as,

   $\delta = \dfrac{PL^3}{3EI}$

   For deflection at centre, Put $L = \left(\dfrac{l}{2}\right)$

$$\therefore \delta = \frac{P\left(\frac{l}{2}\right)^3}{3EI} = \frac{pl^3}{24EI}$$

42. In process charts, the symbol used for inspection is _____.

A. ◯

B. ☐

C. ⇨

D. ▽
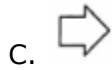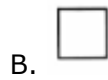
Ans. B

Sol.

Process chart activity	Symbol
Operation	O
Transportation	⇒
Inspection	☐
Delay	D
Storage	▽

43. Which one of the following is the expression of the vorticity component for a 2-D fluid element in x – y plane _____.

A. $\Omega_z = \frac{1}{2}\left(\frac{\partial u}{\partial y} - \frac{\partial v}{\partial x}\right)$

B. $\Omega_z = \frac{1}{2}\left(\frac{\partial v}{\partial x} - \frac{\partial u}{\partial y}\right)$

C. $\Omega_z = \left(\frac{\partial v}{\partial x} - \frac{\partial u}{\partial y}\right)$

D. $\Omega_z = \frac{1}{2}\left(\frac{\partial v}{\partial x} - \frac{\partial u}{\partial y}\right)$

Ans. C

Sol. Since Vorticity (Ω) is given by:

$$\Omega = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ u & v & w \end{vmatrix}$$

$$\Omega = \hat{i}\left(\frac{\partial w}{\partial x} - \frac{\partial v}{\partial z}\right) - \hat{j}\left(\frac{\partial w}{\partial x} - \frac{\partial u}{\partial z}\right) + \hat{k}\left(\frac{\partial v}{\partial x} - \frac{\partial u}{\partial y}\right)$$

On Comparison with: $\Omega = \Omega_x \hat{i} + \Omega_y \hat{j} + \Omega_z \hat{k}$

Vorticity in x-y plane is given by:

$$\boxed{\Omega_z = \frac{\partial v}{\partial x} - \frac{\partial u}{\partial y}}$$

44. The relationship between the linear elastic properties Young's Modulus (E), rigidity modulus (G) and Bulk modulus (K) is given by _____.

A. $\dfrac{9}{E} = \dfrac{3}{K} + \dfrac{1}{G}$

B. $\dfrac{1}{E} = \dfrac{9}{K} + \dfrac{3}{G}$

C. $\dfrac{3}{E} = \dfrac{9}{K} + \dfrac{1}{G}$

D. $\dfrac{9}{E} = \dfrac{1}{K} + \dfrac{3}{G}$

Ans. D

Sol. the relationship between three elastic property is

$$E = \dfrac{9KG}{3K + G}$$

therefore by simplifying

$$\dfrac{9}{E} = \dfrac{1}{K} + \dfrac{3}{G}$$

45. The efficiency of Carnot engine is given as 80 %. If the cycle direction is reversed, what will be the value of COP of reversed Carnot cycle _____?

A. 1.33

B. 0.5

C. 0.25

D. None of these

Ans. C

Sol. Efficiency of heat engine:

$\eta_{engine} = 0.80$

As reversed Carnot cycle is mentioned, thus device will work as a refrigerator.

Since: $(COP)_{ref} = (COP)_{HP} - 1$

and $(COP)_{HP} = \dfrac{1}{\eta_{engine}}$

Thus: $(COP)_{HP} = 1.25$

$(COP)_{ref} = 1.25 - 1 = 0.25$

46. The mean piston speed $\bar{s}_p$ in the internal combustion engines lies in the range of _____.

A. 4 to 8 m/s

B. 8 to 15 m/s

C. 10 to 30 m/s

D. 16 to 35 m/s

Ans. B

Sol. Mean piston speed $\bar{s}_p$ is given by:

$\bar{s}_p = 2\ LN$ m/min

Where L is the stroke and N is the rotational speed (in rpm) of the crankshaft.

Resistance to gas flow in to the engine or stresses due to inertia of the moving parts limit maximum values of $\bar{s}_p$ to within 8 to 15 m/s.

47. The installation of a draft tube in a reaction turbine helps to _____.
    A. Increase the flow rate
    B. Prevent air from entering
    C. Transport water to downstream without eddies
    D. Convert the kinetic energy to pressure head

Ans. D

Sol.

o   A draft tube is a pipe of gradually increasing area which connects the outlet of the runner to the tail race and is used to discharge water from the turbine exit to the tail race.

o   Its purpose is to convert a large proportion of kinetic energy which was being rejected at the outlet if the turbine into useful pressure energy.

48. Silicon steel is widely used in _____.
    A. cutting tools   B. dies and punches
    C. electrical industry   D. chemical industry

Ans. C

Sol. ● Silicon steel are magnetized steel which is manufactured in such a way to minimize hysteresis loss and minimize the loss of heat in electrical device
      ● hence option c is correct

49. The crystal structure of martensite is _____.
    A. FCC   B. BCC
    C. FCP   D. Body centred tetragonal

Ans. D

Sol.

o   Martensite is a phase formed by rapidly cooling or quenching austenite.

o   The rapid cooling prevents carbon atoms from diffusing, and therefore the crystal structure of martensite is body-cantered-tetragonal because carbon atoms are trapped between iron atoms and elongate the body-cantered unit cell in one direction.

o   Martensite is the hardest and most brittle phase of iron.

50. Current range in Sub-merged arc welding _____?
    A. 50-1000Amp   B. 200-2000Amp
    C. 50-500Amp   D. 1000-10000Amp

Ans. B

Sol.

o   In submerged-arc welding (SAW) process, the arc is formed between a continuously fed wire electrode and the workpiece, and the weld is formed by the arc melting the workpiece and the wire.

o   In SAW a shielding gas is not required as the layer of flux generates the gases and slag to protect the weld pool and hot weld metal from contamination.
    As SAW is a high current welding process, the equipment is designed to produce high deposition rates. Current for SAW ranges from as low as 200 A to as high as 2000 A.

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