Q1: A

$m_1gh = \frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2$

$m_1v_1 = m_2v_2$

$v_2 = \frac{m_1}{m_2}v_1$

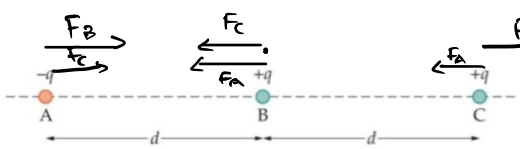
$\Rightarrow m_1gh = \frac{1}{2}m_1v_1^2 + \frac{1}{2}\frac{m_1^2}{m_2}\cdot v_1^2$

$m_1gh = \frac{1}{2}m_1v_1^2\left(1+\frac{m_1}{m_2}\right)$

$v^2 = \frac{2\cancel{m_1}gh}{1+\frac{m_1}{m_2}}$

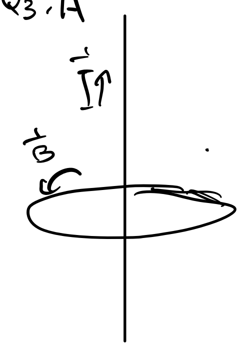
$v^2 = \frac{2gh}{1+\frac{m_1}{m_2}}$ if $m_1\uparrow$ $v^2\downarrow$

Q2: C



$F_{net\,B} > F_{net\,A} > F_{net\,C}$

Q3: A



By right hand rule, u can tell that the electric field circles around $\vec{B}$ in conter close wise direction; which means the answer is A.

Q4: A

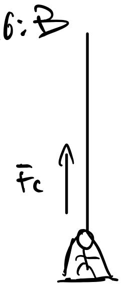
Friction acts as the centripetal force

Q5: A

$\frac{1}{2}mv^2 = Fd$

$F = \frac{1}{2}mv^2\frac{1}{d} = 10N$

Q6: B



centripetal force

Q7: B

Newton's third Law

$$F_{B on g} = F_{g on B} = 2500 N$$

Q8: A

In inelastic case, masses only stop if the have identical momentum, while m_1 and m_2 are different.

$$m_1 v_1 - m_2 v_2 = 0$$

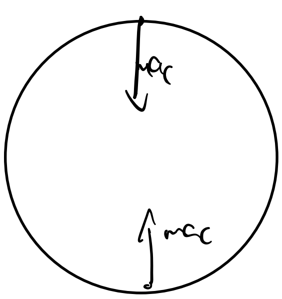
$$m_1 v_1 = m_2 v_2$$

$$\Downarrow$$

$$v_1 \neq v_2$$

Q9: B

passenger's acceleration = a_c = centripetal acceleration

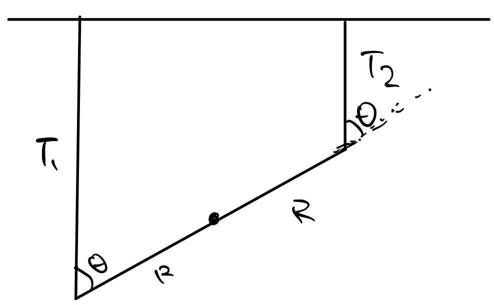


$$\cancel{m} a_c = \cancel{m}\frac{v^2}{r}$$

$$a_c = \frac{v^2}{r}$$

v is constant $\rightarrow$ a_c is constant

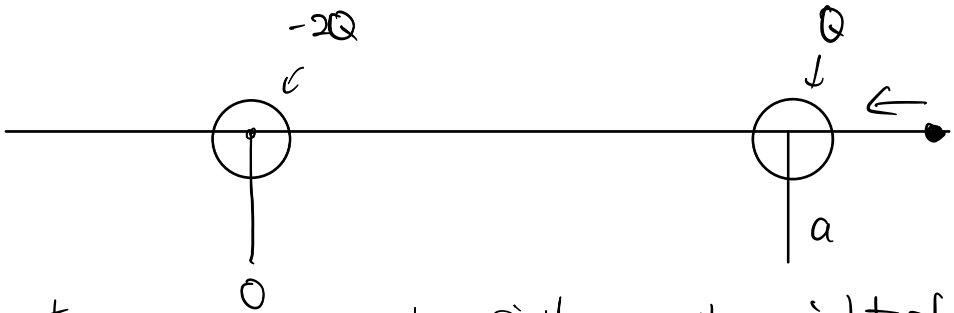
Q10: C



$$T_1 \cdot \cancel{\sin\theta R} = T_2 \cancel{\sin\theta R}$$

$$T_1 = T_2$$

Q11: D



There is a positive Field on the right of +Q charge

Q12: D

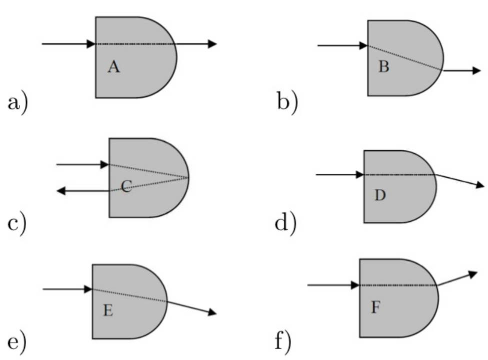
Question 12

In a lab experiment, a laser beam hits a semicircular glass object off the centre axis. The ray enters perpendicularly to the surface, and the environment is air. Which ray diagram is correct?

$\sin\theta_1 n_1 = n_2 \sin\theta_2$

$\theta_2 = 0$

then



$n_1 < n_2$

the light ray will be deflected down.

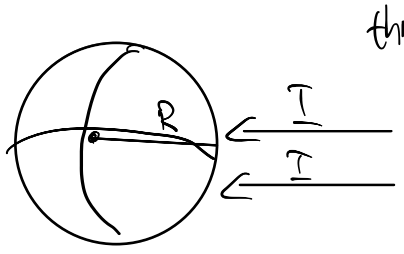
Q13: B

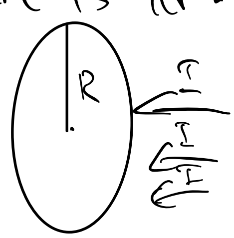
The faster heat conduct, the faster it is going to melt.

Q14: D

Pressure $\propto$ Intensity

From Gauss Law intensity of light passes through the sphere is $\pi r^2 \cdot I$





$P_1 = C\pi R^2 \cdot I$ $\qquad$ $P_2 = C\pi R^2 \cdot I$

$P_1 = P_2$

Q15: B

$f = \frac{c}{\lambda}$

Adrianne's: $f = \frac{3\times10^8}{1.498\times10^3} = 2.003 \times 10^5$

≈ 200 kHz $<$ 20kHz

Q16: C

Before

$g(m_1+m_2) = \rho g V$

water level = x

After:

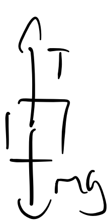
$m_1 g = \rho g V_1 \qquad m_2 g = \rho g V_2$

$\rho g(V_1 + V_2) = (m_1 + m_2)g$

same

Q17: B look at isothermal process online.

Q18: B



$ma = mg - T = 0$

$mg = T$

Q19: A

V_B after 1.2 sec $= 25\frac{m}{s} - 1.2 \cdot 2$

$= 22.6\frac{m}{s}$

$25 - 22.6 = 2.4\frac{m}{s}$

there relative velocity kept constant after 1.2s

Q20 C

$f(x,t) = A\sin(kx + \omega t)$

$g(x,t) = A\sin(kx + \omega t + 90°)$

$f(x,t) + g(x,t) = 2A\cos\left(\frac{90°}{2}\right)\sin\left(k\frac{x}{2} - \omega t + \frac{\phi}{2}\right)$

$A_2 = \sqrt{2}A_1$ $\quad$ $k_1 = k_2$

V is determined by the medium, therefore it remains unchanged.

$\frac{2\pi}{\lambda_1} = \frac{2\pi}{\lambda_2}$

$\lambda_1 = \lambda_2$

Q21 D

Conservation of angular momentum

$\frac{1}{2}I_1\omega_1^2 = \frac{1}{2}I_2\omega_2^2$

$\frac{1}{2}I\omega^2 = \frac{1}{2}\left(\frac{1}{4}I\right)(2\omega)^2$

$\omega_2 = 2\omega$

Q22. C

air resistance is proportional to v

at top $v=0$ $F_{air}=0$

Q23, B

$$g=\frac{GM}{r^2} \qquad M=\frac{4}{3}\pi r^3\cdot\rho$$

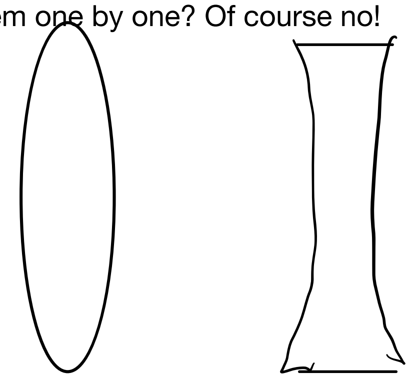
$$g_2=\frac{G\left(\frac{4}{3}\pi(2R)^3\cdot\rho\right)}{(2r)^2}$$

$$g_2=G\left[\frac{4}{3}\pi(2R)\rho\right]=2g_1$$

Q24, A

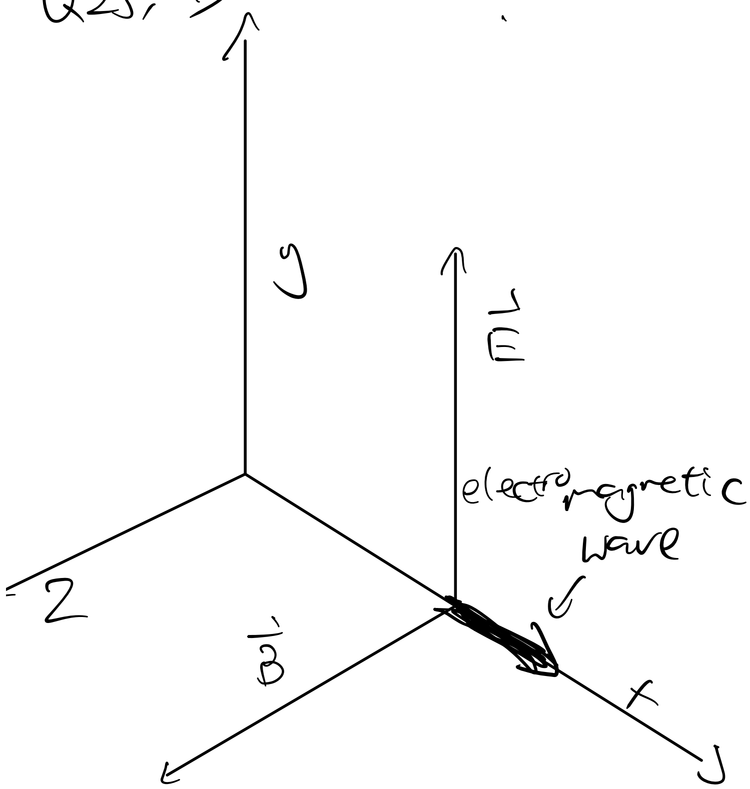
The image of the first lense will be the object for the second lens.

U think im going to try them one by one? Of course no!



By placing an object inside the focal length of a converging lens, there will be a magnified virtual image formed already, and the diverging lens doesn't play any role in this process.

Q25, D



$\vec{B}$ and $\vec{E}$ always perpendicular to each other, as wave in z direction and $\vec{B}$ in x+ direction, the $\vec{E}$ is pointing -y-direction