BK BIRLA CENTRE FOR EDUCATION

SARALA BIRLA GROUP OF SCHOOLS

SENIOR SECONDARY CO-ED DAY CUM BOYS' RESIDENTIAL SCHOOL

PERIODIC TEST-2 -2024-25

PHYSICS (042)

Class: XI — Duration: 1 Hr

Date: 05/12/2024 — Max. Marks: 25

Marking Scheme

Section A (5 X 1)

1. (c) Gravitational force due to earth
2. (a) At polar region
3. (b) remains constant
4. (c) Assertion is true but Reason is false.
5. (b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

Section B (4 X 2)

6. The escape velocity on the surface of moon is lesser than the RMS velocity of the molecules of gas at the surface temperature of moon. Therefore, the gas molecules escape and hence moon cannot hold an atmosphere. 2

7. The acceleration due to gravity on the surface of the earth is given by.
   $g=GM/R^2$ -------(1) ½
   Now, mass = volume × density
   $M=(4/3)\pi R^3\times\rho$
   $g=G\,(4/3)\pi R\times\rho$ . . .. .. (2)
   $g(d)=(4/3)\pi G(R-d)\rho$ . . . .. .(3)
   Dividing equation(3) by (2) we get ½
   $g(d)/g=(R-d)/R=(1-d/R)$
   $g(d)=g(1-d/R)$
   $g(h)= 16g/25$
   Change in g= $g-16g/25= 9g/25$ ½
   % change= $9\times100/25=36\%$. ½

8. Hooke's law states that the strain of the material is proportional to the applied stress within the elastic limit of that material. ½
   When the elastic materials are stretched, the atoms and molecules deform until stress is applied, and when the stress is removed, they return to their initial state.
   Mathematically, Hooke's law is expressed as:
   $F = -kx$
   In the equation, F is the force, x is the extension in length, k is the constant of proportionality known as the spring constant in N/m. 1½

9. It is defined as ratio of normal stress to the longitudinal strain. i.e. Young.s modulus (Y) = Normal stress/Longitudinal strain=$F/A/\Delta L/L=FL/A\Delta L$. 1

Its SI unit is N m^{-2} or pascal (Pa). Dimensional formula - $[ML^{-1}T^{-2}]$ ½ +½

Section C (4 X 3)

10. Escape speed is the minimum speed with which a mass should be projected from the Earth's surface in order to escape Earth's gravitation field. 1

Consider the escape speed, the minimum speed required by an object to escape Earth's gravitational field, hence replace vi with v_e.

$$\frac{1}{2}Mv_i^2 = \frac{GMM_E}{R_E}$$

$$v_e^2 = \frac{GMM_E}{R_E}\cdot\frac{2}{M}$$

$$\text{Using } g = \frac{GM_E}{R_e^2}$$

$$v_e^2 = \frac{2GM_E}{R_E}$$

$$v_e^2 = 2gR_E$$

$$v_e = \sqrt{2gR_E} \quad \ldots(4)$$

2

11. F=m×a

a=F/m …..(1) 1

Where F is the force on the object of mass m dropped from a distance r from the centre of earth of mass M.
So, force exerted by the earth on the object is
$F=GM\times m/r^2$ ...(2)
M = Mass of Earth, m = mass of object, r = distance of object from centre of earth
Now, from equation 1 and 2,
$a=G\times mM/r^2/m$ 1
$a=GM//r^2$
Now, from above,
A(=g) = Acceleration due to gravity
The acceleration due to gravity on the earth is given by
$g=GM/R^2$ i.e. $GM=R^2g$ . . . .(3)
The acceleration due to gravity at height 'h' from the surface of the earth is given by
$g(h)=GM/(R+h)^2$ i.e. $GM=(R+h)^2g(h)$ . . . . . . (4)
From (3) and (4) we have,
$g(h)/g=R^2/(R+h)^2$
$g(h)= g(1-2h/R)$ 1

12.

$$\therefore \Delta L_1 = \frac{F_1 \times L_1}{A_1 \times Y_1} = \frac{F_1 \times L_1}{\pi r_1^2 \times Y_1}$$

$$= \frac{98 \times 1.5}{\pi\left(0.125 \times 10^{-2}\right)^2 \times 2 \times 10^{11}} = 1.49 \times 10^{-4} \text{ m}$$

1 ½

$$\therefore \Delta L_2 = \frac{F_2 \times L_2}{A_2 \times Y_2} = \frac{F_2 \times L_2}{\pi r_2^2 \times Y_2}$$

$$= \frac{58.8 \times 1.0}{\pi \times \left(0.125 \times 10^{-2}\right)^2 \times \left(0.91 \times 10^{11}\right)}$$

$$= 1.3 \times 10^{-4}\,\mathrm{m}$$

1½

Elongation of the steel wire = 1.49×10^{-4} m.
Elongation of the brass wire = 1.3×10^{-4} m

13. (i) The beam has more depth than width. ½
(ii) bridges, Railway tracks etc. have a cross-section of the type I. ½
In above examples the beam or bridges should not bend too much or break.
A bar of length l, breadth b, and depth d when loaded at the centre by a load W sags by an amount given by

$\delta = W\, l\, 3/(4bd^3Y)$ 1

For a given material, increasing the depth d rather than the breadth b is more effective in reducing the bending, since δ is proportional to d^{-3} and only to b^{-1} (of course the length l of the span should be as small as possible). 1

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