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FINAL REVISION MODULE (FRM) SAMPLE

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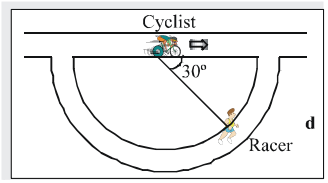
1 Mechanics

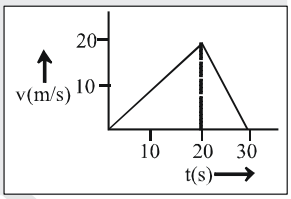
EXERCISE

1. A cyclist is moving with a constant acceleration of 1.2 m/s² on a straight track. A racer is moving on a circular path of radius 150 m at constant speed of 15 m/s. Find the magnitude of velocity of racer which is measured by the cyclist has reached a speed of 20 m/s for the position represented in the figure -



(A) 18.03 m/s (B) 25 m/s (C) 20 m/s (D) 15 m/s

2.* v-t graph of an object of mass 1 kg is shown.
Select the wrong statement-



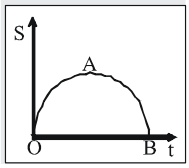
(A) Work done on the object in 30 s is zero
(B) The average acceleration of the object is zero
(C) The average velocity of the object is zero
(D) The average force on the object is zero

3. A train starting from rest travels the first part of its journey with constant acceleration a, second part with constant velocity v and third part with constant retardation a, being brought to rest.

The average speed for the whole journey is $\frac{7v}{8}$. The train travels with constant velocity for ...of the total time -

(A) 3/4 (B) 7/8 (C) 5/6 (D) 9/7

4. The graph of displacement-time for a body travelling in a straight line is given. We can conclude that -



(A) the velocity is constant
(B) the velocity increases uniformly
(C) the body is subjected to acceleration from O to A
(D) the velocity of the body at A is zero

5.* A particle is projected vertically upwards and it reaches the maximum height H in time T seconds. The height of the particle at any time t will be-

(A) g (t - T)2 (B) H - $\frac{1}{2}$ g $(T - t)^2$ (C) g (t - T)2 (D) H - g (t - T)

6. A body moves with uniform velocity of u = 7 m/s from t = 0 to t = 1.5 sec. For t > 1.5 s, it starts moving with an acceleration of 10 m/s2. The distance travelled between t = 0 to t = 3 sec will be -

(A) 47.75 m (B) 32.25 m (C) 16.75 m (D) 27.50 m

7. A person is standing on a truck moving with a constant velocity of 14.7 m/s on a horizontal road. The man throws a ball in such a way that it returns to the truck after the truck has moved 58.8 m. What is the speed of the ball as seen from the truck?

(A) 9.8 m/s (B) 19.6 m/s (C) 29.4 m/s (D) 24.5 m/s

8. A stone is thrown from a bridge at an angle of 30º down with the horizontal with a velocity of 25 m/s. If the stone strikes the water after 2.5 sec then calculate the height of the bridge from the water surface-
(A) 61.9 m (B) 35 m (C) 70 m (D) None

9.* A cannon ball has a range R on a horizontal plane. If h and h' are the greatest heights in the two paths for which this is possible, then-

(A) $R = 4\sqrt{(hh')}$ (B) $R = \frac{4h}{h'}$ (C) $R = 4\,h\,h'$ (D) $R = \sqrt{hh'}$

10. If retardation produced by air resistances to projectile is one-tenth of acceleration due to gravity, the time to reach maximum height approximately-
(A) increase by 9% (B) decrease by 9%
(C) increase by 11% (D) decrease by 11%

11.* A particle starts from the origin of coordinates at time t = 0 and moves in the xy plane with a constant acceleration in the y-direction. Its equation of motion is $y = x^2$. Its velocity component in the x-direction is -

(A) variable (B) $\sqrt{2}$ (C) $\overline{2}$ (D) $\sqrt{\quad 2}$

12.* Two particles are projected from the same point with the same speed, at different angles $_1$ and $_2$ to the horizontal. They have the same horizontal range. Their times of flight are t_1 and t_2 respectively incorrect statement is.

(A) $_1 + _2 = 90º$ (B) $\frac{t_1}{t_2} = \tan\ _1$ (C) $\frac{t_1}{t_2} = \tan\ _2$ (D) $\frac{t_1}{\sin\ _1}\ \frac{t_2}{\sin\ _2}$

13. A particle moves along the positive branch of the curve $y = \frac{x^2}{2}$ where $x = \frac{t^2}{2}$, where x and y are measured in metre and t in second. At t = 2 sec, the velocity of the particle is -

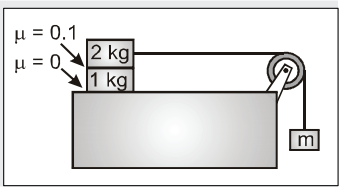
(A) $2\hat{i}\ \ 4\hat{j}$ m/sec (B) $2\hat{i}\ \ 4\hat{j}$ m/sec (C) $2\hat{i}\ \ 2\hat{j}$ m/sec (D) $4\hat{i}\ \ 2\hat{j}$ m/sec

14. A boy standing on a long railroad car throws a ball straight upwards. The car is moving on the horizontal road with an acceleration of $1 m/s^2$ and the projection velcoity in the vertical direction is 9.8 m/s. How far behind the boy will the ball fall on the car -
(A) 1 m (B) 2 m (C) 3 m (D) 4 m

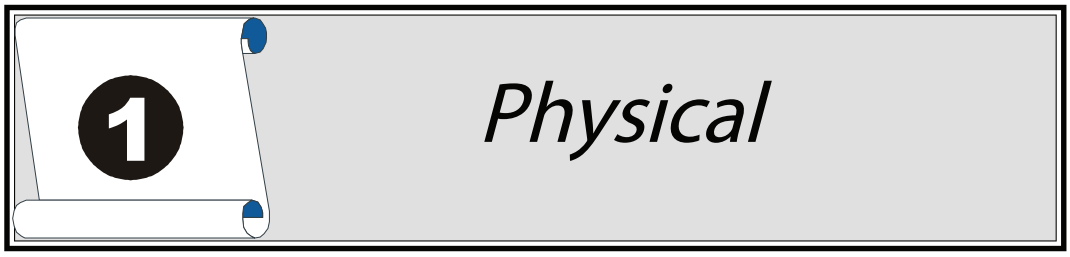
15. A block of mass 4 kg is kept over a rough horizontal surface. The coefficient of friction between the block and the surface is 0.1. At t = 0, 3 m/s $(\hat{i})$ velocity is imparted to the block and simultaneously 2N $(\ \hat{i})$ force starts acting on it. Its displacement in first 5 second is $(g = 10\ m/s^2)$ -

(A) $8\hat{i}$ (B) $8\hat{i}$ (C) $3\hat{i}$ (D) $3\hat{i}$

16. Mass of upper block and lower block kept over the table is 2 kg and 1 kg respectively and coefficient of friction between the blocks is 0.1. Table surface is smooth. The maximum mass M for which all the three blocks move with same acceleration is $(g = 10\ m/s^2)$ -



(A) 1 kg (B) 2/3 kg (C) 1/3 kg (D) 3/4 kg



EXERCISE

1. A sample of protein was analysed for metal content and analysed for metal content and analysis revealed that it contained magnesium and titanium in equal amounts, by mass. If these are the only metallic species present in the protein and contains 0.016% metal, the minimum possible molar mass of the protein is [Mg = 24, Ti = 48]
(A) 600000 (B) 150000 (C) 300000 (D) 1200000

2. 1 mol of N_2 and 4 mol of H_2 are allowed to react in a vessel to form NH_3 gas as only product and after reaction, water is added. Aqueous solution required 1 mol of HCl for complete reaction. Mol fraction of H_2 in the gas mixture after reaction is
(A) 1/6 (B) 5/6 (C) 1/3 (D) 1.0

3. pH of 0.05 M H_2SO_4 solution will be
(A) 0.005 (B) 2 (C) 1 (D) 0.01

4. Which of the following does not make any change in pH when added to 10 ml dilute HCl
(A) 5 ml pure water (B) 20 ml pure water (C) 10 ml HCl (D) Same 20 ml dilute HCl

5. The pH of a soft drink is 3.82. Its hydrogen ion concentration will be
(A) 1.96×10^{-2} mol/l (B) 1.96×10^{-3} mol/l (C) 1.5×10^{-4} mol/ l (D) 1.96×10^{-1} mol / l

6. A monoprotic acid in a 0.1 M solution ionizes to 0.0001%. Its ionization constant is
(A) 1.0×10^{-3} (B) 1.0×10^{-6} (C) 1.0×10^{-8} (D) 1.0×10^{-10}

7. In the reaction $A+2B \rightleftharpoons 2C$, if 2 moles of A.3.0 moles of B and 2.0 moles of C are placed in a 2.0 lit. flask and the equilibrium concentration of C is 0.5 mole/ l. The equilibrium constant (K_C) for the reaction is
(A) 0.073 (B) 0.147 (C) 0.05 (D) 0.026

8. For which state of matter, the coefficient of cubic expansion is independent to chemical composition ?
(A) solid (B) liquid (C) gas (D) all

9. In a reversible $2NO_2 \underset{k_2}{\overset{k_1}{\rightleftharpoons}} N_2O_4$, the rate of disappearance of NO_2 is equal to

(A) $\frac{k_1}{k_2}[NO_2]^2$ (B) $2k_1[NO_2]^2 - 2k_2[N_2O_4]$
(C) $2k_1[NO_2]^2 - k_2[N_2O_4]$ (D) $(2k_1 - k_2)[NO_2]$

10. 4.5 moles each of hydrogen and iodine headed in a sealed ten litre vessel. At equilibrium, 3 moles of HI were found. The equilibrium constant for $H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$ is
(A) 1 (B) 10 (C) 5 (D) 0.33

11. Average velocity of molecules of an ideal gas in a container, moving only in one dimension, is

(A) $\sqrt{\frac{8RT}{M}}$ (B) $\frac{1}{3}\sqrt{\frac{8RT}{M}}$ (C) zero (D) Infinite

12. In a chemical equilibrium A+B $\rightleftharpoons$ C+D, when one mole each of the two reactants are mixed, 0.6 mole each of the products are formed. The equilibrium constant calculated is
(A) 1 (B) 0.36 (C) 2.25 (D) 4/9

13. The ratio PV_m/RT of a gas is known as the compressibility factor. What is the value of this ratio of one mole of a vanderwaal's gas at its Boyle temperature ?

(A) $1 \quad \frac{b^2}{V_m(V_m \quad b)}$ (B) $1 \quad \frac{b^2}{V_m^2}$ (C) $1 \quad \frac{b}{V_m}$ (D) $1 - \frac{b^2}{V_m^2}$

14. The following equilibrium exists in aqueous solution $CH_3COOH \rightleftharpoons CH_3COOH^- + H^+$. If dilute HCl is added without a change in temperature then the
(A) Concentration of CH_3COO^- will increase
(B) Concentration of CH_3COO^- will decrease
(C) Equilibrium constant will increase
(D) Equilibrium constant will decrease

15. Reaction in which yield of product will increases with increases in pressure is
(A) $H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g}$ (B) $H_2O(g) + CO_{(g)} \rightleftharpoons CO_{2(g)} + H_{2(g)}$
(C) $H_2O_{(g)} + C_{(s)} \rightleftharpoons CO_{(g)} + H_{2(g)}$ (D) $CO_{(g)} + 3H_{2(g)} \rightleftharpoons CH_{4(g)} + H_2O_{(g)}$

16. The distance between tow nearest neighbors in body centered cubic lattice of axial length, l, is

(A) l (B) $\frac{\sqrt{3}}{2}$l (C) $\frac{\sqrt{2}}{2}$l (D) none

17. Let the height of hop unit cell is 'h'. The height of tetrahedral voids from the bases i

(A) $\frac{h}{2}$ (B) $\frac{h}{2}, \frac{2h}{3}$ (C) $\frac{h}{8}, \frac{7h}{8}$ (D) $\frac{h}{4}, \frac{3h}{4}$

18. 3.0 molal *NaOH* solution has a density of 1.110 g/ml. The molarity of the solution is
(A) 3.0504 (B) 3.64 (C) 3.05 (D) 2.9732

19. Boiling point of chloroform was raised by 0.323 K, when 0.5143 g of anthracene was dissolved in its 35 g. Molecular mass of anthracene is (K_b for $CHCl_3$ = 3.9 k-kg-mol^{-1})
(A) 79.42 g/mol (B) 132.32 g/mol (C) 177.42 g/mol (D) 242.32 g/mol

20. A solution containing 30 gms of non-volatile solute in exactly 90 gm water has a vapour pressure of 21.85 mm Hg at 25° C. Further 18 gms of water is then added to the solution. the resulting solution has a vapour pressure of 22.15 mm Hg at 25°C, Calculate the molecular weight of the solute
(A) 74.2 (B) 75.6 (C) 70.3 (D) 78.7

21. With 63 gm of oxalic acid how many litres of $\frac{N}{10}$ solution can be prepared
(A) 100 litre (B) 10 litre (C) 1 litre (D) 1000 litre

22. The heat evolved on combustion of 1 gm of starch, $(C_6H_{10}O_5)$, into $CO_2(g)$ and $H_2O(l)$ is 4.18 Kcal. What is the standard enthalpy of formation of 1 gm of starch ? Heat of formation of $CO_2(g)$ and $H_2O(l)$ are –94.05 and –68.32 Kcal/mol.
(A) –2.82 Kcal (B) –0.71 Kcal (C) – 1.41 Kcal (D) – 8.46 Kcal

23. The bond enthalpies of C–C=C and bonds are are 348, 610 and 835 kJ/mol, respectively at 298K and 1 bar. The enthalpy of polymerisation per mole of 2-Butyne at 298K and 1 bar, as shown below, is

n CH_3–C C—CH_3(g) –$(CH_2$–CH=CH–$CH_2)_n$–(g)

(A) –123 kJ (B) –132 kJ (C) – 139 kJ (D) – 37 kJ

1 CALCULUS

EXERCISE

1. Range of the function f defined by $f(x) = \frac{1}{\sin\{x\}}$ (where [*] and {*} respectively denotes the greatest integer and the fractional part function) is

(A) I, the set of integers
(B) N, the set of natural numbers
(C) W, the set of whole numbers
(D) Q, the set of rational numbers

2. If f(x) is an even function and satisfies the relation $x^2 f(x) - 2f\left(\frac{1}{x}\right) = g(x)$, where g(x) is an odd function, then the value of f(5) is

(A) 0 (B) $\frac{37}{75}$ (C) 4 (D) $\frac{51}{77}$

3. $\lim_{x \to /2} \frac{\sin(x\cos x)}{\cos(x\sin x)}$ is equal to

(A) 1 (B) /2 (C) 2/ (D) does not exist

4. $\lim_{x \to 0} \frac{\ln(a \quad x) \quad \ln a}{x} + k \lim_{x \to e} \frac{\ln x \quad 1}{x \quad e} = 1$ then

(A) $k = e^{\quad 1 \quad \frac{1}{a}}$
(B) k =e (1 + a)
(C) k = e (2 – a)
(D) The equality is not possible

5. The set of all points, where $f(x) = \sqrt[3]{x^2 |x|} \quad |x| \quad 1$ is not differentiable is

(A) {0} (B) {–1, 0, 1} (C) {0, 1} (D) none of these

6. If $f(x) = \{x^2\} - (\{x\})^2$, where {x} denotes the fractional part of x, then
(A) f(x) is continuous at x = 2 but not at x = –2
(B) f(x) is continuous at x = –2 but not at x = 2
(C) f(x) is continuous at x = –2 but not at x = –2
(D) f(x) is discontinuous at x = 2 and x = –2

7. The set of values of a for which the function $f(x) = (4a - 3)(x + \ln 5) + 2(a - 7)\cot\frac{x}{2}\sin^2\frac{x}{2}$ does not possess critical points is

(A) (1,) (B) [1,) (C) (– ,2) (D) (– ,–4/3) (2,)

8. If f(x) = x + tan x and f is inverse of g, then g′(x) is equal to

(A) $\frac{1}{1 \quad (g(x) \quad x)^2}$ (B) $\frac{1}{1 \quad (g(x) \quad x)^2}$ (C) $\frac{1}{2 \quad (g(x) \quad x)^2}$ (D) $\frac{1}{2 \quad (g(x) \quad x)^2}$

9. Tangents are drawn from the origin to the curve y = sin x, then their point of contact lie on the curve

(A) $x^2 + y^2 = 1$ (B) $x^2 - y^2 = 1$ (C) $\frac{1}{x^2} + \frac{1}{y^2} = 1$ (D) $\frac{1}{y^2} - \frac{1}{x^2} = 1$

10. The slope of the normal at the point with abscissa x = −2 of the graph of the function $f(x) = |x^2 - |x||$ is

(A) −1/6 (B) −1/3 (C) 1/6 (D) 1/3

11. Let $y = x^2 e^{-x}$, then the interval in which y increases with respect to x is

(A) (− ,) (B) (−2, 0) (C) (2,) (D) (0, 2)

12. On which of the following intervals is the function $x^{100} + \sin x - 1$ decreasing ?

(A) (0, /2) (B) (0, 1) (C) $\frac{}{2}$, (D) None of these

13. The point (0, 5) is closest to the curve $x^2 = 2y$ at

(A) $(2\sqrt{2}, 0)$ (B) (2, 2) (C) $(-2\sqrt{2}, 0)$ (D) $(2\sqrt{2}, 4)$

14. The global maxima of $f(x) = [2\{-x^2 + x + 1\}]$ is (where {*} denotes fractional part of x and [*] denotes greatest integer function)

(A) 2 (B) 1 (C) 0 (D) none of these

15. $\int |\ln x| \, dx$ equals (0 < x < 1)

(A) $x + x|\ln x| + c$ (B) $x|\ln x| - x + c$ (C) $x + |\ln x| + c$ (D) $x - |\ln x| + c$

16. $\int \sqrt{(x \quad 3)} \{\sin^{-1}(\ln x) + \cos^{-1}(\ln x)\} dx$ equals

(A) $\frac{}{3} (x - 3)^{3/2} + c$ (B) 0 (C) does not exist (D) none of these

17. $\int \frac{3 \quad 2\cos x}{(2 \quad 3\cos x)^2} dx$ is equal to

(A) $\frac{\sin x}{2 \quad 3\cos x}$ c (B) $\frac{2\cos x}{2 \quad 3\sin x}$ c (C) $\frac{2\cos x}{2 \quad 3\cos x}$ c (D) $\frac{2\sin x}{2 \quad 3\sin x}$ c

18. The value of $\int_0^{11} [x]^3 . dx$, where [*] denotes the greatest integer function, is

(A) 0 (B) 14400 (C) 2200 (D) 3025

19. If $I_1 = \int_0^{/2} \cos(\sin x) dx$; $I_2 = \int_0^{/2} \sin(\cos x) dx$ and $I_3 = \int_0^{/2} \cos x \, dx$, then

(A) $I_1 > I_2 > I_3$ (B) $I_2 > I_3 > I_1$ (C) $I_3 > I_1 > I_2$ (D) $I_1 > I_3 > I_2$

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