## HAL MT 2022

## Mechanical Engineering

## Sample Question Paper

## Questions \& Answer Key

1. In the following question, select the odd word from the given alternatives.
A. Cobbler
B. Carpenter
C. Farmer
D. Potter

Ans. C
2. How many pairs of letters in the word 'CHAIRS' have as many letters between them in the word as in the alphabet?
A. 3
B. 2
C. 1
D. 5

Ans. B
3. In each of the following questions, select the related word/letters / number from the given alternatives.
2, 4, $2: 4,16,4:: 1,1,1: ?$
A. $2,4,2$
B. $1,1,1$
C. 2, 2, 2
D. $2,13,2$

Ans. B
4. Arrange the given words in the sequence in which they occur in the dictionary:
i. Fantasy
ii. Fanatic
iii. Fascinate
iv. Favourite

Select the correct answer using the codes given below:
A. iv, ii, i, iii
B. ii, i, iii, iv
C. ii, iii, i, iv
D. i, iv, ii, iii

Ans. B
5. In the following questions, find the odd number/word from the given alternatives. Find the odd one out
A. Animal
B. Othello
C. Noun
D. Madam

Ans. C
6. At what time(in minutes after 5 ) between $5: 30$ and 6 will the hands of a clock be at right angle?
A. $478 / 11$
B. $480 / 11$
C. 40
D. 45

Ans. B
7. Directions: In each of the following questions, identify the diagram that best represents the relationship among classes given below:
M.K. Gandhi, Umesh Chandra Bandhopadhyay, Jatin Das and Surya Sen
A.

B.

C.

D.


Ans. B
8. Direction: In the following question, a mirror is placed on line MN. Then which of the answer figures is the correct image of the given figure?

## Question Figure:


A.

B.

C.

D.


Ans. C
9. In the following question, two statements are given each followed by two conclusions I and II. You have to consider the statements to be true even if they seem to be at variance from commonly known facts. You have to decide which of the given conclusions, if any, follows from the given statements.

## Statement:

(I) Some authors are teachers.
(II) No teacher is a lady.

## Conclusions:

(I) Some teachers are not ladies.
(II) Some ladies are not teachers.
A. Conclusion I follows
B. Conclusion II follows
C. Neither I nor II follows
D. Both I and II follows

Ans. D
10. Direction: Select the one which is different from the other three responses.
A. Hour
B. Day
C. Second
D. Time

Ans. D
11. In the sentence, identify the segment which contains the grammatical error. If the sentence has no error, then select 'No error'.

Breaking all the records, the number of applications has risen this year by as many as 50\%.
A. Breaking all the records
B. the number of applications has risen
C. this year by as many as $50 \%$
D. No Error

Ans. C
12. In the sentence, identify the segment which contains the grammatical error. If the sentence has no error, then select 'No error'.
No source of energy is so cheap as solar energy in the present age of energy crisis.
A. No source of energy is so cheap
B. as solar energy
C. in the present age of energy crisis
D. No Error

Ans. A
13. Each of the following sentences in this section has a blank space and four words or group of words are given after the sentence. Select the most appropriate word or group of words for the blank space and indicate your response to the Answer Sheet accordingly. The deserted garden was infested $\qquad$ weeds.
A. for
B. into
C. with
D. on

Ans. C

## 14. Select the most appropriate option to fill in the blank.

The general scientific assumption is that any amount of radiation, however small, will cause genetic damage that will appear as $\qquad$ in the future.
A. mutations
B. disabilities
C. diseases
D. handicaps

Ans. A
15. Choose the most appropriate option to change the narration (direct/indirect) of the given sentence.
"Please, take me to the officer," said the visitor.
A. The visitor requested them to take him to the officer.
B. The visitor told them to take him to the officer.
C. The visitor requested for the officer to be taken.
D. The visitor wanted the officer to take him there.

Ans. A
16. Choose the most appropriate option to change the narration (direct/indirect) of the given sentence.
"Sunday", he said, "is the most awaited day".
A. Sunday, he said that is the most awaited day.
B. He said that Sunday is the most awaited day.
C. He said that it was the most awaited day being sunday.
D. He said that Sunday was the most awaited day.

Ans. D
17. Direction: Given below is a sentence, the words of which are given in a group, in a jumbled manner. These words are numbered from 1. Identify the correct sequence of numbers from the options given. \{Make sure that the reordered sentence would appeal to the reader\}: to education (1)/ but is also (2)/ the cinema offers (3)/ a valuable aid (4)/ not only amusement (5)/
A. 52143
B. 35241
C. 35412
D. 45132

Ans. B
18. Identify the best way to improve the underlined part of the given sentence. If there is no improvement required, select 'no Improvement'.
Migrant workers can seen working on many of the building sites in New Delhi.
A. can be seen working on
B. can be see working on
C. can see working
D. No improvement

Ans. A
19. Identify the incorrect sentence:
A. My recruitment strategies resulted in finding 10 participants.
B. We will stop at many attractions along the way.
C. The ability to read and analyse these records demands significant linguistic and methodological training.
D. Building capacity, by itself, are no panacea for effective policy formulation.

Ans. D
20. Select the most appropriate synonym of the given word. PLEBISCITE
A. referendum
B. reservation
C. representation
D. renunciation

Ans. A
21. Equilibrium of the monopolistic competition
A. necessarily is profitable
B. occurs where $P=M C$
C. occurs where $M R=M C$
D. occurs where $P=M R$

Ans. C
22. Price theory is also known as
A. Macro Economics
B. Development Economics
C. Public Economics
D. Micro Economics

Ans. D
23. Which crop has been given cent percent (100\%) Government assistance under the central government scheme "Thrust"?
A. Wheat
B. Rice
C. Yellow Lentil
D. All of These

## Ans. D

24. Which of the following cities is located on the bank of Spree river?
A. Baghdad
B. Berlin
C. Cairo
D. Moscow

Ans. B
25. The Rajputana Agency included how many princely states?
A. 17
B. 18
C. 19
D. 20

Ans. D
26. Who is the author of the book 'Shahnameh'?
A. Ibn Batuta
B. Ferdowsi
C. Firoz Shah
D. Amir Khusrau

Ans. B
27. 'Mithun' is the state symbol of which of the following state of India?
A. Andhra Pradesh
B. Arunachal Pradesh
C. Assam
D. Uttarakhand

Ans. B
28. What is the responsibility of Delhi Police?
A. Investigating crimes
B. Protection of women
C. Controlling criminal activities
D. All of the above

Ans. D
29. Who was first person to sight the mainland of Antarctica?
A. Alfred Nobel
B. Fabian Bellinghausen
C. Paul Muller
D. William Roentgen

Ans. B
30. Lisp is a programming language built by whom?
A. John McCarthy
B. Dennis Ritchie
C. Larry Wall
D. Rasmus Lerdorf

Ans. A
31. Sensible heat is the heat needed to
A. vaporize water into steam and vice versa
B. Change the temperature of a liquid or vapour
C. convert water into steam and superheat it
D. measure dew point temperature

Ans. B
32. Air flows over a 10 m long plate. The transition from laminar to turbulent flow takes place between Reynolds number of $2.5 \times 10^{6}$ and $3.6 \times 10^{6}$. What is the maximum distance from
the front edge of the plate along which one can expect laminar flow in the boundary layer? The free stream velocity is $30 \mathrm{~m} / \mathrm{s}$ and kinematic viscosity $(\mathrm{v})=1.5 \times 10^{-5} \mathrm{~m}^{2} / \mathrm{s}$.
A. 0.89 m
B. 1.25 m
C. 1.65 m
D. 1.80 m

Ans. B
33. In brazing process the melting takes place in
A. parent metal only
B. filler metals only
C. parent as well as filler metals
D. none of the above

## Ans. B

34. A boiler shell of cylindrical shape, having a capacity of $2 \mathrm{~m}^{3}$ is subjected to an internal pressure of 1600 kPa . The strain gauge readings in the longitudinal and perpendicular directions are $25 \times 10^{-6}$ and $112.5 \times 10^{-6}$. Due to this, the change in volume suffered by the boiler shell is( in $\mathrm{cm}^{3}$ ) $\qquad$ .
A. 300
B. 500
C. 250
D. 600

Ans. B
35. A diesel engine having the compression ratio 16 and cut-off ratio 2.6. The clearance volume of the diesel engine is $45 \mathrm{~cm}^{3}$. Find the volume of the gas when piston has completed $40 \%$ of the compression stroke.
A. $360 \mathrm{~cm}^{3}$
B. $405 \mathrm{~cm}^{3}$
C. $450 \mathrm{~cm}^{3}$
D. Insufficient data

Ans. C
36. Three very large plates of same are kept parallel and close to each other. They are considered as ideal black surfaces and have very high thermal conductivity. The first and third plates are maintained at temperatures 2 T and 3 T respectively. The temperature of the middle (i.e. second) plate under steady state condition is
A. $\left(\frac{65}{2}\right)^{\frac{1}{4}} \mathrm{~T}$
B. $\left(\frac{97}{4}\right)^{\frac{1}{4}} \mathrm{~T}$
C. $\left(\frac{97}{2}\right)^{\frac{1}{4}} \mathrm{~T}$
D. $97^{\frac{1}{4}} \mathrm{~T}$

Ans. C
37. A skateboarder of mass 45 kg runs towards a stationary skateboard of 5 kg with a constant speed of $15 \mathrm{~ms}^{-1}$ and gets on it and the board now moves in the straight direction. The wheels of the skateboard are frictionless. If the law of conservation of momentum holds true, find the speed at which they will move in the horizontal direction.
A. $10 \mathrm{~ms}^{-1}$
B. $15 \mathrm{~ms}^{-1}$
C. $17.5 \mathrm{~ms}^{-1}$
D. $13.5 \mathrm{~ms}^{-1}$

Ans. D
38. In whitworth quick return mechanism, if length of extension link on which tool is pivoted is 150 mm , then what is the length of stroke?
A. 75 mm
B. 150 mm
C. 300 mm
D. 600 mm

Ans. C
39. Vibrating system consists of a mass of 50 kg , a spring with a stiffness of $\mathrm{X} k \mathrm{kN} / \mathrm{m}$ and a damper. The damping provided is $20 \%$ of the critical value. The damped frequency is 24 $\mathrm{rad} / \mathrm{s}$. Then $\mathrm{X}(\mathrm{kN} / \mathrm{m})$ is
A. 15
B. 30
C. 45
D. 60

## Ans. B

40. In an inward flow reaction turbine $\qquad$ .
A. The water flows parallel to the axis of the wheel
B. The water enters the center of wheel and there flows towards the outer periphery of the wheel
C. The water enters the wheel at the outer periphery, and then flows towards the centre of the wheel
D. The flow of water is partly radial and partly axial

## Ans. C

41. For a fluid having prandtl no. equal to 6.54 at $18^{\circ} \mathrm{C}$, if the thermal boundary layer thickness is 8 cm . Find the boundary layer thickness for the fluid.
A. 0.024 m
B. 14.96 cm
C. 24.63 cm
D. 6.73 cm

Ans. B
42. Raw material for all iron and steel product is $\qquad$ .
A. Cast iron
B. Wrought iron
C. Pig iron
D. Steel

Ans. C
43. In a reaction turbine, the draft tube is used $\qquad$ .
A. To run the turbine full
B. To prevent air to enter the turbine
C. To increase the effective head of water
D. To transport water to downstream

## Ans. C

44. Which of the following is true with relative to basic thermodynamics?
A. In free expansion, Since vacuum does not offer any resistance, there is no work transfer involved in free expansion.
B. $100 \%$ heat can't be converted to work but $100 \%$ work can be converted to heat. It depends on second law of thermodynamics.
C. Heat transfer in any finite temp difference is irreversible
D. All of these

Ans. D
45. A body is brought to rest by a force 1 in a very short time. The same body when moving the with the same initial velocity is brought to rest over a longer period of time by force 2? What can be said about the two forces?
A. Force $1>$ Force 2
B. Force $1=$ Force 2
C. Force 1 < Force 2
D. Insufficient information

## Ans. A

46. Which of the following is acceptable phrase of the Kelvin-Planck statement of the $2^{\text {nd }}$ law of thermodynamics $\qquad$ .
A. an engine has to reject heat
B. an engine can produce work without accepting power
C. no process can produce more work than the amount of heat input
D. None of these

Ans. A
47. The whal factor $(k)$ is
(where 'C' is ratio of mean diameter to wire diameter of a spring)
A. $\frac{4 C-1}{4 C-4}+\frac{0.615}{C}$
B. $\frac{4 C+1}{4 C-4}+\frac{0.615}{C}$
C. $\frac{4 C+1}{4 C+4}-\frac{0.615}{C}$
D. $\frac{4 C-1}{4 C-4}-\frac{0.615}{C}$

Ans. A
48. For newly opened industry, smoothing constant should be
A. Low
B. High
C. 0
D. More than 1

Ans. B
49. A porter lifts a luggage of 15 kg from the ground and puts it on his head 1.5 m above the ground. Calculate the work done by him on the luggage. (Take $\mathrm{g}=10 \mathrm{~ms}^{-2}$ )
A. 250 J
B. 225 J
C. 120 J
D. Zero

Ans. B
50. A steel rod of 200 mm length held between two rigid supports is heated by 35 K . If the coefficient of thermal expansion is $15 \times 10^{-6}$ per K and modulus of elasticity is 200 GPa . The stress induced in the rod is $\qquad$
A. 150 MPa
B. 250 MPa
C. 100 MPa
D. 105 MPa

## Ans. D

51. What is the loading in grinding operation?
A. Blunt wheel grinding
B. Dressing of grinding wheel
C. Chips clogged around the abrasives
D. None of these

Ans. C
52. While cooling, a cubical casting of side 50 mm undergoes $1 \%, 2 \%$ and $3 \%$ volume shrinkage during the liquid state, phase transition and solid state, respectively. The volume of metal compensated from the riser is $\qquad$ _.
A. $2 \%$
B. $3 \%$
C. $5 \%$
D. $6 \%$

Ans. B
53. If given relation is $\sigma=1000(\epsilon)^{0.4}$ then the average stress is equal to
A. $\sigma_{\mathrm{avg}}=1000(0.4)^{0.4}$
B. $\sigma_{\mathrm{avg}}=\frac{1000(\epsilon)^{0.4}}{0.8}$
C. $\sigma_{\mathrm{avg}}=0.4(\epsilon)^{0.4}$
D. $\sigma_{\mathrm{avg}}=\frac{1000(\epsilon)^{0.4}}{1.4}$

Ans. D
54. A reversible thermodynamic device operates between the temperature limits of 500K, 1100 K and 300 K and produces 1000 kJ of work. If it absorbs 500 kJ of heat from Thermal reservoir of 500 K , find the heat exchanged with 300 K reservoir.
A. 300kJ absorbed by the device
B. 150 kJ rejected by the device
C. 300kJ rejected by the device
D. 600 kJ rejected by the device

Ans. D
55. For a constrained kinematic chain having 6 link and no higher pair, the relative motion among the links is also assumed to have a Degree of Freedom as 1. Find the number of binary joints.
A. 7
B. 8
C. 10
D. 6

Ans. A
56. Which of the following measuring device is used to measure cutting force.
A. Autocollimator
B. Dynamometer
C. Anemometer
D. Hygrometer

Ans. B
57. Wet Bulb Depression is equal to $\qquad$ .(DBT means dry bulb temperature, WBT means wet bulb temperature and DPT means dew point temperature)
A. DBT-WBT
B. WBT-DPT
C. DBT-DPT
D. None of These

Ans. A
58. A steel bar of $50 \mathrm{~mm} \times 50 \mathrm{~mm}$ square cross-section is subjected to an axial compressive load of 200 kN . If the length of the bar is 2 m and $\mathrm{E}=160 \mathrm{GPa}$, then the magnitude of deformation of the bar will be?
A. 1 mm
B. 2 mm
C. 4 mm
D. 1.1 mm

Ans. A
59. Essential gradient of any hardened steel is $\qquad$ .
A. Carbon
B. Austentite
C. Martensite
D. Pearlite

Ans. C
60. In a reaction turbine the enthalpy drop in a stage is 45 units, the enthalpy drop in moving blades is 23 units. The degree of reaction is $\qquad$ ?
A. 0.345
B. 0.511
C. 0.682
D. 1.386

Ans. B
61. At a point in 2 D stress system $\sigma_{x}=130 \mathrm{~N} / \mathrm{mm}^{2}, \sigma_{y}=\mathrm{T}_{\mathrm{xy}}=40 \mathrm{~N} / \mathrm{mm}^{2}$. What is the radius of the Mohr circle for stress drawn with a scale of $1 \mathrm{~cm}=10 \mathrm{~N} / \mathrm{mm}^{2}$
A. 3 cm
B. 4 cm
C. 5 cm
D. 6 cm

Ans. D
62. The brakes applied to a car moving at $24 \mathrm{~m} / \mathrm{s}$ produce an acceleration of $6 \mathrm{~m} \mathrm{~s}^{-2}$ in the opposite direction to the motion. If the car takes 2 s to stop after the application of brakes, the distance travelled by car is
A. 24 m
B. 18 m
C. 36 m
D. 16 m

Ans. C
63. A shaft of diameter $D$ is subjected to a torque $T$. To have the angle of twist four times as that before, the percentage reduction in diameter needed is $\qquad$ .
A. 20
B. 30
C. 40
D. 50

## Ans. B

64. Lancashire Boiler is a
A. Water tube boiler
B. Fire tube boiler
C. Locomotive boiler
D. High pressure boiler

Ans. B
65. A heat engine receives 1000 kJ of heat and produces 600 kJ of work. The amount of heat rejected in kJ and the efficiency percentage of the engine, respectively will be
A. $400,40 \%$
B. $400,60 \%$
C. $600,40 \%$
D. $600,60 \%$

Ans. B
66. A roller contact type bearing has a rated bearing capacity of 20000 N and design load of 4000 N . The speed of the journal is 600 rpm . Determine the life of the bearing in million revolutions.
A. 3472
B. 987
C. 558
D. 213

Ans. D
67. The cycle generally used for petrol engine is:
A. Otto cycle
B. Dual cycle
C. Carnot cycle
D. Brayton cycle

Ans. A
68. Which cycle consists of two reversible isothermals and two isochoric $\qquad$ ?
A. Lenoir cycle
B. Atkinson cycle
C. Stirling cycle
D. Ericsson cycle

Ans. C
69. Find the modulus of elasticity of a rod, which tapers uniformly from 30 mm to 15 mm diameter in a length of 300 mm . The rod is subjected to axial load of 5 kN and extension of rod is 0.022 mm .
A. $1.96789 \times 10^{5} \mathrm{~N} / \mathrm{mm}^{2}$
B. $2.145 \times 10^{5} \mathrm{~N} / \mathrm{mm}^{2}$
C. $1.92915 \times 10^{5} \mathrm{~N} / \mathrm{mm}^{2}$
D. $1.8976 \times 10^{5} \mathrm{~N} / \mathrm{mm}^{2}$

## Ans. C

70. In a fillet welded joint, the weakest area of the weld is
A. Toe
B. Root
C. Throat
D. Face

Ans. C
71. An open system is one in which:
A. Mass does not cross boundaries of the system, though energy may do so
B. Neither mass nor energy crosses the boundaries of the system
C. Both energy and mass cross the boundaries of the system
D. Mass crosses the boundary but not the energy

## Ans. C

72. Two involute gears in mesh have a module of 7.5 mm and pressure angle of $20^{\circ}$. The gear has 60 and pinion has 32 teeth. The ratio of sliding to the rolling velocity at the pitch point, considering addenda on pinion and gear wheel as one module, will be
A. 0.34
B. 0.296
C. 0.32
D. 0

Ans. D
73. Consider a system of two identical particles. One of the particles is at rest and the other has an acceleration $a$. The center of mass has an acceleration
A. Zero
B. $1 / 2 \mathrm{a}$
C. a
D. $2 a$

Ans. B
74. In order to facilitate the withdrawal of pattern $\qquad$
A. Pattern is made smooth
B. Water is applied on pattern surface
C. Allowances are made on pattern
D. Draft is provided on pattern

## Ans. D

75. A spring mass damper system, the mass is 5 kg and undamped natural frequency is 40 Hz . What is the value of critical damping coefficient?
A. $2514 \mathrm{~N}-\mathrm{s} / \mathrm{m}$
B. $2717 \mathrm{~N}-\mathrm{s} / \mathrm{m}$
C. $3316 \mathrm{~N}-\mathrm{s} / \mathrm{m}$
D. $3712 \mathrm{~N}-\mathrm{s} / \mathrm{m}$

Ans. A
76. Which one of the following numbers represents the ratio of kinematic viscosity to the thermal diffusivity?
A. Grashoff number
B. PrandtI number
C. Mach number
D. Nusselt number

Ans. B
77. A 0.5 m diameter pipe bifurcates at a Y -section into two branches 20 cm and 40 cm in diameter. If the rate of flow in the main pipe is $0.6 \mathrm{~m}^{3} / \mathrm{sec}$ and through the smaller diameter pipe is $0.25 \mathrm{~m}^{3} / \mathrm{sec}$. Determine the velocity of flow in 40 cm pipe.
A. $6.36 \mathrm{~m} / \mathrm{s}$
B. $1.452 \mathrm{~m} / \mathrm{s}$
C. $2.785 \mathrm{~m} / \mathrm{s}$
D. $2.425 \mathrm{~m} / \mathrm{s}$

Ans. C
78. A self-service store employs one cashier at its counter. Nine customers arrive on an average every 5 minutes while the cashier can serve 10 customers in 5 minutes. Assuming Poisson distribution for arrival rate and exponential distribution for service time.
Average number of customers in the system and the average queue length, respectively, will be
A. $9,8.1$
B. $8.1,9$
C. 7,6.5
D. $6.5,9$

Ans. A
79. In a shaping operation, one double stroke comprises of cutting stroke and return stroke. If the velocity of cutting stroke is $12 \mathrm{~mm} / \mathrm{min}$, the most probable velocity of return stroke will be
A. $10 \mathrm{~mm} / \mathrm{min}$
B. $6 \mathrm{~mm} / \mathrm{min}$
C. $15 \mathrm{~mm} / \mathrm{min}$
D. $8 \mathrm{~mm} / \mathrm{min}$

Ans. C
80. What is the shape factor of a hemispherical body placed on a flat surface with respect to itself?
A. Zero
B. 0.25
C. 0.5
D. 1.0

Ans. C

