Mechanical Engineering — Sample Paper-1

Q.1- When two spur gears having involutes profiles on their teeth engage, the line of action is tangential to the---
(a) Pitch circles (b) Dedendum circles (c) Addendum circles (d)Base circles

Q.2- Which of the following is correct in respect of poission ratio (μ) limits for an isotropic elastic solid?
(a) $-\infty \le \mu \le \infty$ (b)¼ $\le \mu \le 1/3$ (c) $-1 \le \mu \le ½$ (d) $-½ \le \mu \le ½$

Q.3- A 31.8mm HSS drill is used to drill a hole in a cast iron block 100mm thick at a cutting speed 20m/mm and feed 0.3mm/rev. If the over travel of drill is 4mm and approach 9mm then the time required to drill the hole is-
(a) 1 min 40 sec (b)1 min 49 sec (c)1 min 44 sec (d) 1 min 53 sec

Q.4- Match the following

P-Reciprocating pump	1.plant with power output below 100kW
Q-Axial flow pump	2.plant with power between 100kW to 1MW
R-Microhydel plant	3.Positive displacement
S- Backward curved vanes	4.Draft tube
	5.High flow rate,low pressure ratio
	6.centrifugal pump impeller

Codes :
(a) P-3 Q-5 R-6 S-2 (b) P-3 Q-5 R-2 S-6
(c) P-3 Q-5 R-1 S-6 (d) P-4 Q-5 R-2 S-6

Q.5- Consider an actual regenerative Rankine cycle with one open feed water heater. For each kg steam entering the turbine, if m kg steam with a specific enthalpy of h1 is bled from the turbine of saturated liquid leaving the heater is equal to
(a) $mh_1 -(h_2 - h_1)$ (b) h_1-$m(h_2 - h_1)$ (c) h_2-$m(h_2$-$h_1)$ (d) mh_2-$(h_2$-$h_1)$

Q.6- In a m/c tool gear box the smallest and largest spindles are 100 rpm and 1120 rpm respectively. It there are 8 speeds in all, the speed will be-
(a) 400 rpm (b) 280 rpm (c) 800 rpm (d) 535 rpm

Q.7- What is the expression for the strain energy due to bending of a cantilever beam (length 'L' modulus of elasticity 'E' and moment of inertia 'I')

(a) $P^2L^3/3EI$ (b) $P^2L^3/6EI$ (c) $P^2L^3/4EI$ (d) $P^2L^3/48EI$

Q.8- A strip is to be rolled from a thick-ness of 30mm to 15mm using two high mill having rolls of diameter 300mm. The coefficient of friction for unaided bite should nearly be-

(a) 0.35 (b) 0-5 (c) 0.25 (d) 0.07

Q.9- In a standard vapour compression refrigeration cycle, operating between an evaporator temperature of -10^{O}C and a condenser temperature of 40^{O}C, the enthalpy of the refrigerant, from – 12, at the end of compression is 220 kJ/kg. Show the cycle diagram on T-s plane.

Calculate

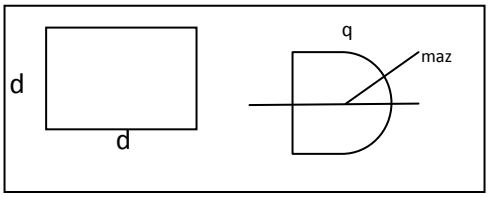
A. The COP of the cycle
B. The refrigeration capacity and the compressor power assuming a refrigerant flow rate of 1kg/min.

T(^{O}C)	p(MPa)	h_f(kj/kg)	h_g(kj/kg)
-10	0.2191	26.85	183.1
40	0.9607	74.53	203.1

(a) 2.94 (b) 3.44 (c) 56.4 (d) 12.3

Q.10- The ratio of average shear stress to the maximum shear in a beam with a square cross-section is

(a) 1
(b) 2/3
(c) 3/2
(d) 2



Q.11- A ranking cycle operates between pressures of 80 bar and 0.1 bar. The maximum cycle temperature is 600^{O}C. If the steam turbine and condensate pump efficiencies are 0.9 and 0.8, respectively, calculate the specific work and thermal efficiency. Relevant steam table extract is given below:

P bar	T^{O}C	Specific volume m^3/kg		Specific enthalpy kj/kg			Specific entropy kJ/kg K		
		V_f	V_g	H_f	H_{fg}	H_g	S_r	S_{fg}	S_g
0/1 80	45.84 295.1	0.0010103 0.001385	14.68 0.0235	191.9 1317	2392.3 1440.5	2584.2 2757.5	0.6488 3.2073	7.5006 2.5351	8.1494 5.7424

80 bar - 600^{O}C	v	0.486
Superheat table	h	3642
	S	7.0206

(a) 21.7 (b) 23.2 (c) 27.1 (d) 23.4

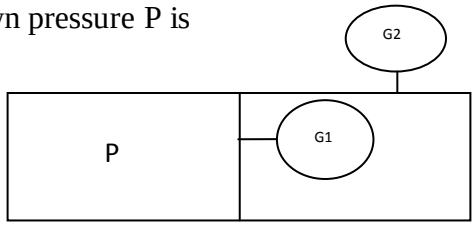
Q.12- Find the required air- fuel ratio in a gas turbine whose turbine and compressor efficiencies are 85% and 80% respectively. Maximum cycle temperature is 85^{O}C. The working fluid can be taken as air (Cp = 1.00 kJ/kg K, γ=1.4) which enters the compressor at 1 atm and 27^{O}C. The pressure ratio is 4. The fuel used has calorific value of 42000 kJ/kg. There is a loss of 10% of calorific value in the combustion chamber.
(a) A/F ratio =56.80 (b) A/F ratio =45.85 (c) A/F ratio =23.63 (d) A/F ratio =53.82

Q.13- When an ideal gas with constant specific heats is throttled adiabatically, with negligible changes in kinetic and potential energies.
(a) dh=0, dt=0 (b) dh>0, dt=0 (c) dh>0, ds>0 (d) dh=0, ds>0
Where h, T and s represent respectively, enthalpy, temperature and entropy.

Q.14- A gas having a negative joule- Thompson coefficient (μ<0), when throttled, will
(a) become colder (b) either be cooler or warmer depending on the type of gas
(c) remain at the same temperature (d) become warmer

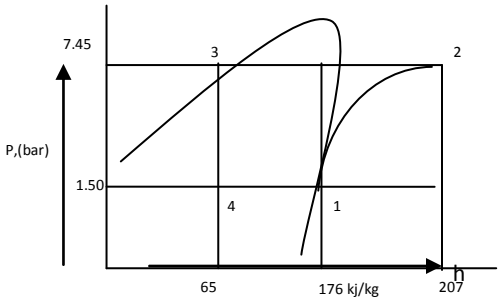
Q.15- The pressure gauges G1 and G2 installed on the system show pressure of Pg1 = 5.00 bas and PG2 = 1.00 bar. The value of unknown pressure P is

(a) 1.01 bar
(b) 2.01 bar
(c) 5.00 bar
(d) 7.01 bar



Q.16- A R-12 refrigerant reciprocating compressor operates between the condensing temperature of 30^{O}C and evaporator temperature of 20^{O}C. The clearance volume ratio of the compressor is 0.03. Specific heat ratio of the vapour is 1.15 and the specific volume at the suction is 0.1089 m^3/kg. Other properties at various states are given in the figure. To realize 2 tons of refrigeration, the actual volume displacement rate considering the effect of clearance is

(a) 6.35 * 10-3 m^3/s
(b) 635 *10-3 m^3/s
(c) 63.5 *10-3 m^3/s
(d) 4.88 *10-3 m^3/s

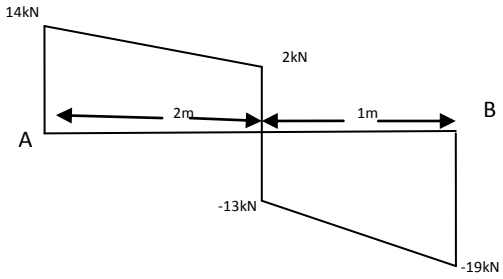


Q.17- The operating temperature of a cold storage is -2^{O}C. Heat leakage from the surrounding is 30 kW for the ambient temperature of 40^{O}C. The actual COP of the refrigeration plant is one-fourth that of an ideal plant working between the same temperatures. The power required to drive the plant is

(a) 1.86kW (b) 3.72kW (c) 7.44kW (d) 18.6kW

Q.18- The shear force diagram of a loaded beam is shown in the figure given below. The maximum bending moment of the beam is

(a) 16 kN-m
(b) 11kN-m
(c) 28kN-m
(d) 8kN-m



Q.19- Match List I (Parts) with List II (Manufacturing process) and select the correct answer using the codes given below the lists:

List I (Parts)	List II (Manufacturing processes)
A. Seamless tubes	1. Roll Forming
B. Accurate and smooth tubes	2. Shot Pining
C. Surface having higher hardness and fatigue strength	3. Forging
	4. Cold forming

(a) A-1 B-4 C-2 (b) A-2 B-3 C-1
(c) A-1 B-3 C-2 (d) A-2 B-4 C-1

Q.20- Otto cycle efficiency is higher than Diesel cycle efficiency for the same compression ratio and heat input because, in Otto cycle
(a) Combustion is at constant volume
(b) Expansion and compression are isentropic
(c) Maximum temperature is higher
(d) Heat rejection is lower

Q.21- If D_1, D_2 are two diagonal matrices, then
(a) $D_1 D_2 = D_2 D_1$ (b) $D_1 D_2$ is a Diagonal matrix
(c) Both of the above (d) $D_1 D_2$ may or may not defined

Q.22- If $A = \begin{bmatrix} 1 & 2 \\ 4 & -3 \end{bmatrix}$, then $A^2 + 4A - 5I$ equal to

(a) $\begin{bmatrix} 8 & 4 \\ 8 & 0 \end{bmatrix}$ (b) $\begin{bmatrix} 0 & -4 \\ 8 & 8 \end{bmatrix}$ (c) $\begin{bmatrix} 2 & 1 \\ 2 & 0 \end{bmatrix}$ (d) $\begin{bmatrix} 1 & 1 \\ 1 & 0 \end{bmatrix}$

Q.23- If tow square are chosen at random on a chess board the probability that they have side in common is

(a) 1/9 (b) 2/7 (c) 1/18 (d) none

Q.24- An I.F. of the differential equation $(1-x^2)\frac{dy}{dx} - xy = 1$ is

(a) $-x$ (b) $\frac{x}{1-x^2}$ (c) $\sqrt{1-x^2}$ (d) $\frac{1}{2}\log_e(1-x^2)$

Q.25- A garrison of 3000 men has provision for 25 days, when given at the rate of 900g per head. At the end of 11 days, a reinforcement arrives and it was found that now the provision will be last 10 days more, when given at the rate of 840 g per head. The strength of reinforcement is
(a) 1200 men (b) 1500 men (c) 1600 men (d) 1800 men

Q.26- Out of the given alternatives, choose the one which can be substituted for the given words or sentences.
Too much official formality
(a) delayed (b) officiousness (c) formality (d) red tapism

Q.27- The following questions comprise two word each that have a certain relationship between them, followed by four lettered pair of word. Select the lettered pair that has the relationship as the original pair of words.
i) shrub : prune
(a) beard : shave (b) hair : trim
(c) lawn: mow (d) wool : shear

Q.28- A group of employees promise to do a piece of work in 12 days, but 5 of them do not turn up. If the rest of the group does the work in 18 days, find the original number of men.
(a) 15 (b) 25 (c) 35 (d) 45

Q.29- Hari (H), Gita(G), Irfan(I) and Saira(S) are siblings(i.e., brothers and sisters). All were born on Ist January. The are difference between any two successive siblings (that is born one after another) is less than 3 year. Given the following facts:
I. Hari's age + Gita's age > Irfan's age + Saira's age
II. The age difference between Gita ans Saira os 1 year. However, Gita is not the oldest and Saira is not the youngest.
III. There are no twins.
In what order were they born (oldest first)?
(a) HSIG (b) SGHI (c) IGSH (d) IHSG

Q.30- Given digits 2,2,3,3,3,4,4,4,4 how many distinct 4 digit numbers greater than 3000 can be formed?
(a) 50 (b) 51 (c) 52 (d) 54