

JK Lakshmipat University Jaipur
INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination, November 2018

B. Tech. [All Branches], Semester I

Roll No.....

BES101: Calculus and Applied Mechanics

Time: 2 hours

Max. Marks: 60

Instructions to students:

1. Do not write anything other than your roll number on question paper.

Q.1A Choose the correct answer for the following (1 × 6 = 6 Marks)

06

- i. How can relatively denser object be made to float on the less dense fluid?
a) By altering the shape b) By altering the forces acting on the object
c) None of the mentioned d) By altering the shear forces acting on the object
- ii. According to work energy principle, a particle of mass m when subjected to unbalanced force system, the work done during displacement by all forces is equal to change in _____ during displacement.
a) gravitational energy b) kinetic energy
c) mechanical energy d) potential energy
- iii. What is the angle of projection for a bullet fired over a horizontal plane, when horizontal range is equal to 4 times the maximum height?
a) 30° b) 45°
c) 76° d) 90°
- iv. The percentage error in the volume of a right circular cylinder when an error of 1% is made in measuring its height and radius of the base is equal to
a) 1% b) 2% c) 0% d) 3%
- v. An integrating factor transforms first-order differential equation to
a) Bernoulli's form b) a homogeneous form
c) a linear form d) exact form
- vi. The order of the differential equation $\left(\frac{d^3 y}{dx^3}\right)^4 + 6x\left(\frac{dy}{dx}\right)^8 + e^y = \sin x$ is
a) 1 b) 3 c) 4 d) 8

Q.2 Solve the following problems (2 × 2 = 4 Marks)

- i. A rectangular pontoon is 5 m long, 3 m wide and 1.40 m high. The depth of immersion of the pontoon is 0.60 m in seawater. If the centre of gravity is 0.7 m above the bottom of the pontoon, determine the metacentric height. The density for seawater = 1045 kg/m^3 .
- ii. Solve the ODE $e^y dx + (xe^y + 2y) dy = 0$.

Q.3 Answer any five

- i. The skateboard rider leaves the ramp at A with an initial velocity v_a at 30° angle. If he strikes the ground at B, determine v_a and the time of flight. **06**

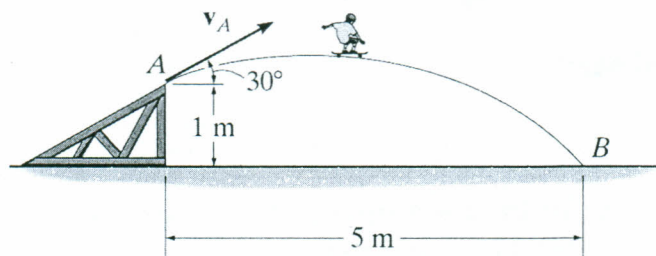


Figure 1

- ii The spring in the toy gun has an unstretched length of 100 mm. It is compressed 06
and locked in the position shown. When the trigger is pulled, the spring
unstretches 12.5 mm, and the 20 gm ball moves along the barrel. Determine the
speed of the ball when it leaves the gun. Neglect friction.

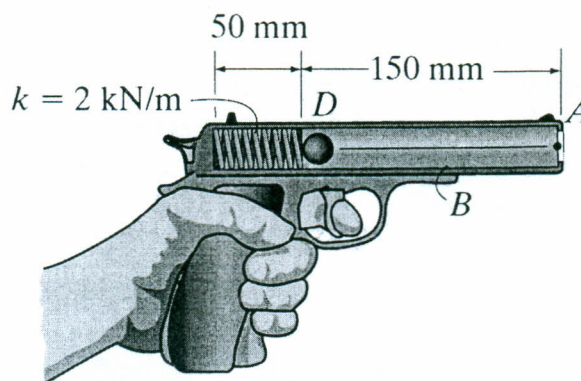


Figure 2

- iii The three balls each have a mass m . If A has a speed just before a direct collision 06
with B, determine the speed of C after collision. The coefficient of restitution
between each ball is e . Neglect the size of each ball.

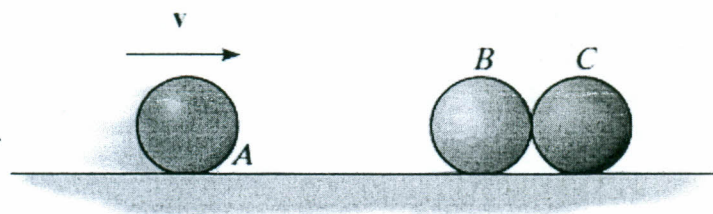


Figure 3

- iv Solve the following ODEs : 06

(i) $\tan y \frac{dy}{dx} + \tan x = \cos y \cos^2 x$

(ii) $\frac{dy}{dx} + \frac{y \ln y}{x - \ln y} = 0$

- v If V is a function of u and v i.e. $V = f(u, v)$ where $u = x - y$ and $v = xy$, prove that 06

$$x \frac{\partial^2 V}{\partial x^2} + y \frac{\partial^2 V}{\partial y^2} = (x + y) \left(\frac{\partial^2 V}{\partial u^2} + xy \frac{\partial^2 V}{\partial v^2} \right)$$

- vi An 80 g weight is suspended at the lower end of a coil spring suspended from the 06
ceiling. The weight comes to rest in its equilibrium position, thereby stretching the
spring 6 cm. the weight is then pulled down 3 cm below its equilibrium position

and released at $t=0$ with an initial velocity of 1 m/sec directed downward. Neglecting air resistance of the medium and assuming that no external forces are present, determine the amplitude, period and frequency of the resulting motion.

Q.4 The temperature T at any point (x, y, z) in space is $T(x, y, z) = kxyz^2$ where k is a constant. Find the highest temperature on the surface of the sphere $x^2 + y^2 + z^2 = a^2$ 10

Q.5A Determine the velocity of the 250 N block A if the two blocks are released from rest and the 500 N block B moves 1 m up the incline. The coefficient of kinetic friction between both blocks and the inclined planes is $\mu_k = 0.10$. 10

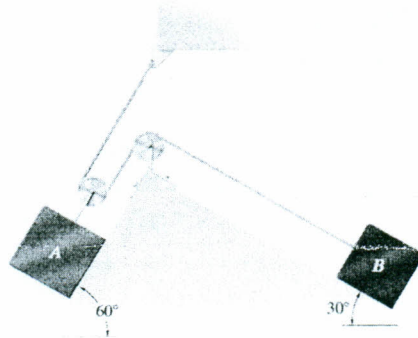


Figure 4

OR

Q.5B The 15 kg suitcase A is released from rest at C. After it slides down the smooth ramp, it strikes the 10 kg suitcase B, which is originally at rest. If the coefficient of restitution between the suitcases is $e = 0.3$ and the coefficient of kinetic friction between the floor DE and each suitcase is $\mu_k = 0.4$, determine (a) the velocity of A just before impact, (b) the velocities of A and B just after impact, and (c) the distance B slides before coming to rest. 10

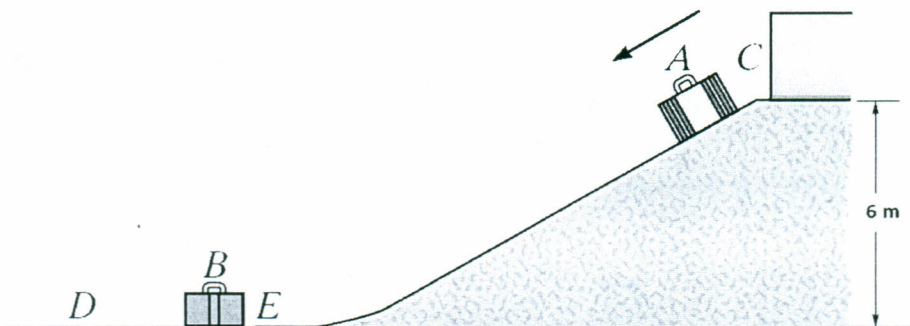


Figure 5