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CHEMICAL ENGINEERING REFRESHER PROGRAM

PHYSICS

1. A car is initially moving at a constant velocity. If it comes to a stop due to a uniform acceleration, the direction of the acceleration is:
    a. In the same direction as the initial velocity.
    b. Opposite to the direction of the initial velocity.
    c. Perpendicular to the initial velocity.
    d. Zero, since the car stops.

2. A satellite orbiting the Earth in a circular orbit feels a force due to gravity. This force acts:
    a. towards the center of the Earth.
    b. tangential to the satellite's orbit.
    c. opposite to the satellite's motion.
    d. none of the above.

3. If the frequency of a wave doubles while its speed remains constant, its wavelength:
    a. is halved.
    b. doubles.
    c. remains the same.
    d. quadruples.

4. The energy of a photon is directly proportional to its:
    a. speed.
    b. amplitude.
    c. frequency.
    d. wavelength.

5. A block is pushed across a table at a constant velocity. The net force acting on the block is:
    a. equal to the weight of the block.
    b. zero.
    c. greater than the weight of the block.
    d. depends on the velocity of the block.

6. In a hydraulic system, a small force applied to a small piston can be transformed to a large force on a large piston because of the conservation of:
    a. energy.
    b. momentum.
    c. volume.
    d. pressure.

7. Two resistors are connected in series with a battery. If the resistance of one of the resistors is doubled, the total current in the circuit will:
    a. double.
    b. halve.
    c. remain the same.
    d. quadruple.

8. A convex lens can produce:
   a. a real and inverted image only.
   b. a virtual and erect image only.
   c. both real and inverted, and virtual and erect images.
   d. neither real nor virtual images.

9. The temperature at which the pressure of an ideal gas becomes zero, provided its volume remains constant, is called:
   a. boiling point.
   b. freezing point.
   c. absolute zero.
   d. critical temperature.

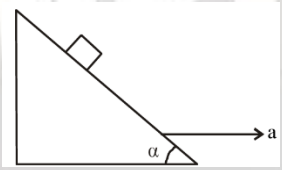
10. If you stand on a rotating merry-go-round and throw a ball straight up (from your perspective), where will the ball land when you are not holding onto any bars or handles?
   a. Right back into your hand.
   b. Behind you.
   c. In front of you.
   d. It depends on the rotation speed

11. Let *l*, *r*, *c* and *v* represent inductance, resistance, capacitance and voltage, respectively. The SI unit of ℓ/rcv will be:
   a. mA^{-2}
   b. A^{-1}
   c. msA
   d. ms^2

12. An automobile, travelling at 40 km/h, can be stopped at a distance of 40 m by applying brakes. If the same automobile is travelling at 80 km/h, the minimum stopping distance, in meters, is (assume no skidding)
   a. 75 m
   b. 160 m
   c. 100 m
   d. 150 m

13. A boy can throw a stone up to a maximum height of 10 m. The maximum horizontal distance that the boy can throw the same stone up to will be
   a. 20√2 meters
   b. 10√2 meters
   c. 20 meters
   d. 10 meters

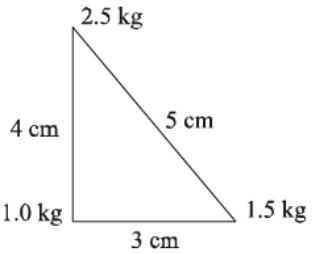
14. A block is kept on a frictionless inclined surface with angle of inclination 'α'. The incline is given an acceleration '*a*' to keep the block stationary. Then *a* is equal to



   a. *g* cosec α
   b. *g* / tan α
   c. *g* tan α
   d. *g*

15. A person pushes a box on a rough horizontal platform surface. He applies a force of 200 N over a distance of 15 m. Thereafter, he gets progressively tired, and his applied force reduces linearly with distance to 100 N. The total distance through which the box has been moved is 30 m. What is the work done by the person during the total movement of the box?
   a. 3280 J
   b. 2780 J
   c. 5690 J
   d. 5250 J

16. Three point particles of masses 1.0 kg, 1.5 kg and 2.5 kg are placed at three corners of a right angle triangle of sides 4.0 cm, 3.0 cm and 5.0 cm as shown in the figure. The center of mass of the system is at a point:



   a. 0.6 cm right and 2.0 cm above 1 kg mass
   b. 1.5 cm right and 1.2 cm above 1 kg mass
   c. 2.0 cm right and 0.9 cm above 1 kg mass
   d. 0.9 cm right and 2.0 cm above 1 kg mass

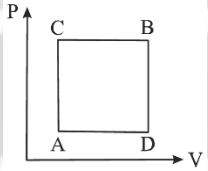
17. The ratio of the weights of a body on the Earth's surface to that on the surface of a planet is 9:4. The mass of the planet is 1/9 of that of the Earth. If 'R' is the radius of the Earth, what is the radius of the planet ? (Take the planets to have the same mass density).
    a. R/3
    b. R/4
    c. R/9
    d. R/2

18. A steel wire can sustain 100 kg weight without breaking. If the wire is cut into two equal parts, each part can sustain a weight of
    a. 50 kg
    b. 400 kg
    c. 100 kg
    d. 200 kg

19. An ideal fluid flows (laminar flow) through a pipe of nonuniform diameter. The maximum and minimum diameters of the pipes are 6.4 cm and 4.8 cm, respectively. The ratio of the minimum and the maximum velocities of fluid in this pipe is:
    a. 9/16
    b. √3/2
    c. 3/4
    d. 81/256

20. On a linear temperature scale Y, water freezes at – 160°Y and boils at – 50°Y. On this Y scale, a temperature of 340 K would be read as : (water freezes at 273 K and boils at 373 K)
    a. – 73.7°Y
    b. – 233.7°Y
    c. – 86.3°Y
    d. – 106.3°Y

21. A gas can be taken from A to B via two different processes ACB and ADB.



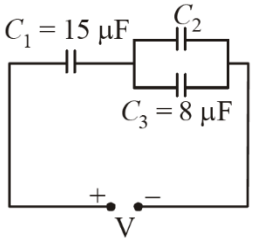
When path ACB is used 60 J of heat flows into the system and 30J of work is done by the system. If path ADB is used work done by the system is 10 J. The heat flow into the system in path ADB is:
    a. 40 J
    b. 80 J
    c. 100 J
    d. 20 J

22. A pendulum with negligible mass has a length 1 m and oscillates in simple harmonic motion. Determine the period of oscillation.
    a. 1 sec
    b. 2 secs
    c. 3 secs
    d. 4 secs

23. A string of length 1 m and mass 5 g is fixed at both ends. The tension in the string is 8.0 N. The string is set into vibration using an external vibrator of frequency 100 Hz. The separation between successive nodes on the string is close to:
    a. 10.0 cm
    b. 33.3 cm
    c. 16.6 cm
    d. 20.0 cm

24. Three charges + Q, q, + Q are placed respectively, at distance, d/2 and d from the origin, on the *x*-axis. If the net force experienced by + Q, placed at *x* = 0, is zero, then value of q is:
    a. -Q/4
    b. +Q/2
    c. +Q/4
    d. -Q/2

25. In the circuit shown in the figure, the total charge is 750 mC and the voltage across capacitor C_2 is 20 V. Then the charge on capacitor C_2 is:



    a. 450 μC
    b. 590 μC
    c. 160 μC
    d. 650 μC

26. Three resistors of 4 Ω, 6 Ω and 12 Ω are connected in parallel and the combination is connected in series with a 1.5 V battery of 1 Ω internal resistance. The power in the 4 Ω resistor is
    a. 0.55 W
    b. 0.33 W
    c. 0.25 W
    d. 0.86 W

27. An AC circuit has R = 100 Ω, C = 2 microF and L = 80 mH, connected in series. The quality factor of the circuit is:
    a. 2
    b. 20
    c. 0.5
    d. 400

28. To get three images of a single object, one should have two plane mirrors at an angle of
    a. 60º
    b. 90º
    c. 120º
    d. 30º

29. A lens has a convex surface of radius 17 cm and a concave surface of radius 38 cm and is made of glass of refractive index of 1.55. Calculate the focal length of the lens and classify the type of the lens whether it's diverging or converging.
    a. 55.93 cm, converging.
    b. 55.93 cm, diverging.
    c. 57.45 cm, converging.
    d. 57.45 cm, diverging.

30. A beam of light enters a lake at an angle of incidence of 40º. Find the angle of refraction.
    a. 29º
    b. 71º
    c. 19º
    d. 40º