

ENGINEERING ENTRANCE EXAMINATION

QUESTIONS IN MATHEMATICS

NOTE: ANSWER ANY 11 QUESTIONS OUT OF 16 QUESTIONS

1. Evaluate $\int_0^2 (e^x + \sin x) dx$

2. Find the value of x that results in a maximum value for y if $x^2 - 4x + y^2 + 4y = -2$

3. Find the value of the determinant $\begin{vmatrix} 3 & 2 & 1 \\ 0 & -1 & -1 \\ 2 & 0 & 2 \end{vmatrix}$

4. Find the projection of $A = 10i - 2j + 8k$ in the direction of $B = 2i - 6j + 3k$.

5. Evaluate $\lim_{x \rightarrow \infty} \frac{2x^2 - x}{x^2 + x}$

6. Evaluate $\int_{\pi/6}^{\pi/3} \frac{\cos x}{\sin x} dx$

7. If $x^3 - y^3 = 1$, find d^2y/dx^2

8. If $y = \frac{1}{8} (\cos(4x))^2$, then $y' =$

9. Evaluate $\frac{d}{dx} \left(\int_2^x \ln t \, dt \right) =$

10. Evaluate $\int_0^1 x^3 e^{x^4} \, dx$

11. Find the derivative of $\sqrt{1 + \sin^2 x}$

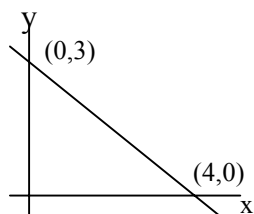
12. A growth curve is given by $A = 10 e^{2t}$. At what value of t is $A = 100$?

13. If $y = \ln x + e^x \sin x$, find dy/dx at $x = 1$

14. Evaluate $\int 2x \ln x \, dx$

15. Evaluate $\int_0^{\pi} \sin 2\theta \cos^2 \theta \, d\theta$

16. What is the equation of the line passing through the two points shown?



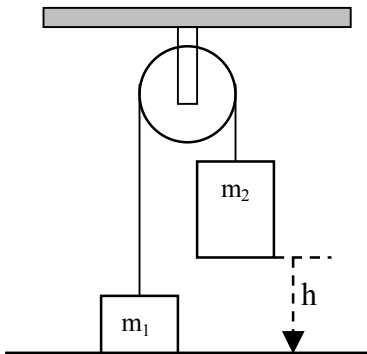
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QUESTIONS IN PHYSICS

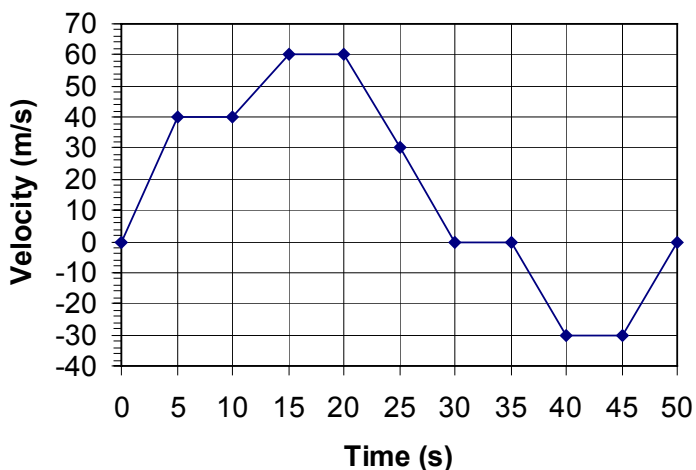
NOTE: ANSWER ANY 11 QUESTIONS OUT OF 16 QUESTIONS

ASSUME $g = 9.8\text{m/sec}^2$

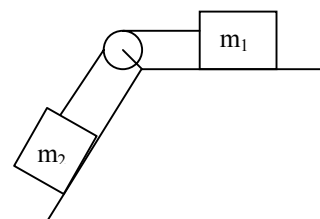
1. A man drags a large, 54-kg log a distance of 30m across his level field at a constant speed by means of a rope attached to the log. As the man pulls on the rope, the rope forms an angle of 25° above the horizontal. The coefficient of kinetic between the log and the ground is 0.600. What is the tension in the rope?
2. A car starting from rest moves with a constant acceleration of 10mi/hr^2 for 1 hour, then decelerates at a constant -5mi/hr^2 until it comes to a stop. How far has it traveled?
3. A ball is thrown downward from the top of a tower. One second after it is thrown the ball is 224 ft from the ground. Three seconds after it is thrown the ball is 76ft from the ground. Determine the average velocity of the ball during this period.
4. A body is acted upon by a force acting in the x direction and which varies with position according to the equation $F_x = 6x^3 + 4x^2 - 8$ in MKS units. How much work is done by this force when the object is moved from $x = 3\text{m}$ to $x = 7\text{m}$?
5. A man pushes a 2400-kg car from the rest to a speed of 4m/s with a constant horizontal force. During this time, the car moves a distance of 40m. Neglecting friction between the car and the road, determine the work done by man.
6. Two masses are connected by a light string passing over a light, frictionless pulley. Such a device is known as an "Atwood machine." Mass m_1 is 2kg and mass m_2 is 5kg. Mass m_2 is initially 2m above the floor when the system is released. What is the speed of m_1 just as m_2 strikes the floor?



7. At a distance 3m from a pneumatic hammer, the sound level is 120dB and the sound intensity is 1.00W/m^2 . At 90m from the hammer, what is the sound level in dB.
8. The take-off speed of a Boeing 747 plane is 300km/h. Starting from rest, the airplane takes 18s to reach this speed. The mass of the loaded plane is 20,000 kg. What is the average power delivered by the jet engines to the airplane during take-off?
9. A 500-kg crate is pulled across a warehouse floor by means of a horizontal cable connected to an engine. The coefficient of kinetic friction between the crate and the floor is 0.450. How much power must the engine deliver in order to move the crate at a constant speed of 4m/s?
10. An 800-gram block, resting on a level floor is pressed against a horizontal spring, compressing it 8cm. The force constant of the spring is 300N/m. If the coefficient of kinetic friction between block and floor is 0.003, how far will the block slide before coming to rest?
11. The velocity time-graph of an object moving along the x axis is shown. Determine the total distance traveled during the time interval from $t = 10\text{s}$ to $t = 45\text{s}$.



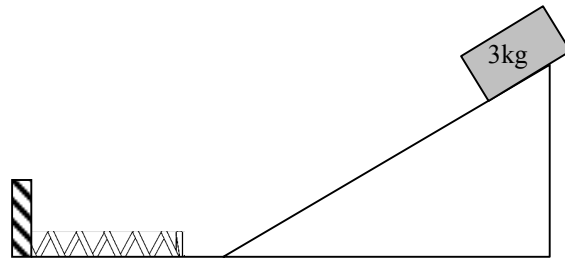
12. Block m_1 is 4kg. When the blocks are released, the system slides to the left with an acceleration of 2m/s^2 . If all surfaces are smooth, what is the mass of block m_2 ?
 [Note: Assume that the pulley is frictionless and of small mass. The tension is then the same throughout the string.]
 [Hint: Make a free-body diagram of each block.]



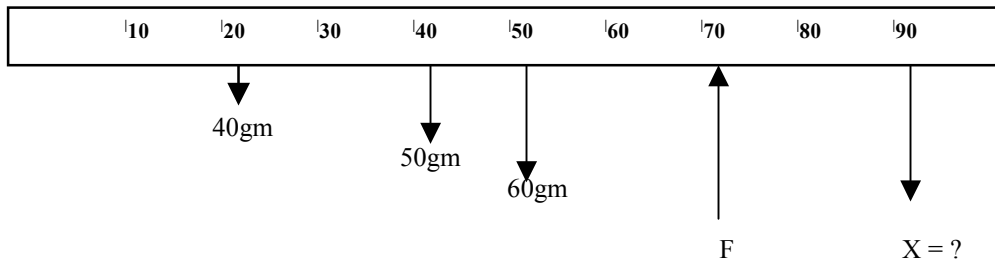
13. A cannonball is fired at an angle of 53° over level terrain and lands 1200 m away. What is the muzzle velocity of the cannonball?

53°

14. A 3-kg block is released at the top of a 37° incline, 10m in length. The coefficient of kinetic friction between the block and the incline is 0.400. At the base of the incline, on a smooth horizontal surface, is a spring of force constant 200N/m. How much does the block compress the spring when the block comes momentarily to rest?



15. A uniform 60-gm meterstick has loads suspended from it as follows: 40gm at the 20-cm mark; 50gm at the 40-cm mark; and X gm at the 90-cm mark. If the fulcrum must be placed beneath the meterstick at the 70-cm mark for complete equilibrium, what is the magnitude of the mass X?



16. A heat engine operates in a Carnot cycle between the temperatures 60°C and 400°C . During each cycle, it absorbs 6×10^3 calories of heat from the high-temperature reservoir. If the duration of each cycle is one second, How much heat is expelled during each cycle?

ENGINEERING ENTRANCE EXAMINATION

QUESTIONS IN CHEMISTRY

NOTE: ANSWER ANY 3 OUT OF 5 QUESTIONS

1. If 23.05 ml of 0.1 molarity NaOH solution is required to neutralize 10.0 ml of HCl solution of unknown strength, what is the molarity of the acid solution?
2. How many grams of $\text{Al}_2(\text{SO}_4)_3$ are there in 600ml of (1.50)M solution?
3. A piece of metal weighing 26.0g is immersed in a quantity of water in a graduated cylinder. The initial volume of the water was 16.0ml and the volume of water plus metal is 22.0ml. The density of the metal in g/ml is:
4. What is the oxidation number of PO_4 in the compound $\text{Ca}_3(\text{PO}_4)_2$?
5. A piece of metal weighing 20.0g is immersed in a quantity of water in a graduated cylinder. The initial volume of the water was 16.0ml and the volume of water plus metal is 22.0ml. The density of the metal in g/ml is: