GATE – Mining Engineering

(Topic Wise Questions 2007-2017)

Topic: Engineering Mechanics

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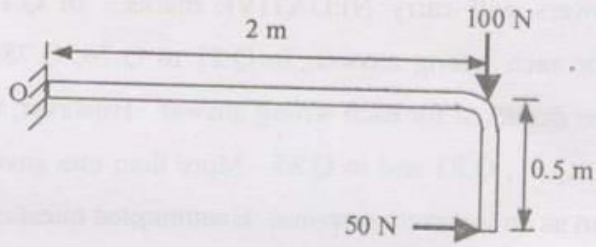
GATE SYLLABUS: ENGINEERING MECHANICS

Equivalent force systems; Equations of equilibrium; Two dimensional frames and trusses; Free body diagrams; Friction forces; Particle kinematics and dynamics.

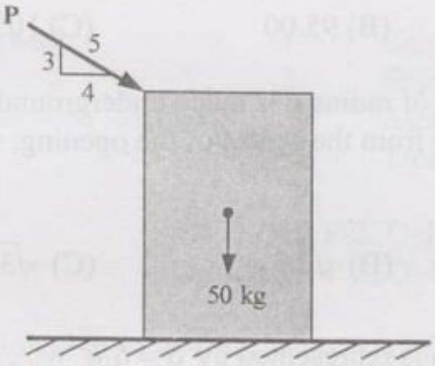
2007

Q.4 The magnitude of the resultant moment about point O in Nm of the two forces acting on the rod shown below is



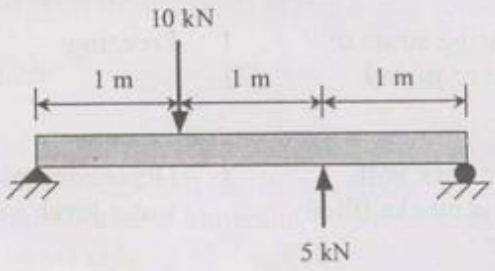
(A) 25 (B) 125 (C) 175 (D) 225

Q.24 A wooden block of 50 kg rests on the floor (shown in figure below) for which the coefficient of static friction is 0.5. The smallest magnitude of the force **P** in kg that will cause impending motion of the block is

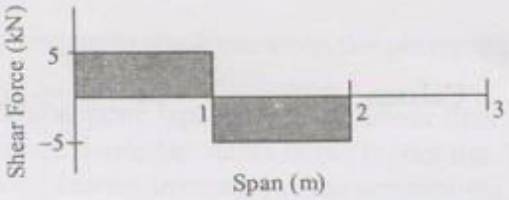


(A) 50 (B) 40 (C) 30 (D) 25

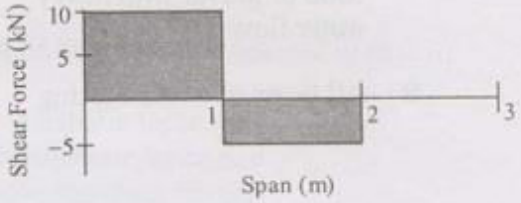
Q.43 The shear force diagram for the shaft shown below resembles which one of the following graphs?



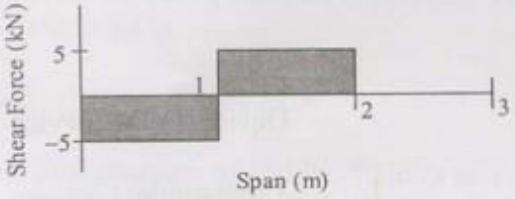
Graph-I



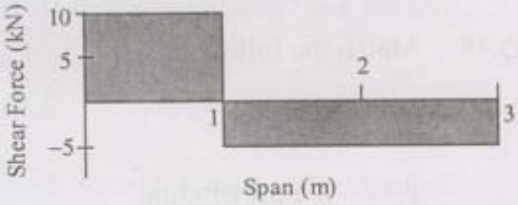
Graph-II



Graph-III

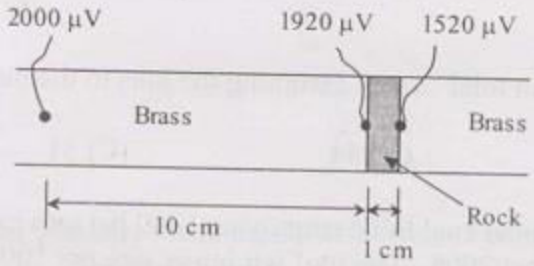


Graph-IV



(A) Graph-I (B) Graph-II (C) Graph-III (D) Graph-IV

Q.56 In an experiment to determine rock thermal conductivity a disc of rock specimen is placed between two solid brass cylinders and one dimensional heat flow is created as shown. The readings of the thermocouple sensors with respect to zero potential are shown in the figure. Brass thermal conductivity is 90 W/m °C, and the thermocouple constant is 40 μV/°C. The rock thermal conductivity in W/m °C and the heat flux in W/m^2 respectively are



(A) 1.8, 1800 (B) 0.6, 1020 (C) 3.2, 540 (D) 2.1, 670

2008

Q.4 A phreatic surface experiences a pressure

(A) Less than atmospheric pressure
(B) Equal to atmospheric pressure
(C) More than barometric pressure
(D) Less than barometric pressure

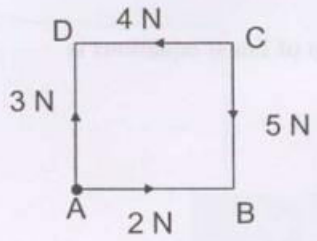
Q.37 A drum winder of radius 2.5 m draws a power of 308 kW when the maximum rope speed is 7 m/s. The RMS torque in kNm is

(A) 55 (B) 76 (C) 110 (D) 144

Q.58 If H is the maximum height attained by a projectile, the maximum horizontal range when fired at 45^0 inclination from ground level is

(A) 4.0H (B) 3.6H (C) 3.2H (D) 2.7H

Q.59 Force diagram for a square frame is shown below. Considering clockwise moment as positive, the resultant moment about an axis passing through the point A in Nm is



(A) 8 (B) 5 (C) 3 (D) -2

Q.64 A cage of floor area 5.0 m^2 suspended in a shaft has a drag coefficient 2.5. If the velocity of air in the shaft is 6.0 m/s, the drag force (N) experienced by the cage is

(A) 120 (B) 170 (C) 200 (D) 270

Common Data Questions

Common Data for Questions 71, 72 and 73: Two blocks of mass 5 kg and 10 kg are connected with cords and frictionless pulleys as shown. Friction coefficient between the 5 kg block and table is 0.2.

Q.71 The acceleration of the system when the blocks are released from rest ('g' is acceleration due to gravity) is

(A) 5g (B) 2g (C) g/5 (D) g/10

Q.72 Tension (N) in the cord connected to the10 kg block is

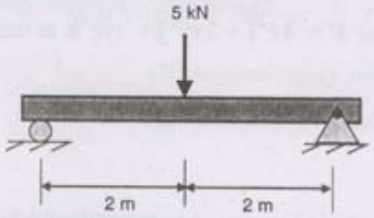
(A) 8g (B) 6g (C) 4g (D) 2g

Q.73 Tension (N) in the cord connected to the 5 kg block is

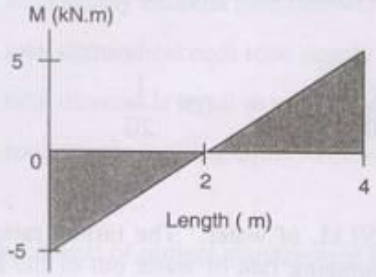
(A) 8g (B) 6g (C) 4g (D) 2g

2009

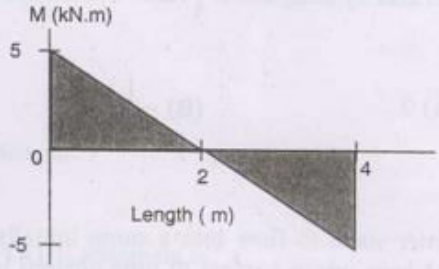
Q.30 The bending moment diagram for the shaft shown below resembles which one of the following graphs ?



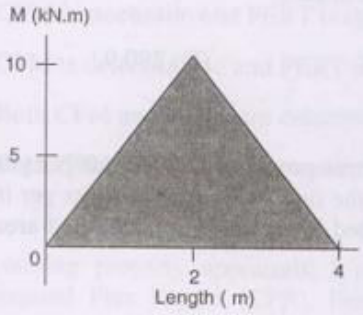
(A)



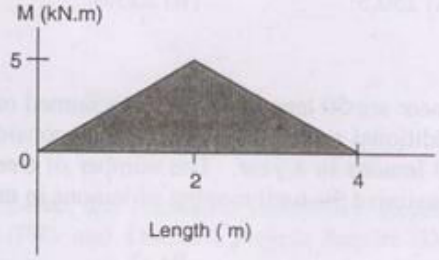
(B)



(C)

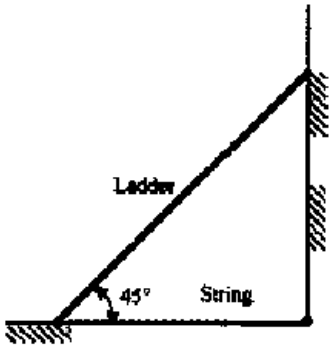


(D)



2010

Q.20 A ladder of weight 50 N rests against a frictionless wall and floor as shown in the figure. A horizontal string ties the base of the ladder to the wall. The tension in the string in N is

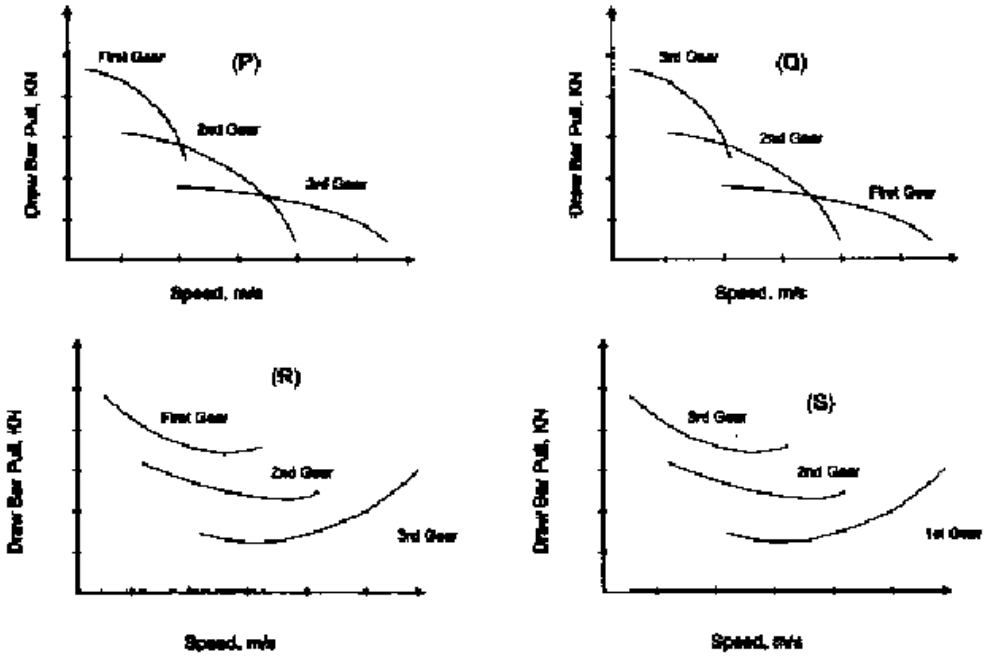


(A) 100 (B) 50 (C) 72 (D) 25

Q.24 A cage weighing 12000 kg is raised by four chains each making an angle of 30° with the vertical. The tension in each chain in kN is

(A) 41 (B) 34 (C) 25 (D) 20

Q.25 The relationship between the drawbar pull and the speed for different gears of a self propellin vehicle is represented by

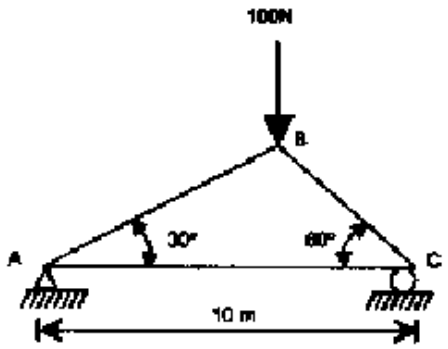


(A) Q (B) S (C) R (D) P

Q.28 A balanced winder raises 3000 tonnes per day from a depth of 500 m. The payload of the winding cage is 7 tonnes. The energy consumed per day in kWh at 70% winder efficiency is

(A) 6030 (B) 5840 (C) 5750 (D) 5630

Q.29 A truss is loaded as shown in the figure. The force in the member AC is



(A) tension 75.9 N
(B) compression 43.3 N
(C) tension 43.3 N
(D) compression 75.9 N

Q.30 In the frictionless pulley system shown in the figure, each pulley weighs 20 N. The weight W, in N, that can be lifted by the system under the conditions shown is

(A) 200 (B) 170 (C) 150 (D) 100

Q.31 A force of $50\hat{i} - 50\hat{j}$ N is moved from the origin to a coordinate $(4.0m, 2.0m)$. The work done in the process in J is

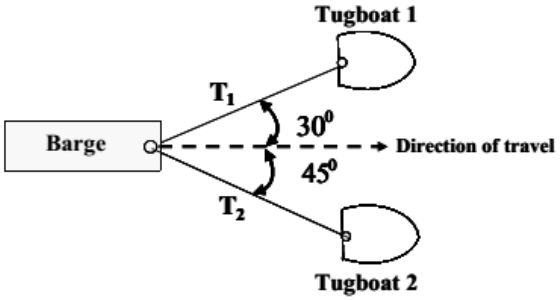
(A) 75.6
(B) 85.5
(C) 90.2
(D) 100.0

2011

Q.30 A 1 tonne mine car traveling at a constant speed of 10 km/h collides with a stationary buffer and comes to rest. If the buffer spring stiffness is 200 kN/m, the maximum compression in the spring in mm is

(A) 49 (B) 98 (C) 196 (D) 247

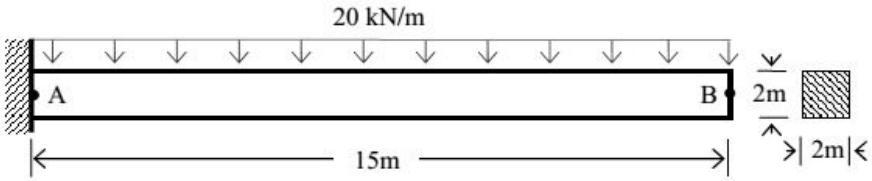
Q.31 In an iron ore handling port, a barge is pulled by ropes using two tugboats as shown in the figure. In equilibrium, the resultant of the forces T_1 and T_2 along the axis of the barge in the direction of its travel is 5000 N. The tensions T_1 and T_2 in N respectively are



(A) 9700 and 6831
(B) 6831 and 9700
(C) 3660 and 2588
(D) 2588 and 3660

2012

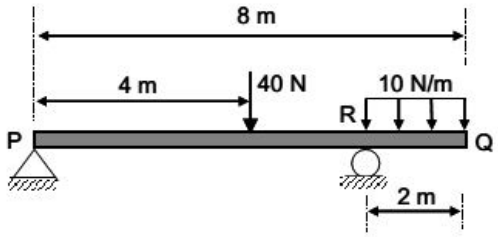
Q.8 A uniformly distributed load of 20 kN/m is acting on a 15 m long cantilever beam AB of area of cross section 2 m x 2 m, as shown in the figure. The beam is fixed at point A. The modulus of elasticity of the material is 1.0 GPa.



The maximum vertical displacement of the beam in m is

(A) 0.004 (B) 0.020 (C) 0.071 (D) 0.190

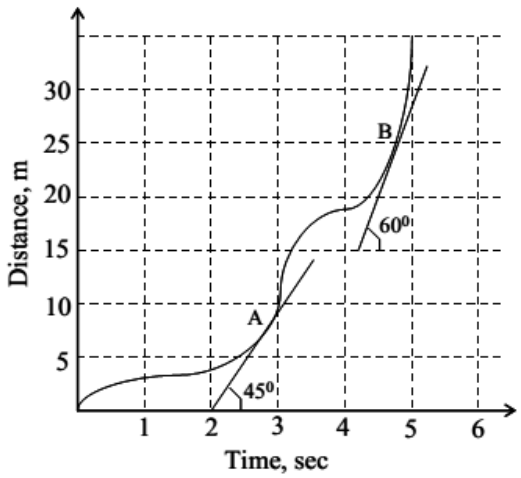
Q.28 The figure shows a weightless beam PQ of length 8 m resting on a hinge support at P and on a roller support at R. A vertical force of 40 N is acting at a distance of 4 m from P. A uniformly distributed load of 10 N/m is acting on a length of 2 m of the beam from Q.



The magnitude of reaction force at R in N is

(A) 20 (B) 30 (C) 40 (D) 50

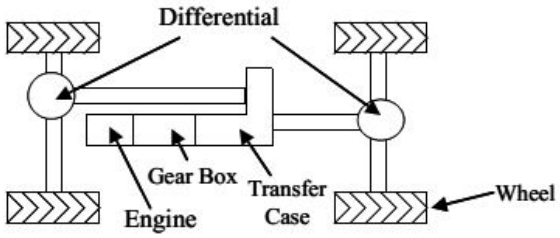
Q.29 The figure shows the distance vs time graph of a moving particle. The tangents to the curve at A and B make angles of 45^0 and 60^0 respectively with the time axis.



The ratio of the speeds of the particle at B and at A is

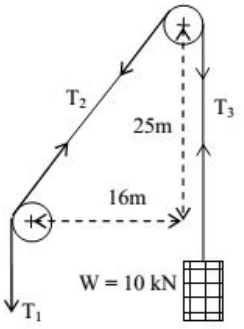
(A) 0.72 (B) 1.38 (C) 1.58 (D) 1.75

Q.30 The gear ratios of the first gear, transfer case and differential of a four wheel drive vehicle are 3.81:1, 2.72:1 and 4.11:1 respectively. If the engine is rotating at 1000 rpm and the wheel diameter is 1.2 m, the speed of the vehicle in first gear in km/h is



(A) 5.31 (B) 3.68 (C) 2.42 (D) 1.68

Q.46 Figure shows a two pulley system for hoisting a load of 10 kN. The coefficient of friction between each pulley and the rope is 0.2. The vertical and horizontal distances between the centers of the pulleys are 25 m and 16 m respectively.

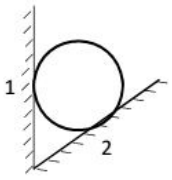


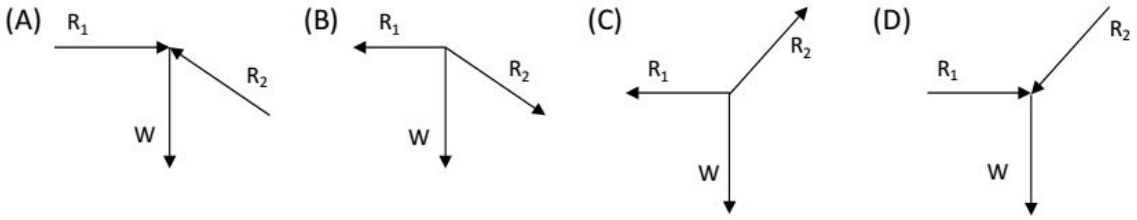
The tensions T_1 and T_2 respectively in kN are

(A) 6.00, 5.38 (B) 12.37, 11.06 (C) 18.74, 16.73 (D) 25.11, 22.41

2013

Q.4 A ball of weight W is supported on smooth walls as shown in the following figure. R_1 and R_2 are reactions from the walls 1 and 2. The free body diagram of the ball is represented by

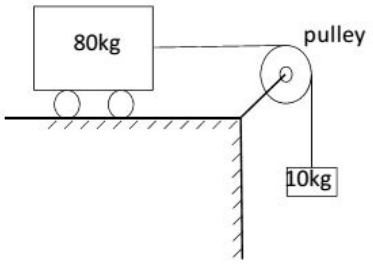




Q.11 The pressure on a phreatic surface is

(A) less than atmospheric pressure
(B) greater than atmospheric pressure
(C) equal to atmospheric pressure
(D) independent of atmospheric pressure

Q.19 In the following figure, the coefficient of kinetic friction between the trolley and the surface is 0.04. When the block is released from rest, the acceleration of the trolley in m/s^2 becomes

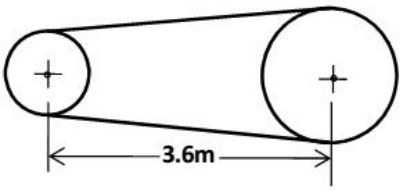


(A) 9.65 (B) 1.23 (C) 1.09 (D) 0.74

Q.20 Two meshing spur gear wheels of Module 6 have 24 and 42 teeth. The distance in mm between the centres of the gear wheels is

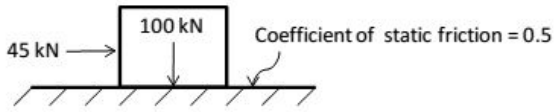
(A) 1000 (B) 198 (C) 126 (D) 72

Q.29 An open belt drive connects two pulleys on parallel shafts that are 3.6 m apart as shown in the figure. The diameters of the pulleys are 2.4 m and 1.6 m. The angle of contact on the smaller pulley in degrees is _____



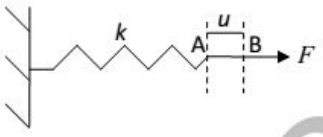
2014

Q.1 A block of weight 100 kN rests on a floor as shown in the figure. The coefficient of static friction between the block and the floor is 0.5. A force of 45 kN is applied horizontally on the block. The static frictional force in kN is



(A) 22.5 (B) 50.0 (C) 55.0 (D) 100.0

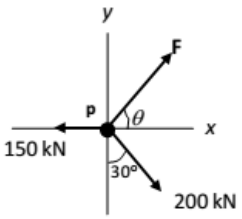
Q.2 A spring of constant stiffness k is stretched from point A to point B (displacement u in the figure) by a force F. The potential energy of the spring is expressed by



(A) $\frac{1}{2}ku^2 - Fu$ (B) $\frac{1}{2}ku^2 + Fu$

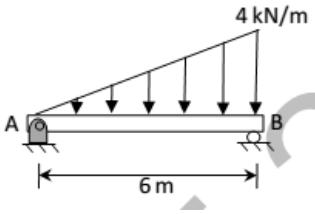
(C) $ku - F$ (D) $ku + F$

Q.26 A particle P is in equilibrium as shown in the figure. The magnitude in kN and the orientation θ in degrees of the force **F** respectively are

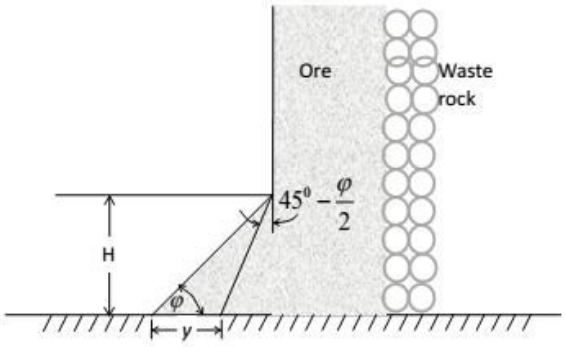


(A) 52.1, 16.1 (B) 221.2, 23.2 (C) 102.3, 53.4 (D) 180.3, 73.9

Q.27 A distributed load of 4 kN/m acts on a beam of 6 m length supported by a hinge and a roller as shown in the figure. The distance in m of the point of zero shear in the beam from the point A is __



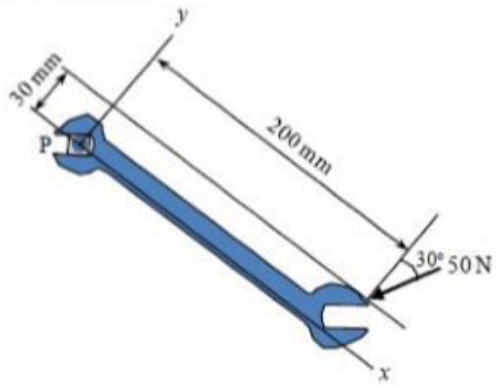
Q.35 The height H of a drawpoint in a sublevel caving stope is 3.0 m. If the angle of repose (φ) of broken ore is 35^0, the digging depth y of the loader as shown in the figure in m is _____



2015

Q-24

A force of 50 N is applied to a wrench as shown in the figure. The magnitude of the moment in N-mm of this force about the point P is _____



Correct Answer:
7900 to 7920

Question Number : 48 Question Type : NAT

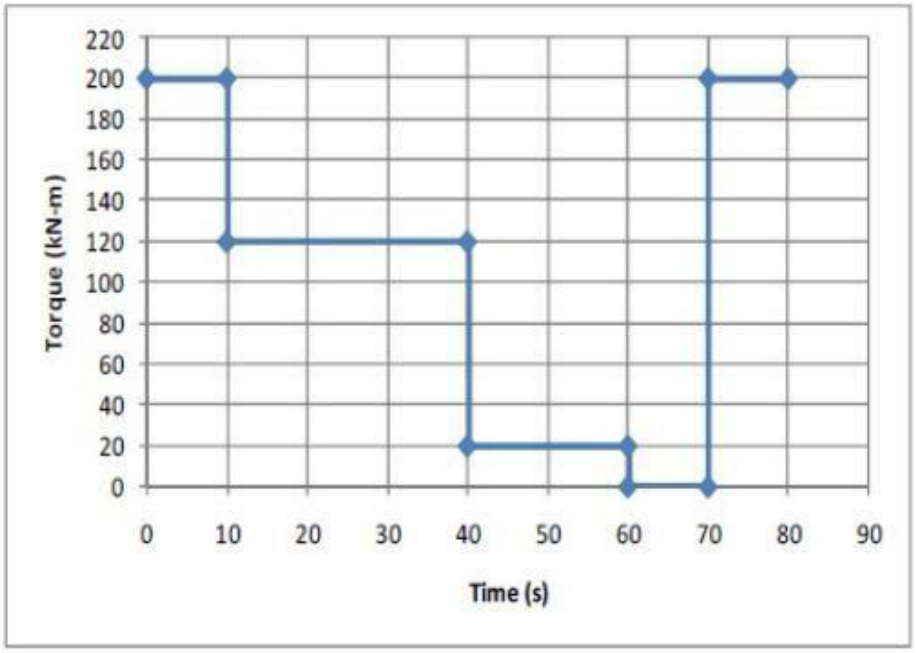
A single-acting reciprocating pump delivers 0.018 m^3/s of water when running at 45 cycles per minute. The piston diameter is 300 mm and stroke length is 400 mm. The volumetric efficiency of the pump in % is _____

Correct Answer :

83 to 87

Question Number : 53 Question Type : NAT

The 3-period torque-time diagram of a statically balanced hoist is shown in the figure.



The rms torque for the motor in kN-m is _____

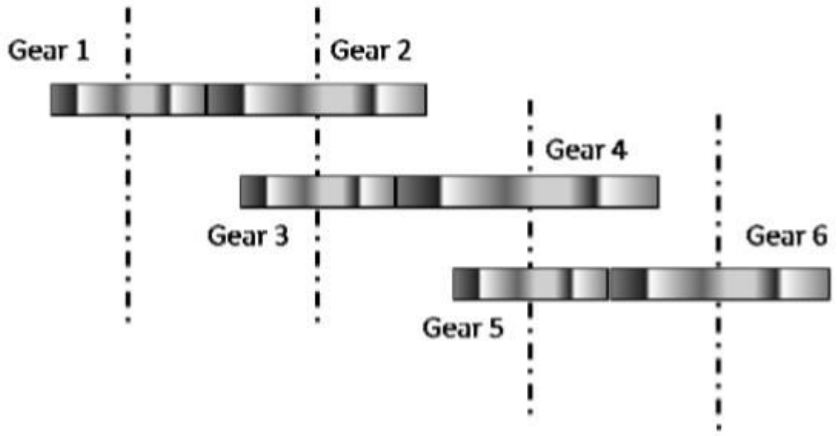
Correct Answer :

106 to 113

2016

Q.36 A ladder placed against a frictionless wall at an inclination of 60^0 with horizontal, is in a state of limiting equilibrium. The ladder has a length of 13 m and a uniform mass of 4 kg/m. The coefficient of friction between the ladder and the floor is _____

Q.43 In the gear assembly shown, the rpm of Gear 1 is 600. The number of teeth in Gear 1, Gear 2, Gear 3, Gear 4, Gear 5 and Gear 6 is 30, 45, 15, 20, 10 and 30, respectively. The rpm of Gear 6 is _____



2017

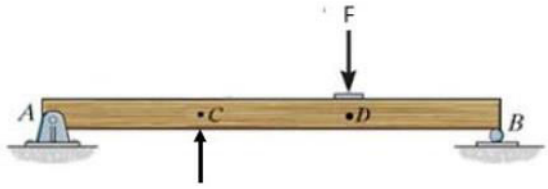
Question Number : 3 **Correct : 1 Wrong : -0.33**

The position vector of a moving particle is given by $\vec{r}(t) = t^3\hat{\imath} + t\hat{\jmath} + t^2\hat{k}$. The acceleration of the particle in the direction of the motion is

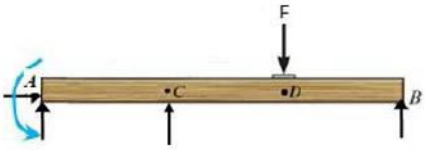
(A) 0
(B) $60\hat{\imath} + 2\hat{k}$
(C) $6t\hat{\imath} + 4\hat{\jmath} + 2\hat{k}$
(D) $6t\hat{\imath} + 2\hat{k}$

Question Number : 9 **Correct : 1 Wrong : -0.33**

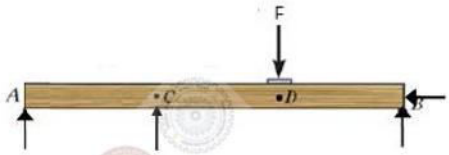
The beam shown in the figure is hinged at one end and rested on a roller at the other end. The free body diagram of the system is



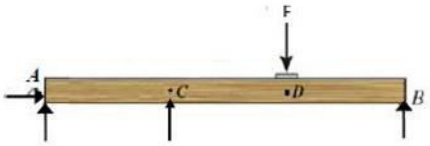
(A)



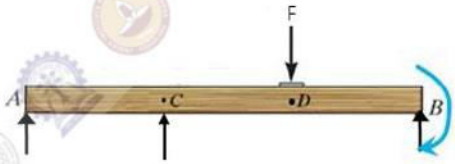
(B)



(C)

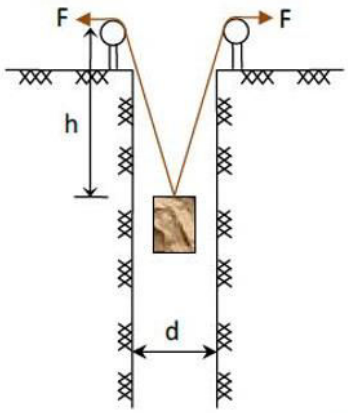


(D)



Question Number : 41 **Correct : 2 Wrong : -0.66**

A blasted muck of mass m is being lifted from a shaft of diameter d by an arrangement of two pulleys as shown in the figure. Ignoring friction in the pulleys, as the height h decreases, tension in the ropes



(A) increases
(B) decreases
(C) remains constant
(D) increases until h > d, then decreases

Question Number : 47 **Correct : 2 Wrong : 0**

The discharge rate of a water pump is 0.25 m^3/s. The diameter of the discharge and suction nozzles are 300 and 350 mm respectively. The measured pressure at the discharge end located 0.25 m above the centerline of the impeller is 150 kN/m^2 and the pressure at the suction gage located at the centre line of the impeller is 20 kN/m^2. Specific weight of water is 9810 N/m^3. The total dynamic head for the above installation in m is _____

Question Number : 55 **Correct : 2 Wrong : 0**

A wheel of radius 0.5 m rotates under a moment of 2000 N-m as shown in the figure. A block brake is used to stop the wheel. If the coefficient of static friction between the wheel and the block brake is 0.3, the smallest force of P in N required to stop the wheel is _____