

Physics 101
Final Examination

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For use by Instructors only

Prob.	1	2	3	4	5	6	7	8	9	10	11	12	Total
Marks													

- Answer all the questions.
- The solution should be given explicitly for each problem.
- No solution = no points.
- Check the correct answer for each question.
- Take $g = 10 \text{ m/s}^2$, $\cos 37 = 0.8$ $\sin 37 = 0.6$
- Mobile phone and pagers are not allowed.

Physics Department

1. A disk starts from rest accelerates uniformly upto 15 RPM in 5 s. What is its angular acceleration in rad/s^2 ?

- a) 1.5 **(b) 0.31** c) 0.62 d) 10 e) Others

$$\omega = 15 \left(\frac{2\pi}{60} \right) = 1.57 \text{ rad/s}$$

$$\alpha = \frac{\omega - \omega_0}{t} = \frac{1.57 - 0}{5} = 0.31 \text{ rad/s}^2$$

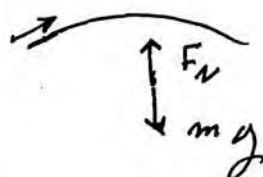
2. A car moves towards a hill its upper part in the form of a circle of radius 40 m. What is the maximum speed of the car in order not to fly out?

- a) 10 m/s **(b) 20 m/s** c) 30 m/s d) 40 m/s e) 50 m/s

$$V \quad mg - F_N = m \frac{v^2}{R}$$

$$F_N = mg - m \frac{v^2}{R} = 0 \Rightarrow v =$$

$$v = \sqrt{Rg} = \sqrt{40(10)} = 20 \text{ m/s}$$



3. A small object of mass 12 kg falls from a height of 4 m on a sandy medium. It is embedded in the sand 50 cm. What is the average frictional force of sand? (Use energy method)

- (a) 1080 N** b) 540 N c) 2160 N d) 6000 N e) 3000 N

$$W_f = E_f - E_i$$

$$- \bar{F}(0.5) = 0 - 12(10)(4 + 0.5)$$

$$\bar{F} = 1080 \text{ N}$$

4. A speed car (A) moves with constant velocity of 180 km/h past a police car (P). The police car starts to accelerate immediately with constant acceleration of 5 m/s^2 . Find the distance traveled by the police car to arrive the speed car.

- a) 0.5 km **(b) 1.0 km** c) 1.5 km d) 2.0 km e) 9.4 km

$$V_A = 50 \text{ m/s}$$

$$x_A = V_A t$$

$$x_B = 0 + \frac{1}{2} a t^2$$

$$\left. \begin{array}{l} x_A = V_A t \\ x_B = 0 + \frac{1}{2} a t^2 \end{array} \right\} \rightarrow t = \frac{2V_A}{a} = 20 \text{ s}$$

$$x = V_A t = 50(20) = 1000 \text{ m}$$

$$= 1 \text{ km}$$

5. A car moves up a mountain with constant speed of 30 km/h. On its return back its speed is 60 km/h. What is the average speed of the car during the entire trip?

a) 35 km/h **b) 40 km/h** c) 45 km/h d) 50 km/h e) 75 km/h

$$t_1 = \frac{d}{30} \quad t_2 = \frac{d}{60} \quad t = t_1 + t_2 = \frac{d}{30} + \frac{d}{60} = \frac{d(30+60)}{(30)(60)}$$

$$\bar{v} = \frac{\text{distance}}{\text{time}} = \frac{2d(30)(60)}{d(90)} = 40 \text{ km/h}$$

6. Vector $\vec{A} = 3\vec{i} + 2\vec{j}$ and vector $\vec{B} = 2\vec{i} + 4\vec{j}$. Find the angle of the vector $\vec{C} = \vec{A} \times \vec{B}$ with respect to the x-axis?

a) 0 b) 90 c) 180 **d) 270** e) Others

$$\vec{C} = -12\vec{k} - 4\vec{k} = -16\vec{k}$$

$$\theta = 270^\circ$$

7. Two particles A and B are projected with velocities $\vec{v}_A = 30\vec{i} + 40\vec{j}$ and $\vec{v}_B = -60\vec{i} + 40\vec{j}$ respectively. They meet in air at their maximum height. What is the distance between A and B?

a) 120 m b) 160 m c) 299 m d) 240 m **e) 360 m**



$$v_y = v_{y0} - gt \Rightarrow t = \frac{40}{10} = 4 \text{ s}$$

$$d = (30)(4) + (60)(4) = 360 \text{ m}$$

8. A & B are two particles of equal masses each of 8 kg. Particle A starts from rest at height of 5 m sliding on a frictionless track and collides elastically with particle B at rest at the bottom of this track. Particle B moves on a horizontal frictionless track and collides with a spring of spring constant $k = 3200 \text{ N/m}$. Find the maximum compression of the spring?

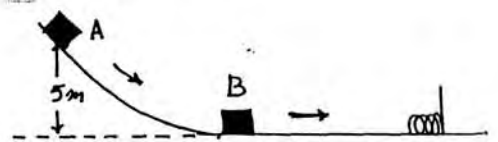
a) 25 cm **b) 50 cm** c) 12.5 cm d) 1 cm e) Others

$$v_{Bf} = v_{Ai} \text{ (at collision)}$$

$$mgh = \frac{1}{2} m v_A^2$$

$$mgh_A = \frac{1}{2} k x^2$$

$$x = \sqrt{\frac{2mgh}{k}} = \sqrt{\frac{2(8)(10)(5)}{3200}} = 0.5 \text{ m}$$

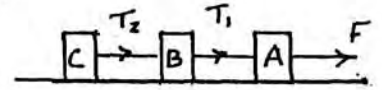


9. A, B and C are three equal blocks each of mass m . A force F pulls the whole group on a horizontal frictionless surface. The tension T_1 in the cord between A and B is found to be of 20 N. Find the force F ?

- a) 10 N b) 20 N c) 30 N d) 40 N e) 50 N

$$T_1 = 2ma$$

$$a = \frac{T_1}{2m} = \frac{20}{2m}$$



$$F = 3ma = 3m \left(\frac{20}{2m} \right) = 30 \text{ N}$$

10. A cabinet in Ferris wheel loaded with passengers has mass of 300 kg. It rotates vertically in a circle of radius 25 m. The work done by force of gravity from point A to point B is :

- a) $9 \times 10^4 \text{ J}$ b) $12 \times 10^4 \text{ J}$ c) $7.5 \times 10^4 \text{ J}$ d) $6 \times 10^4 \text{ J}$ e) $4.5 \times 10^4 \text{ J}$

$$h = 2r \cos \theta = 50(0.8) = 40 \text{ m}$$

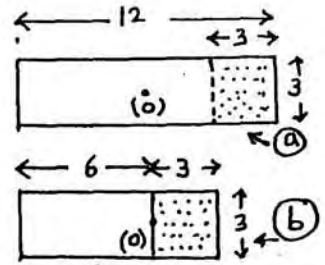
$$W_g = mgh = (300)(10)(40) = 120000 \text{ J} = 12 \times 10^4 \text{ J}$$



11. A rectangle of 12 cm length and 3 cm wide at the dotted line 3 cm from the far end it is folded as shown in the figure (b). How far will the center of mass of this new configuration move with respect to the original one at (O)?

- a) -0.75 cm b) -0.5 cm c) -1 cm d) -1.5 cm e) -3 cm

$$X_{cm} = \frac{(6 \times 3)(-3) + (6 \times 3)(1.5)}{12 \times 3} = -0.75 \text{ cm}$$



12. A tennis ball of mass 40 g moves horizontally toward a wall with speed v_0 . It rebounds backward with the same speed. During the collision time it is found that the force changes with time according to the curve shown in figure. The velocity v is:

- a) 25 m/s b) 12.5 m/s c) 1 m/s d) 2 m/s e) Others

$$J = \frac{1}{2} (1000) (2 \times 10^{-3}) = 1 \text{ kg m/s}$$

$$J = \Delta P = 2mV$$

$$V = \frac{1}{2m} = \frac{1}{2(0.04)}$$

