Physics (Engineering) Grand Test -2014

1. **Using a scale calibrated up to millimeters, the diameter of a sphere is measured to be 4.2 *cm*. The percent error in the calculation of its volume is nearly**

   1) 3.5% 2) 7% 3) 0.7% 4) 2%

2. **A river is 480 m wide and a boat that can travel at 15 m s^{-1} relative to the still water crosses the river by shortest path in 40 seconds. The velocity of water in the river must be**

   1) 7.5 ms^{-1} 2) 12 m s^{-1} 3) 9 m s^{-1} 4) 6 m s^{-1}

3. **Two players of same height are separated by a large distance in the play ground. The ball thrown by one player is received by the other. The point of projection and the point of reception are at the same height above the ground. If the ball during its motion rises to a height of 5 *m* above the point of projection, the time interval for which the ball is in motion is (g = 10 ms^{-2})**

   1) 1 *s* 2) 2 *s* 3) 4 *s* 4) 1/2 *s*

4. **Two bodies of masses 3 kg and 2 kg are connected by a long string, and the string is made to pass over a smooth fixed pulley. Initially the bodies are held at the same level and released from rest. The velocity of the 3 kg body after one second is (take g = 10 m/s^2)**

   1) 2 m/s 2) 1 m/s 3) 0.4 m/s 4) 4 m/s

5. **Choose the correct option from those given below**

   A) The cause of motion of an object is force

   B) The cause of changes of motion of an object is inertia

   1) A true, B false 2) A false, B true 3) A true, B true 4) A false, B false

6. **A ball A moves directly towards an identical ball B at rest with a linear momentum *p*. During the collision, A transfers 80% of its linear momentum to B. The percentage loss of kinetic energy during the collision is**

   1) 64% 2) 32% 3) 16% 4) 68 %

7. **The center of mass of a system of particles of total mass 10 *kg* is moving with a velocity of 4 *m/s* due north. If one of the particles of mass 2 *kg* in the system is moving with a velocity of 8 *m/s* due south, the velocity of the center of mass of the remaining particles of the system is**

   1) 7 *m/s* due north 2) 3 *m/s* due north 3) 12 *m/s* due south 4) 3 *m/s* due south

8. **A block of mass 2 *kg* is resting on a rough horizontal surface. A steady horizontal force of 10 *N* is applied on the block and moves it over a certain distance. If the kinetic energy acquired by the block is 80% of the work done by the applied force, the coefficient of friction between the block and the surface is (g = 10 m/s^2)**

1) 0.05 2) 0.1 3) 0.2 4) 0.4

9. **A steady torque is applied by a motor on a fly wheel initially at rest. When the fly wheel has made '*n*' rotations, the instantaneous power delivered by the motor to the fly wheel is proportional to**

1) n 2) $\frac{1}{n}$ 3) $\frac{1}{\sqrt{n}}$ 4) $\sqrt{n}$

10. **A uniform circular disk of mass 2 kg is rolling without slipping on a rough horizontal table. If the velocity of the centre of mass of the disk is 4 m/s, the kinetic energy of the disk is**

1) 16 J 2) 32 J 3) 24 J 4) 22.4 J

11. **At a given place where acceleration due to gravity is 'g' $m/\sec^2$, a sphere of lead of density 'd' kg/m^3 is gently released in a column of liquid of density $'\rho' kg/m^3$. If $d > \rho$, the sphere will**

1) Fall vertically with an acceleration 'g' $m/\sec^2$
2) Fall vertically with no acceleration
3) Fall vertically with an acceleration $g\left(\frac{d-\rho}{d}\right)$
4) Fall vertically with an acceleration $g\left(\frac{\rho}{d}\right)$

12. **A particle is executing simple harmonic motion. The maximum force it experiences during the motion is *F* and the maximum kinetic energy during the motion is *K*. The amplitude of the motion is**

1) $2K/F$ 2) $F/2K$ 3) $K/2F$ 4) $2F/K$

13. **Two steel wires A and B have lengths *L* and 2*L* and radii *r* and 2*r*. If they are stretched by applying the same tension force, the ratio of strain energies per unit volume stored in them is**

1) 1 : 4 2) 4 : 1 3) 16 : 1 4) 1 : 16

14. **Assertion (A): When two soap bubbles one small in size and the other large in size are in communication with each other, then the small bubble becomes smaller and the large bubble becomes larger.**

Reason (R): The pressure inside the smaller bubble is less and that inside the larger bubble is more.

1) Both A and R are individually true and R is the correct explanation of A

2) Both A and R are individually true but R is not the correct explanation of A

3) A is true but R is false

4) Both A and R are false

15. **Two steel balls have masses in the ratio 1 : 8. They are released in to a tall jar containing glycerin. When they attain their respective terminal velocities, the ratio of those terminal velocities is**

1) 1 : 4 2) 4 : 1 3) 1 : 2 4) 2 : 1

16. **An open mouthed flask has air inside it, initially at a temperature of 27°C. The density of the air in the flask is ρ. If the flask is heated to a temperature of 127°C, the density of air in the flask now is**

1) ρ 2) 3ρ/4 3) 4ρ/3 4) 27ρ/127

17. **The temperature expressed in Fahrenheit scale varies linearly with the same temperature expressed in Celsius scale, i.e. the graph drawn with temperatures in Celsius scale on X-axis and the corresponding temperatures expressed in Fahrenheit scale on Y-axis is a straight line. The slope of this line is**

1) 5/9 2) 9/5 3) 1 4) 1/32

18. **During an adiabatic process, the square of the pressure of an ideal gas is found to be directly proportional to the absolute temperature raised to power seven. The gas must be**

1) Monatomic 2) Diatomic

3) Polyatomic 4) a mixture of mono and diatomic gases

19. **A copper vessel of mass 100 *gm* (specific heat of copper = 0.1 cal/gm/C°) contains 290 *gm* of water at 20°C. Now steam is passed in to the system until the temperature rises to 40°C. The mass of the system towards the end is**

1) 10 *gm* 2) 400 *gm* 3) 310 *gm* 4) 410 *gm*

20. **A uniform copper rod has a temperature difference of 100 C° across its ends. Under steady state conditions, the rate of flow of heat through it is Q. If one third of the length of the rod is cut and removed, assuming that the same temperature difference is maintained across its ends, the present rate of flow of heat will be**

1) Q 2) 3Q/2 3) 2Q/3 4) 9Q/4

21. **A string of length 2 *m* is stretched between two ends and a stationary wave is setup on it with five nodes. The minimum distance between a node and antinode is**

1) 20 *cm* 2) 25 *cm* 3) 40 *cm* 4) 50 *cm*

22. **To the driver of a train approaching a cliff with a speed of 36 kmph, the frequency of the echo of the whistle of the train appears to be 510 Hz. If velocity of sound in air is 330 m/s the actual frequency of the whistle must be**

1) 540 Hz 2) 480 Hz 3) 510 Hz 4) 520 Hz

23. **A ray of light undergoes a minimum deviation of 60° when incident on an equilateral prism made of material of refractive index $\sqrt{3}$. The angle of emergence of the ray from the second refracting surface of the prism is**

1) 30° 2) 45° 3) 60° 4) 0°

24. **A convex lens of focal length 6*cm* is used as a simple microscope by a person having least distance of distinct vision of 30 *cm*. The maximum magnification he can achieve is**

1) 5 2) 4 3) 6 4) 8

25. **The average magnetic field energy density of an electromagnetic wave is $1.2\times10^{-12} J/m^3$. The intensity of the radiation is ($c = 3\times10^8 ms^{-1}$)**

1) $3.6\times10^{-4} Wm^{-2}s^{-1}$ 2) $4.0\times10^{-21} Wm^{-2}s^{-1}$

3) $1.08\times10^{5} Wm^{-2}s^{-1}$ 4) $1.33\times10^{-29} Wm^{-2}s^{-1}$

26. **Two coherent sources are at a distance "d" apart. Interference bands are produced with monochromatic light of wavelength 'λ' on a screen at a distance "D" from the coherent sources. If "ω" is the band width, then the correct relation between the various parameters is**

1) $\omega = \frac{d\lambda}{2D}$ 2) $\omega = \frac{D\lambda}{2d}$ 3) $\omega = \frac{d\lambda}{D}$ 4) $\omega = \frac{D\lambda}{d}$

27. Match the following.

List I	**List II**
(A) Magnetic dipole moment	(e) newton/ampere^2
(B) Magnetic flux	(f) weber/meter^2
(C) Permeability of vacuum	(g) joule/tesla
(D) Magnetic induction	(h) ampere meter
	(i) weber

1) A – g, B – h, C – e, D – f
2) A – h, B – i, C – e, D – f
3) A – g, B – i, C – e, D – f
4) A – f, B – g, C – h, D – i

28. The time period of oscillation of two bar magnets placed together in a vibration magnetometer is found to be doubled when the alignment of one of the magnets is reversed. The magnetic moments of two magnets must be in the ratio

1) 5 : 3 2) 1 : 2 3) 3 : 1 4) 2 : 1

29. If ϕ_1 electric flux enters an enclosed surface and ϕ_2 electric flux leaves that surface, the charge enclosed by the surface is

a) zero if $|\phi_1| = |\phi_1|$ *b*) positive if $|\phi_1| > |\phi_1|$ *c*) negative if $|\phi_1| > |\phi_1|$

d) Positive if $|\phi_1| < |\phi_1|$ *e*) negative if $|\phi_1| < |\phi_1|$

1) *a*, *c* and *d* are correct
2) *c* and *d* are correct
3) *a*, *b* and *e* are correct
4) *b* and *e* are correct

30. **A charged condenser of capacity *C*, having a charge *Q* is connected parallel to an uncharged condenser of capacity 2*C*. The charge lost by the first condenser is**

1) *Q*/3 2) 2*Q*/3 3) *Q*/2 4) 3*Q*/2

31. **A cylindrical copper rod connected across an ideal source of emf with zero internal resistance has drift velocity of the electrons 'v'. If a coaxial cylindrical hole is drilled all along its length with a radius which is half the radius of the rod and it is connected across the same source, now the drift velocity of the electrons will be**

1) 4v/3 2) 3v/4 3) 2v 4) v

32. **The resistance in the left and right gaps of meter bridge are in the ratio 2 : 3. A balance point is obtained at P on the wire. Now, the gap resistances are interchanged, the new balance point is at Q. The value of PQ in cm is**

1) 40 2) 60 3) 20 4) 50

33.**A cylindrical conductor of radius '*R*' carries a current '*i*'. The value of magnetic field at a point which is *R*/4 distance inside from the surface is 10 *T*. Find the value of magnetic field at point which is 4*R* distance outside from the surface**

(a) $\frac{4}{3}T$ (b) $\frac{8}{3}T$ (c) $\frac{40}{3}T$ (d) $\frac{80}{3}T$

34. **An AC current through a conductor is represented by i = 10 sin (100 t)A, here *t* is in seconds. The minimum time taken for the current to increase from *zero* to 5 *A* is**

1) π/300 *s* 2) π/450 *s* 3) π/600 *s* 4) π/900 *s*

35. **A galvanometer of resistance 20Ω is converted in to an ammeter by connecting a shunt resistance1/2 Ω in parallel with it. If the current in the shunt is *x*, the current through the galvanometer is *y* and the current through the ammeter is *z*, then the ratio *x* :*y* : *z* is**

1) 40 : 1 : 41 2) 41 : 1 : 40 3) 1 : 40 : 41 4) 1 : 41 : 40

36. **An oil-drop of radius one micron carries a charge equal to that of three electrons. If the density of the oil is 2000 kg/m³, the electric field to be applied to keep the drop stationary is (neglect the buoyancy force)**

1) 1.71×10^4 V/m 2) 1.71×10^3 V/m 3) 1.71×10^5 V/m 4) 1.71×10^2 V/m

37. **An X-ray tube operates at a voltage 'V'. The maximum linear momentum of the X-photons emitted from the tube is (e = quantum of charge, c = speed of light in vacuum)**

1) $\frac{c}{eV}$ 2) $\frac{cV}{e}$ 3) $\frac{eV}{c}$ 4) $\frac{eV}{c^2}$

38. **A radio-active substance can decay simultaneously by two different processes in which the decay constants are λ_1 and λ_2, and the effective decay constant of the substance is λ. If $\lambda_1 < \lambda_2$, which of the following is the correct ascending order of the three decay constants?**

1) $\lambda < \lambda_2 < \lambda_1$ 2) $\lambda_2 < \lambda_1 < \lambda$ 3) $\lambda_2 < \lambda < \lambda_1$ 4) $\lambda_1 < \lambda_2 < \lambda$

39. **The two inputs of a logic gate are low and its output is high, then the gate is (are)**

1) OR gate 2) AND gate 3) OR gate *or* AND gate 4) NOR gate *or* NAND gate

40. **The height of a transmitting antenna is *h* and that of a receiving antenna *h*/4. The maximum possible distance between them for line-of-sight transmission is (*R* is the radius of Earth)**

1) $\sqrt{2Rh}$ 2) $\sqrt{4.5Rh}$ 3) $\sqrt{3.1Rh}$ 4) $\sqrt{6Rh}$

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1) 2	2) 3	3) 2	4) 1	5) 4	6) 2	7) 1	8) 2	9) 4	10) 3
11) 3	12) 1	13) 3	14) 3	15) 1	16) 2	17) 2	18) 2	19) 2	20) 2
21) 2	22) 2	23) 3	24) 3	25) 1	26) 4	27) 3	28) 1	29) 1	30) 2
31) 4	32) 3	33) 3	34) 3	35) 1	36) 3	37) 3	38) 4	39) 4	40) 2

1. Relative error in diameter = relative error in radius = 0.1/4.2 = 1/42. Relative error in volume = 3×relative error in radius and percent error = relative error×100

2. Time of crossing a river by shortest path, $t = \frac{b}{\sqrt{v_B^2 - v_W^2}}$

3. 5 m given is greatest height, from this get $u\sin\theta$. Using this time of flight can be calculated.

4. The common acceleration is given by $a = \left(\frac{m_1 - m_2}{m_1 + m_2}\right) \times g$. Next v = u + at.

5. The cause of motion is inertia. The cause of change of motion is force.

6. If u is initial velocity of A, after collision the velocity of B must be 0.8u and that of A 0.2u. (Linear momentum is directly proportional to the velocity)

7. $\overline{v}_{CM} = \frac{m_1\overline{v}_1 + m_2\overline{v}_2}{m_1 + m_2}$.

8. When 80% of work converts into kinetic energy, the remaining 20% must be the work done in overcoming the friction. $\mu mgs = 0.2Fs$.

9. $\omega^2 - 0 = 2\alpha\theta$ and $P_i = \tau \times \omega$.

10. $K_{ROLL} = \frac{1}{2}mv^2(1+\beta)$, here β = 1/2 for the disk.

11. Apparent weight = actual weight – up thrust force

$$Vdg' = Vdg - V\rho g$$

$$\Rightarrow g' = \left(\frac{d-\rho}{d}\right) g$$

12. Maximum force in SHM = mass × maximum acceleration and maximum kinetic energy = ½×mass×maximum velocity². $a_{MAX} = A\omega^2$ and $v_{MAX} = A\omega$.

13. Strain energy per unit volume = ½×stress×strain. Here the stresses are in the ratio 4:1 and strains are also in the ratio 4 : 1.

14. Excess pressure is inversely proportional to the radius.

15. When masses are in the ratio 1 : 8, the radii must be in the ratio 1 : 2 and terminal velocity ∝ radius².

16. $PV = mTr$, where r is specific gas constant. And $\rho = m/V$.

17. $\frac{F-32}{9} = \frac{C}{5} \Rightarrow \frac{y-32}{9} = \frac{x}{5}$, and hence $y = (9/5)x + 32$, compare this with $y = mx + c$ and the slope m.

18. For adiabatic process: $P^{\gamma-1} \propto T^{\gamma}$

19. H = msΔθ and H = mL.

20. $\frac{Q}{t} = \frac{KA(\theta_1 - \theta_2)}{\ell}$, i.e. the rate of flow is inversely proportional to length.

21. For a string 5 nodes implies 4 antinodes and 4 loops formed. Loop length (λ/2) = 1/2 *m*. Minimum distance between node and antinode is λ/4.

22. In Doppler effect with echo, the virtual source approaches the observer and the observer approaches the virtual source, hence $f' = f\left(\frac{v + v_L}{v - v_S}\right)$.

23. When minimum deviation occurs, the angle of incidence and the angle of emergence are equal and each is equal to $\left(\frac{A + D_m}{2}\right)$.

24. Maximum magnification of a simple microscope = $1 + \frac{D}{f}$.

25. Intensity of electromagnetic wave = Average energy density of either the magnetic field or electric field × speed of light in vacuum.

26. Standard formula: $\omega = \frac{D\lambda}{d}$

27. Conceptual.

28. $T = 2\pi\sqrt{\frac{I}{(M_1+M_2)B_H}}$ and $2T = 2\pi\sqrt{\frac{I}{(M_1-M_2)B_H}}$.

29. If flux entering is equal to flux leaving, net flux being zero, the enclosed charge is zero. If more flux leaves, the enclosed charge must be positive and vice versa

30. Common potential = (Total charge Q)/(C+2C). The charge gained by the second condenser is charge lost by the first condenser. Use $C = \frac{Q}{V}$.

31. Drift velocity $v_d = \frac{j}{ne} = \frac{i}{Ane} = \frac{V}{RAne} = \frac{V}{sL\cancel{A}ne/\cancel{A}} = \frac{V}{sne}$, obviously it is independent of the area of cross section of the conductor.

32. First balance point is at a distance of 40 *cm* from the left end. The next balance point will be at 60 *cm* from the left end. Shift is 20 *cm*

33. Magnetic field inside the cylindrical conductor

$B_{in} = \frac{\mu_0}{4\pi}.\frac{2ir}{R^2}$ (*R*=Radius of cylinder, *r* = distance of observation point from axis of cylinder)

Magnetic field out side the cylinder at a distance r' from it's axis $B_{out} = \frac{\mu_0}{4\pi}.\frac{2i}{r'}$

$$\Rightarrow \frac{B_{in}}{B_{out}} = \frac{rr'}{R^2} \Rightarrow \frac{10}{B_{out}} = \frac{\left(R-\frac{R}{4}\right)(R+4R)}{R^2} \Rightarrow B_{out} = \frac{8}{3}T$$

34. Put *i* = 5 and solve for *t*.

35. The current through the ammeter = current through galvanometer + current through shunt. The ratio of the currents in the shunt and galvanometer is the inverse ratio of their resistances.

36. *mg* = *qE*, and mass *m* = volume × density

37. Linear momentum of a photon is Energy/*c*.

38. $\lambda = \lambda_1 + \lambda_2$.

39. Both inputs Low and output High is given by NOR gate and also NAND gate.

40. $d = \sqrt{2Rh_1} + \sqrt{2Rh_2}$