Indian Association of Physics Teachers

NATIONAL STANDARD EXAMINATION IN Astronomy 2013-2014

Total time: 120 minutes **Marks: 240**

Only one out of four options is correct

Hints to selected questions for NSEA question paper version 484 - 2013

Q 08.

When Venus lies east of the sun, it sets after the sun sets. So it is an evening "star".

Q 9.

Venus had phases like the moon

Q 12

$$\alpha = \frac{\Delta i_c}{\Delta i_E} = \frac{7.8}{8.0} = 0.975$$

$$\beta = \frac{\alpha}{1-\alpha} = 39$$

$$\Delta i_B = \frac{\Delta i_c}{\beta} = \frac{7.8}{39} mA = 200 \mu A$$

Q 27.

To solve this problem, it is helpful to draw segment *OB* in the figure. Since *OB* and *OD*are both radii of the circle, they both equal 5. Therefore, the angles opposite these congruent sides of $\triangle$ *BOD* are congruent and $\angle$ *OBD* = 36°. The third angle of the triangle, $\angle$ *BOD*, equals 180°- 36°- 36° = 108°. Arc *BCD* is a fraction of the circumference of the circle and more specifically equals $\frac{108}{360} \cdot 2\pi(5)$, which equals 3π The correct answer is choice (D).

Q 28.

When the denominator of a fraction is increased, the value of the fraction decreases. Therefore, adding 1 go *b*, *d*, or *e* will decrease the sum *S*. Increasing one of the numerators, either *a* or *c*, will increase *S*. Adding 1 to *a* changes $\frac{a}{b}$ to $\frac{a+1}{b}$, thereby increasing *S* by $\frac{1}{b}$. Adding 1 to *c* changes $\frac{c}{d}$ to $\frac{c+1}{d}$, thereby increasing *S* by $\frac{1}{d}$. Since $b<d$, then $\frac{1}{b}>\frac{1}{d}$. Therefore, adding 1 to *a* will result in the greatest increase in*S*. The correct answer is (a).

Q 29.

If *m* is even, then the expression (*m* + *p*) x *m* will always be even and it cannot be determined whether *p* is even or odd. This eliminates choices (C) and (D). If *m* is odd, then (*m* + *p*) x *m* will be even only when *m* + *p* is even and *m* + *p* will be even only when *p* is odd. The correct answer is (a) since the truth of statement (A) also eliminates choices (b).

Q30.

Minimum number newspapers necessary for satisfying the second condition is 300/60 = 5

For satisfying the first condition and the second the condition are (300X5)/60 = 25 (Exactly)

Q 33.

Expln; With m as the mass of the load, v the speed at the bottom of the pendulum path and T the tension. In this situation :$mgl=1/2\ mv^2$, $T-mg/l = mv^2/l$; so T=3mg=3X1X10=30N; Tension is much larger than the breaking load so the wire will torn.

Q 34.

Viscous force is proportional to nrv so the damping coefficient b in the expression $A=A_0$ Exp(-bt), (A, and A_0 are the amplitudes at time t and t=0s) is proportional to na/m, where m=mass of the pendulum bob which is again proportional to a^3 so b is proportional to na/a^3 =n/a. . But time t in which amplitude becomes half is proportional to 1/b, so a/n is the answer.

Q 35.

If a particle is projected from an exterior point at a distance r from the centre of the earth then the particle will escape from its gravitational field if the projection velocity is $(2GM/r)^{1/2}$. If R is the radius of the earth then $(2GM/R)^{1/2}$=11km per second . In the present problem r=3R+R= 4R. So eascape velocity= 5.5km per second.

Q 36.

Let m is the mass of the beam, h is the height of the CG=l/2 (l=30m is the length), v the velocity of the top when it is about to hit the ground and I the MI of the rod about a horizontal axis passing through the foot of the beam. Then loss in PE, mgh =gain in K E, ½ Iw^2= ½ $(ml^2/3)(v/l)^2$. From these relations, $v=(3gl)^{1/2}=30ms^{-1}$ =108km per hour.

Q 37.

Moment of the weight, mg about a point where a tyre is in contact with the road=mbg/2 and that of the centripetal force= $(mv^2 /r)h$, two moments are to be equal; so b=0.72 m

Q 38.

The magnitude of angular momentum with respect to the origin is mvx, m = mass of the particle , v is the constant speed , x is the perpendicular distance of the particle path from the origin (constant as the particle moves parallel to y-axis)

Q 39.

There are 8 queens in 104 cards. The probability of the first card to be a queen is 8 / 104. The probability of the second card also to be a queen is 7 / 103 . The required probability is (8 / 104) x (7 / 103) = 7 / 1339

Q 40.

Energy loss due to resistance= KE-PE=1/2 $X1(200)^2$ -1X10X1600= 4kJ. Total downward acceleration = acceleration due to gravity(g)+ that due to air resistance(a)= $v^2/2h=12.5ms^{-2}$, so a $=2.5ms^{-2}$, and thrust due to air resistance = 2.5X1= 2.5N. So (4kJ, 2.5N) are the answer.

Q 41.

Magnitude of the common acceleration of the blocks $=g(m_2-m_1)/ (m_2+m_1)$=g(3-1/3+1)=5 ms^{-2} and that of the centre of mass of the combined system=g $[(m_2-m_1)/ (m_2+m_1)]^2=2.5ms^{-2}$.

Q 45.

a) Since the capacitors are are connected in series, they must have the the same charge

120 V = $V_1 + V_2$. $C_1 = \frac{Q}{V_1}$ $C_2 = \frac{Q}{V_2}$

Using these equations one finds V_1 = 80 Volts

Q 46.

Wave Number = $1/\lambda$ = 2144 cm^{-1}

So, the frequency = c / λ = (2144 cm^{-1})(3*10^{10} cm/sec)= 6.43*10^{13} sec^{-1}

Q 47.

We must have, at full scale, a voltage drop of 120 volts across the resistor and the galvanometer while having a current of 0.01 Amp. therefore the resistor and the galvanometer must be in series.

(0.01 Amp)(R + 10) = 120 Volts

R = 11990

Q 50.

$E_e = E_\gamma - \varphi$, φ = work function , So, E_e is 8.42 eV. 1eV = 1.60x10^{-19} Joules.

Therefore, $(1/2)m_e v^2$ = 8.42 x (1.60 $*$ 10^{-19}) Joules

From the above equation , we get

v = 1.72 $*$ 10^6 m/sec

Q 51.

$T = \frac{1}{2} mv^2$, $\frac{mv^2}{r} = \frac{GMm}{r^2}$, $V = \frac{GMm}{r}$ E=T+V;

Therefore , $E = -\frac{GMm}{2r}$

Q 54.

In the steady state , no current flows through the branch containing the capacitor. Let us consider a anti-clockwise circular current I through the rest of the loop.

Then, from Kirchoff's second law,

- 2V +I (2R) + I (R) + V = 0 or I = V / (3R)

Potential drop across the capacitor C = (I R + V) - V = I R = V / 3

Q 55.

The de Broglie wavelength of a particle of mass M moving with a speed v is given by

$\lambda = \frac{h}{M\text{v}}$. Kinetic energy of the particle , K= $\frac{1}{2}$ Mv^2 or Mv = $\sqrt{2\text{KM}}$

Therefore, $\lambda = \frac{h}{M\text{v}} = \frac{h}{\sqrt{2\text{KM}}}$

Since K is the same for both particles ,

$$\frac{\lambda_1}{\lambda_2} = \sqrt{\frac{m_2}{m_1}} = \sqrt{\frac{4m}{m}} = 2$$

Q 56.

Heat supplied , Q = n C_P (T_2-T_1)

Increase in internal energy , (U_2-U_1) = n C_V (T_2-T_1)

Therefore , (U_2-U_1) / Q = C_V / C_P = 1/ γ = 3 / 5 (For , monoatomic gas , γ = 5 / 3)

Q 57.

Since the points A,B ,C are equidistant from the centre , all are at the same electric potential .

Hence , no potential difference between A & B , A & C. Hence $W_1 = W_2 = 0$

Q 59.

Magnetic Moment is IA = $\pi ne r^2$, where I is ne and A = πr^2