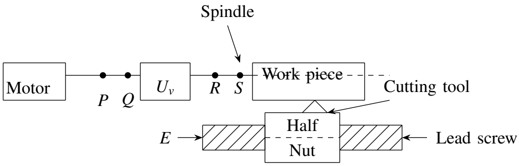
2008-ME-69-85

EE24BTECH11010 - BALAJI B

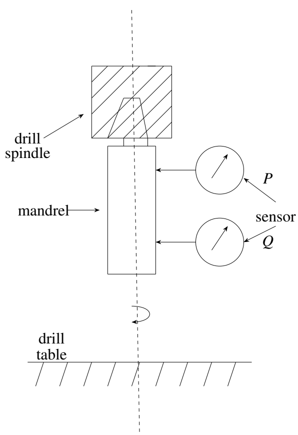
1) The figure shows an incomplete schematic of a conventional lathe to be used for cutting threads with different pitches. The speed gear box U_v is shown and the feed gear box U_s is to be placed. P, Q, R and S denote locations and have no other significance. Changes in U_v should **NOT** affect the pitch of thread being cut and changes in U_s should **NOT** affect the cutting speed.



The correct connections and the correct placement of U_s are given by (2008-ME)

a) Q and E are connected. U_s is placed between P and Q
b) S and E are connected. U_S is placed between R and S
c) Q and E are connected. U_s is placed between Q and E
d) S and E are connected. U_s is placed between S and E

2) A displacement sensor (a dial indicator) measures the lateral displacement of a mandrel on the taper hole inside a drill spindle. The mandrel axis is an extension of the drill spindle taper hole axis and the protruding portion of the mandrel surface is perfectly cylindrical. Measurement are recorded as R_x = maximum deflection minus minimum deflection, corresponding to sensor position at X , over one rotation.

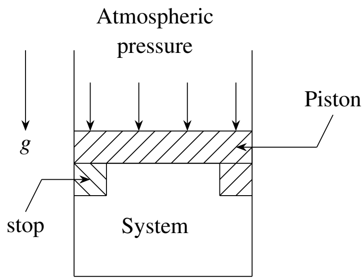


If $R_P = R_Q > 0$ which one of the following would be consistent with the observation? (2008-ME)

a) The drill spindle rotational axis is coincident with the drill spindle taper hole axis
b) The drill spindle rotational axis intersects the drill spindle taper hole axis at the point P
c) The drill spindle rotational axis is parallel to the drill spindle taper hole axis
d) The drill spindle rotational axis intersects the drill spindle taper hole axis at point Q

Common Data for Questions 3, 4 and 5

In the figure shown, the system is a pure substance kept in a piston- cylinder arrangement. The system is initially a two- phase mixture containing $1kg$ of liquid and $0.03kg$ of vapour at a pressure of $100kPa$. Initially, the piston rests on a set of stops, as shown in the figure. A pressure of $200kPa$ is required to exactly balance the weight of the piston and the outside atmospheric pressure. Heat transfer takes place into the system until its volume increases by 50% . Heat transfer to the system occurs in such a manner that the piston, when allowed to move, does so in a very slow (quasi-static / quasi-equilibrium) process. The thermal reservoir from which heat is transferred to the system as a temperature of $400^{\circ}C$. Average temperature of the system boundary can be taken as $175^{\circ}C$ Heat transfer to the system is $1kJ$, during which its entropy increases by $10J/K$



Specific volume of liquid $\left(v_f\right)$ and vapour $\left(v_g\right)$ phases, as well as values of saturation temperatures, are given in the table below.

Pressure(kPa)	Saturation temperature $T_{sat}v\left({}^{\circ}C\right)$	$v_f(m^3/kg)$	$v_g(m^3/kg)$
100	100	0.001	0.1
200	200	0.0015	0.002

3) At the end of the process, which one of the following situations will be true? (2008-ME)

a) superheated vapour will be left in the system
b) no vapour will be left in the system
c) a liquid + vapour mixture will be left in the system

d) the mixture will exist at dry saturated vapour state

4) The work done by the system during the process is (2008-ME)

a) $0.1kJ$ b) $0.2kJ$ c) $0.3kJ$ d) $0.4kJ$

5) The net entropy generation (considering the system and the thermal reservoir together) during the process is closest to (2008-ME)

a) $7.5J/K$ b) $7.7J/K$ c) $8.5J/K$ d) $10J/K$

Common Data for the Questions 6 and 7

Consider the Linear Programme (LP)

Max $4x + 6y$
subjects to
$3x + 2y \leq 6$
$2x + 3y \leq 6$
$x, y \geq 0$

6) After introducing slack variables s and t , the initial basic feasible solution is represented by the table below (basic variables are $s = 6$, $t = 6$ and the objective function value is 0).

	-4	-6	0	0	0
s	3	2	1	0	6
t	2	3	0	1	6
	x	y	s	t	RHS

After some simpex iterations, the following table is obtained

	0	0	0	2	12
s	$\frac{5}{3}$	0	1	$-\frac{1}{3}$	2
y	$\frac{2}{3}$	1	0	$\frac{1}{3}$	2
	x	y	s	t	RHS

From this, one can conclude that (2008-ME)

a) The LP has a unique optimal solution
b) The LP has an optimal solution that is not unique
c) The LP is infeasible
d) The LP is unbounded

7) The dual for the LP in 6 is (2008-ME)

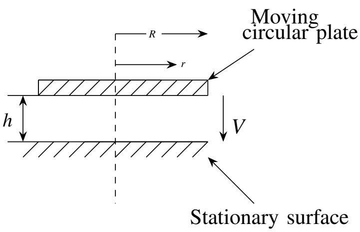
a) Min $6u + 6v$
subject to
$3u + 2v \geq 4$
$2u + 3v \geq 6$
$u, v \geq 0$

b) Max $6u + 6v$
subject to
$3u + 2v \leq 4$
$2u + 3v \leq 6$
$u, v \geq 0$

c) Max $4u + 6v$
subject to
$3u + 2v \leq 4$
$2u + 3v \leq 6$
$u, v \geq 0$

d) Min $4u + 6v$
subject to
$3u + 2v \leq 6$
$2u + 3v \leq 6$
$u, v \geq 0$

Statement for Linked Answer Questions 8 and 9:
A cylindrical container of radius $R = 1m$, wall thickness $1mm$ is filled with water upto a depth of m and suspended along with its upper rim. The density of water is $1000kg/m^3$ and acceleration due to gravity is $10m/s^2$. The self weight of the cylinder is negligible. The formula for hoop stress in a thin walled cylinder can be used at all points along the height of the cylindrical container.



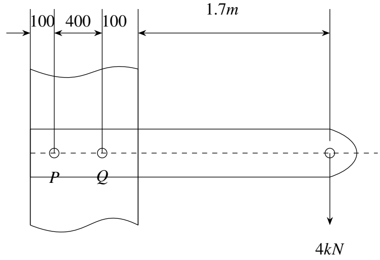
8) The axial and circumferential stress (σ_a, σ_c) experienced by the cylinder wall a mid-depth ($1m$ as shown) are (2008-ME)

a) $(10, 10)\, MPa$ b) $(5, 10)\, MPa$ c) $(10, 5)\, MPa$ d) $(5, 5)\, MPa$

9) If the Young's modulus and Poisson's ratio of the container material are $100GPa$ and 0.3, respectively. The axial strain in the cylinder wall at mid height is (2008-ME)

a) 2×10^{-5}
b) 6×10^{-5}
c) 7×10^{-5}
d) 1.2×10^{-5}

Statement for Linked Answer Questions 10 and 11:
A steel bar of $10mm \times 50mm$ is cantilevered with two $M12$ bolts (P and Q) to support a static load of as shown in figure aside.



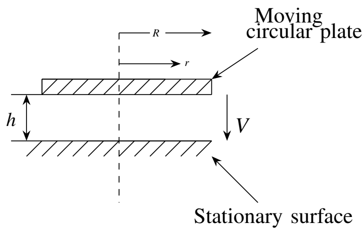
10) The primary and secondary shear loads on rivet P, respectively are (2008-ME)

a) 2 kN, 20kN
b) 20kN, 2kN
c) 20kN, 0kN
d) 0kN, 20kN

11) The resultant shear stress on rivet P is closest to (2008-ME)

a) 132MPa b) 159MPa c) 178MPa d) 195MPa

Statement for Linked Answer Questions 12 and 13:
The gap between a moving circular plate and a stationary surface is being continuously reduced, as the circular plate comes down at a uniform speed V towards the stationary bottom surface, as shown in the figure. In the process, the fluid contained between the two plates flows out radially. The fluid is assumed to be incompressible and inviscid.



12) The radial component of the fluid acceleration at $r = R$ is (2008-ME)

a) $\frac{3V^2R}{4h^2}$ b) $\frac{V^2R}{4h^2}$ c) $\frac{V^2R}{2h^2}$ d) $\frac{V^2h}{4R^2}$

13) The radial velocity V_r at any radius r , when the gap width is h is (2008-ME)

a) $V_r = \frac{Vr}{2h}$ b) $V_r = \frac{Vr}{h}$ c) $V_r = \frac{2Vh}{r}$ d) $V_r = \frac{Vh}{r}$

Statement for Linked Answer Questions 14 and 15:
Orthogonal turning is performed on a cylindrical work piece with shear strength of 250MPa. The following conditions are used: cutting velocity is 180m/min feed is

$0.2 mm/rev$ depth of cut is $3 cm$ chip thickness ratio is 0.5 The orthogonal rake angle is 7°. Apply Merchants theory for analysis.

14) The shear plane angle (in degrees) and the shear force respectively are (2008-ME)

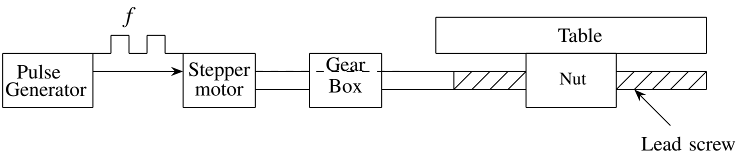
a) $22.65; 150N$
b) $22.65; 320N$
c) $28; 400N$
d) $28; 320N$

15) The cutting and frictional forces respectively are (2008-ME)

a) $568N; 387N$
b) $565N; 381N$
c) $202N; 120N$
d) $202N; 356N$

Statement for Linked Answer Questions 16 and 17

In the feed drive of a point to point open loop drive, a stepper motor rotating at drives a table through a gear box and lead screw-nut mechanism (pitch = $4mm$, number of starts). The gear ratio $\left(= \frac{\text{Output rotational speed}}{\text{Input rotational speed}}\right)$ is given by $U = \frac{1}{4}$. The stepper motor (driven by voltage pulses from a pulse generator) executes 1 step / pulse from a pulse generator) executes step / pulse of the generator. The frequency of the pulse train from the pulse generator is $f = 10,000$ pulses per minute.



16) The basic length unit (BLU) , i.e. the table movement corresponding to 1 pulse of the pulse generator (2008-ME)

a) 0.5 microns
b) 5 microns
c) 50 microns
d) 500 microns

17) A customer insists on a modification to change the BLU of the CNC drive to 10 microns without changing the table speed. The modification can be accomplished by

(2008-ME)

a) changing U to $\frac{1}{2}$ and reducing f to $\frac{f}{2}$
b) changing U to $\frac{1}{8}$ and increasing f to $2f$
c) changing U to $\frac{1}{2}$ and keeping f to $2f$
d) keeping U unchanged and increasing f to $2f$