42 YEARS OF EXCELLENCE

SRAMAYEVA JAYATHE

NARAYANA
EDUCATIONAL INSTITUTIONS

JEE MAIN 2020

NARAYANA'S
SENSATIONAL SUCCESS ACROSS INDIA

NARAYANA IIT-JEE (MAIN) 2020
ALL INDIA TOP RANKS IN OPEN CATEGORY

1st Rank
SWAYAM CHUBE
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6th Rank
HARSHVARDAHAN AGARWAL
HT No. HR09300789

8th Rank
SHIVA KRISHNA
HT No. TL01330751

| BELOW 10 | **21** RANKS *All Cat | BELOW 100 | **126** RANKS *All Cat | TOTAL QUALIFIED FOR JEE-ADV. | **16292** |

ADMISSIONS OPEN (2020-21)

OUR REGULAR CLASSROOM PROGRAMME

One Year Classroom Program
JEE/NEET-2021
(for students moving from XI to XII)

Two Year Classroom Program
JEE/NEET-2022
(for students moving from X to XI)

Three Year Integrated Classroom Program
JEE/NEET-2023
(for students moving from IX to X)

Four Year Integrated Classroom Program
JEE/NEET-2024
(for students moving from VIII to IX)

FOUNDATION PROGRAMMES
For NTSE, NSEJS, JSTSE, Olympiads & School/Board Exams
(for students moving to Class VI, VII, VIII, IX & X)

APEX BATCH
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For JEE Main & Advance / NEET (for XI Studying Students)
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- Online Parent Teacher Meeting
- Personalized Extra Classes & Live Doubt Solving
- Hybrid/Customized Classroom model
- Video Solution of Weekly/Fortnightly Test
- Printed Study Material will be sent by us
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- Affordable Fee
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- Once Classes resume by just paying nominal fee

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For Class 7th to 12th+

JEE-MAIN-2021

FEBRUARY ATTEMPT

24.02.21_SHIFT-I

PHYSICS

PHYSICS

1. If two identical capacitor once connected in series ($C_{eq} = C_1$) and once connected in parallel ($C_{eq} = C_2$) then find ratio $\dfrac{C_1}{C_2}$.
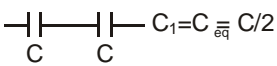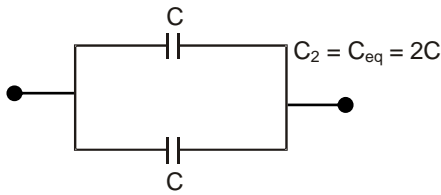
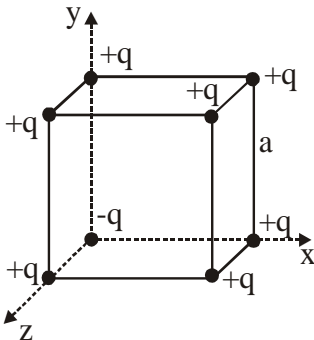(1) $\dfrac{3}{4}$ (2) $\dfrac{5}{6}$ (3) $\dfrac{4}{3}$ (4) $\dfrac{1}{4}$

Ans. (4)

Sol.

$C_1 = C_{eq} = C/2$

$C_2 = C_{eq} = 2C$

$$\boxed{\dfrac{C_1}{C_2} = \dfrac{1}{4}}$$

2.

Find electric field at centre of cube ?

(1) $\dfrac{-2q}{\pi 3\sqrt{3}\varepsilon_0 a^2}\left[\hat{i} + \hat{j} + \hat{k}\right]$ (2) $\dfrac{q}{\pi 3\sqrt{3}\varepsilon_0 a^2}\left[\hat{i} + \hat{j} + \hat{k}\right]$

(3) $\dfrac{-q}{\pi 3\sqrt{3}\varepsilon_0 a^2}\left[\hat{i} + \hat{j} + \hat{k}\right]$ (4) $\dfrac{2q}{\pi 3\sqrt{3}\varepsilon_0 a^2}\left[\hat{i} + \hat{j} + \hat{k}\right]$

Ans. (1)

Sol. If we consider two point charges $+q$ and $-q$ at position of $-q$ charge, then after interchanging $-q$ charge with $+q$ charge, net electric field at centre of cube is zero due to symmetry. Now remaining charges are $-2q$ so net electric field at centre is $\left(\dfrac{-8kq}{3a^2}\right)$.

3. In a transistor if increase in emitter current is 4 mA and corresponding increase in collector current is 3.5 mA. Find β.
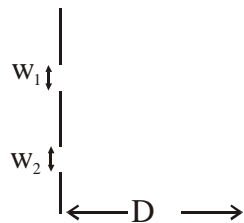
(1) .875 (2) .5 (3) 7 (4) 1

Ans. **(3)**

Sol. $\Delta I_E = 4$

$\Delta I_C = 3.5$

$\alpha = \dfrac{\Delta I_C}{\Delta I_E} = \left(\dfrac{3.5}{4}\right) = \left(\dfrac{7}{8}\right)$

$\beta = \dfrac{\alpha}{1-\alpha} = \dfrac{\dfrac{7}{8}}{1-\dfrac{7}{8}} = 7$

4. If $\dfrac{w_1}{w_2} = \dfrac{1}{3}$ (w is width) and its given that amplitude is proportional to w. Find $\dfrac{I_{max}}{I_{min}}$.
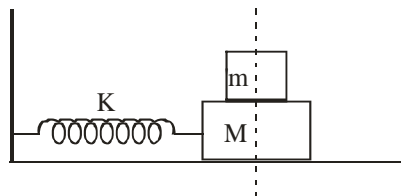

(1) 1 : 4 (2) 3 : 1 (3) 4 : 1 (4) 2 : 1

Ans. **(3)**

Sol. $\dfrac{A_1}{A_2} = \dfrac{1}{3}$ $A_1 = x,\ A_2 = 3x$

$\dfrac{I_{max}}{I_{min}} = \left(\dfrac{(A_1 + A_2)^2}{(A_1 - A_2)^2}\right) = \dfrac{(4x)^2}{(2x)^2} = \dfrac{16}{4} = 4:1$

5. If a small block of mass m is placed gently on M when it is passing through its mean position.

Find it's new amplitude of SHM, if initial amplitude is A.

(1) $\sqrt{\dfrac{M}{M+m}}$ (A)   (2) $\sqrt{\dfrac{M+m}{M}}$ (A)   (3) $\sqrt{\dfrac{M+m}{2M}}$ (A)   (4) $\sqrt{\dfrac{M}{M-m}}$ (A)
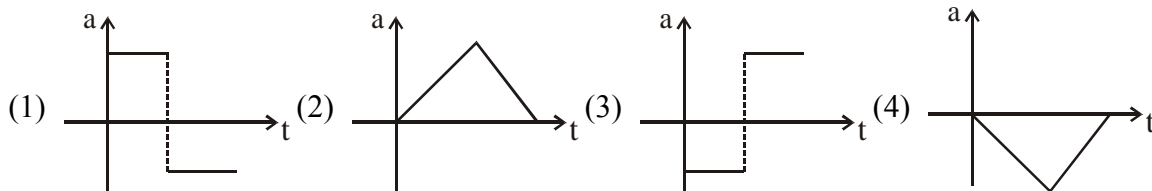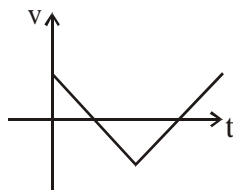
Ans. **(1)**

Sol. Velocity at mean position is $= A\omega$

Conserving momentum $MA\omega_O = (M + m)V'$

$$V' = \frac{MA\omega_O}{M+m} = (A')\sqrt{\frac{K}{M+m}}$$

$$A' = \frac{MA\sqrt{\frac{K}{M}}}{M+m} \times \sqrt{\frac{M+m}{K}} = \sqrt{\frac{M}{(M+m)}}A$$

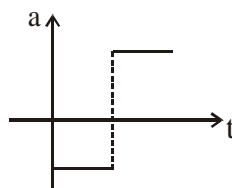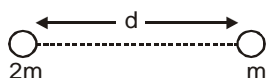**6.** From given velocity time graph which of the following is acceleration time graph.

Ans. (3)

Sol.
$$\begin{vmatrix} v = -mt + C \\ \dfrac{dv}{dt} = -m \end{vmatrix} \begin{vmatrix} v = mt - C \\ \dfrac{dv}{dt} = m \end{vmatrix}$$

7. Two stars are rotating about their common center of mass. Find the period of revolution of mass m about center of mass.
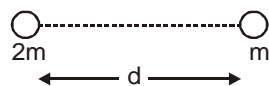

(1) $2\pi\sqrt{\dfrac{d^3}{3Gm}}$ (2) $2\pi\sqrt{\dfrac{3Gm}{d^3}}$ (3) $\dfrac{1}{2\pi}\sqrt{\dfrac{d^3}{3Gm}}$ (4) $\dfrac{1}{2\pi}\sqrt{\dfrac{3Gm}{d^3}}$

Ans. (1)

Sol.

$$\frac{G(m)(2m)}{d^2} = m\omega^2 \times \frac{2d}{3}$$

$$\frac{2Gm}{d^2} = \omega^2 \times \frac{2d}{3}$$

$$\omega^2 = \frac{3Gm}{d^3}$$

$$\omega = \sqrt{\frac{3Gm}{d^3}} \quad ; \qquad T = 2\pi\sqrt{\frac{d^3}{3Gm}}$$

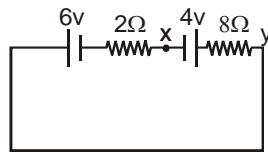**8.** Find relation between modulus

If

$Y \rightarrow$ young's modulus

$K \rightarrow$ Bulk modulus

$\eta \rightarrow$ modulus of rigidity

(1) $K = \dfrac{\eta Y}{9\eta - 3Y}$ (2) $Y = \dfrac{\eta K}{9\eta - 3K}$ (3) $K = \dfrac{\eta Y}{9\eta + 3Y}$ (4) $Y = \dfrac{\eta K}{9\eta + 3K}$

Ans. **(1)**

9. Circuit is given find $|V_x - V_y|$
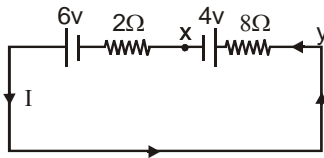

(1) 5.6 volt   (2) 3.6 volt   (3) 10 v   (4) 240 volt

Ans. (1)

Sol. Current $I = \dfrac{6-4}{10} = \dfrac{1}{5}A$

$v_x + 4 + 8 \times \dfrac{1}{5} = v_y$

$\boxed{v_x - v_y = -5.6v}$

10. If work $= \alpha \cdot \beta^2 \cdot e^{-\frac{x^2}{\alpha \cdot KT}}$,

where, K = Boltzmann constant, T = temp, then find dimension of β

(1) $M^1L^1T^{-2}$ (2) $M^{-1}L^{-1}T^2$ (3) $M^1L^2T^{-2}$ (4) $M^2L^1T^2$

Ans. **(1)**

Sol. $\dfrac{x^2}{\alpha KT} = $ dimensionless

$\dfrac{L^2}{KT} \Rightarrow \alpha$

$\alpha \Rightarrow \dfrac{L^2}{v^2 M} = L^2 M^{-1} L^{-2} T^2 = M^{-1}T^2$
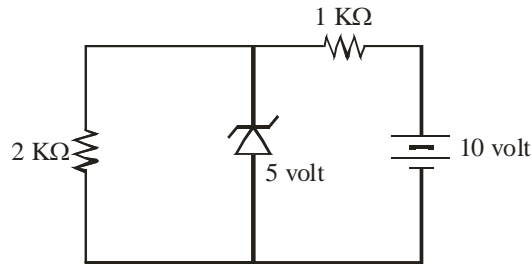
work $= \alpha \cdot \beta^2 \cdot$ (dimensionless)

$$M^1L^1T^{-2} \cdot L^1 = M^{-1}T^2 \beta^2$$

$$v = \sqrt{\frac{3KT}{M}}$$

$$\frac{v^2 \cdot M}{3} = KT$$

$$\beta = M^1L^1T^{-2}$$

11. Zener diode is connected in circuit as shown. Find current in $2k\Omega$ resistance.

(1) 2.5mA   (2) 30mA   (3) 10mA   (4) 20mA

Ans. **(1)**

Sol. Zener diode breakdown

$$\Rightarrow \qquad i = \frac{5}{2\times10^{-3}} = 2.5 \times 10^{-3}$$

$$x \times 10^{-4} = 2.5 \times 10^{-3}$$

$$x = 2.5mA$$

12. Given AB is Isothermal and BC is Isobaric and CA is isochoric process. Find total work done in cyclic process. (Given $p_1v_1 = nRT$).
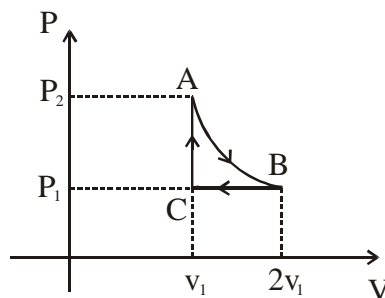
(1) nRT [ℓn2 –2]   (2) 2nRT [ℓn2 –1/2]   (3) nRT [ℓn2 –1/2]   (4) nRT [ℓn2 +2]

Ans. **(2)**

Sol. $W_{AB} = 2\,P_1V_1\,\ell n\,2$

$W_{BC} = -P_1V_1$

$W_{CA} = 0$

$W_{ABCA} = (2\,P_1V_1\,\ell n\,2 - P_1V_1)$

$= nRT\,(2\,\ell n\,2 - 1)$

13. A side of cube a is made from 6 identical sheet. If coefficient of linear expansion is α and temperature is now made $T + \Delta T$ from temperature T then find change in volume

(1) $\Delta V = 3a^3\,\alpha\,\Delta T$ (2) $\Delta V = \dfrac{4}{3}\pi a^3\,\alpha\,\Delta T$ (3) $\Delta V = 4a^3\,\alpha\Delta T$ (4) $\Delta V = 6a^3\,\alpha\,\Delta T$

Ans. **(1)**

Sol. $\dfrac{\Delta V}{V} = \gamma\Delta T$

$= 3\alpha\Delta T$

$\Delta V = 3a^3\,\alpha\,\Delta T$

14. If intensity after passing through a polaroid is 100 Lumen. Now this same polaroid is rotated by 30° about it's axis then find new intensity after passing through it.

(1) 50 Lumen   (2) 100 Lumen   (3) 25 Lumen   (4) 65 Lumen
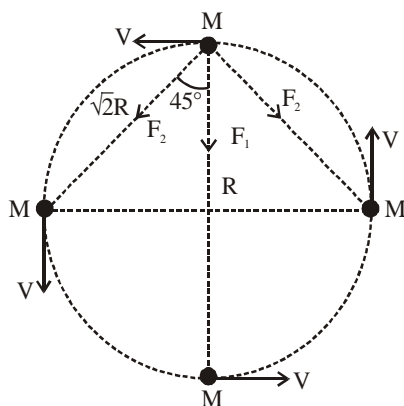
Ans. **(2)**

Sol. $I_{P_1} = I_{P_2}$ = 100 Lumen

15. Four particles, each of mass 1 kg and equidistant from each other, move along a circle of radius 1 m under the action of their mutual gravitational attraction. The speed of each particle is :

(1) $\sqrt{G(1+2\sqrt{2})}$ (2) $\dfrac{1}{2}\sqrt{G(1+2\sqrt{2})}$ (3) $\sqrt{G}$ (4) $\sqrt{2\sqrt{2}G}$

Ans. **(2)**

Sol.

Net force on one particle

$F_{net} = F_1 + 2F_2 \cos 45° = $ Centripetal force

$$\Rightarrow \frac{GM^2}{(2R)^2} + \left[\frac{2GM^2}{(\sqrt{2}R)^2}\cos 45°\right] = \frac{MV^2}{R}$$

$$V = \frac{1}{2}\sqrt{\frac{GM}{R}(1+2\sqrt{2})}$$

$$v = \frac{1}{2}\sqrt{G(1+2\sqrt{2})}$$

16. Choose the correct options.

Column-I	**Column-II**
(P) Adiabatic	(i) Pressure constant
(Q) Isothermal	(ii) Volume constant
(R) Isochoric	(iii) Temperature constant
(S) Isobaric	(iv) Heat content constant

from above match the column find out correct options.

(1) P-iv ; Q-iii ; R-ii ; S-i   (2) P-iv ; Q-iii ; R-i ; S-ii

(3) P-iii ; Q-ii ; R-iv ; S-i   (4) P-iv ; Q-ii ; R-iii ; S-i

Ans. **(1)**

Sol. P-iv ; Q-iii ; R-ii ; S-i

17. Relation between radius of curvature & focal length of a convex mirror is.

(1) $f = \frac{R}{2}$ (2) $R = \frac{f}{2}$ (3) $2f = 3R$ (4) none

Ans. **(1)**

Sol. $\frac{R}{2} = f$

18. I_1 = Moment of Inertia of ring of mass M and radius R about its diameter.

I_2 = Moment of Inertia of Disc of mass M and radius R through central axis perpendicular to plane of ring.

I_3 = Moment of Inertia of solid cylinder mass M and radius R about its axis.

I_4 = Moment of Inertia of solid sphere through its diameter.

(1) $I_1 + I_2 = I_3 + \dfrac{5}{4}I_4$

(2) $I_1 = I_2 = I_3 < I_4$

(3) $I_1 > I_2 = I_3 = I_4$

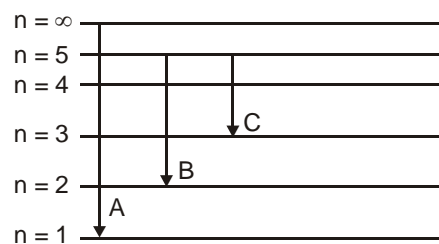(4) $I_1 + I_2 = I_3 + \dfrac{2}{5}I_4$

Ans. **(1)**

Sol. $I_1 = \dfrac{MR^2}{2}$

$I_2 = \dfrac{MR^2}{2}$

$I_3 = \dfrac{MR^2}{2}$

$I_4 = \dfrac{2}{5}MR^2$

19. Spectral lines of hydrogen atoms are given is below

Which of the following is correct for spectral lines A, B & C

(1) Series limit of lyman, 3rd line of Balmer, 2nd line of paschan

(2) Series limit of lyman, 2nd line of Balmer, 2nd line of paschan

(3) 2nd line of lyman, 3rd line of Balmer, 2nd line of paschan

(4) Series limit of lyman, 3rd line of Balmer, 3rd line of paschan

Ans. **(1)**

Sol. A → Series limit of laymen

B → 3rd line of Balmer

C → 2rd line of paschan

20. **Statement-1:** de-Broglie wavelength of proton varies inversely with linear momentum.

Statement-2: As λ increases, energy and momentum increases.

(1) Statement-1 is true and Statement-2 is false.

(2) Statement-1 is false and Statement-2 is true.

(3) Statement-1 is false and Statement-2 is false.

(4) Statement-1 is true and Statement-2 is true.

Ans. **(1)**

Sol. $\lambda = \dfrac{h}{p}$

21. A 220 volts AC supply is given to the primary circuit of transformer and as output of 12 volts DC is taken out using rectifier. If secondary number of turns was 24, then find the no. of turns in primary coil.

Ans. **440**

Sol. $\dfrac{N_P}{N_S} = \dfrac{V_P}{V_S}$

$\dfrac{N_P}{24} = \dfrac{220}{12}$; $N_P = 440$

22. A vertical cross-section of plane is $y = \dfrac{x^2}{4}$, coefficient of friction is 0.5. Find maximum height at which particle can stay (in cm).

Ans. **25 cm**

Sol. $\mu \ge \tan\theta = \dfrac{dy}{dx} = \dfrac{dx}{4} = \dfrac{x}{2}$
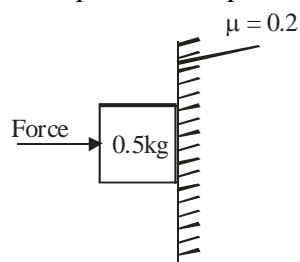
$0.5 \ge \dfrac{x}{2}$

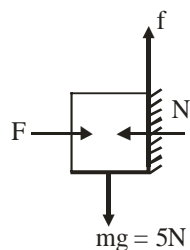$x \le 1$

$\sqrt{4y} \le 1$

$2\sqrt{y} \le 1$

$y \le \dfrac{1}{4}$

23. Find out minimum force required to stop block from falling (given $g = 10 \text{ m/s}^2$)

Ans. **25**

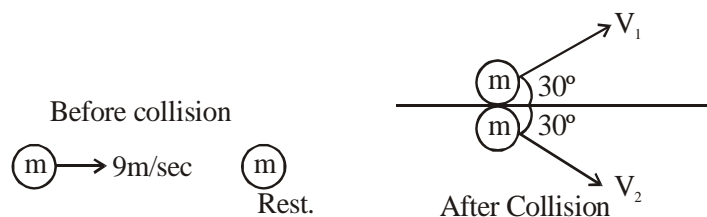**Sol.** $F = N$, $f = 0.2 \times N$

$0.2 \ N \le 5$

$N \le 25$

24. Two identical particles of same mass are shown just before collision and just after collision than $\dfrac{v_1}{v_2}$ is

Ans. **1**

Sol. Using linear momentum conservation in y-direction

$P_i = 0$

$P_f = m \times \dfrac{1}{2} v_1 - m \times \dfrac{1}{2} v_2$

$v_1 = v_2$

25. $i = 20t + 8t^2$

Find charge flown during $0 \le t \le 15$

Ans. **11250**

Sol. $\dfrac{dq}{dt} = (20t + 8t^2)$

$\int dq = \int_0^{15} (20t + 8t^2)dt$

$\Delta q = \left[20\dfrac{t^2}{2} + \dfrac{8t^3}{3} \right]_0^{15}$

$= \dfrac{20 \times (15)^2}{2} + \dfrac{8 \times (15)^3}{3}$

$\Delta q = 11250$ C

26. A 100 kg block can be lift by placing a mass m on a piston (hydraulic lift). If diameter of piston placed at one and is increased by 4 times and that of second piston is decreased by 4 times. Now same mas m is placed at piston than how many kg weight can be lift up for the new set up?

Ans. 25600

Sol. Initially $\dfrac{100g}{A_1} = \dfrac{mg}{A_2}$ ....(i)

Initially $\dfrac{Mg}{16A_1} = \dfrac{mg}{\left(\dfrac{A_2}{16}\right)}$ ....(ii)

$\dfrac{100 \times 16}{M} = \dfrac{1}{16} = M = 25600$kg

27. Two planet are resolving about planet with $\dfrac{T_1}{T_2} = \dfrac{1}{8}$. Find the ratio of the angular speed $\dfrac{\omega_1}{\omega_2}$

Ans. 8

Sol. Ratio of time period

$\dfrac{T_1}{T_1} = \dfrac{1}{8}$

$\dfrac{\dfrac{2\pi}{\omega_1}}{\dfrac{2\pi}{\omega_2}} = \dfrac{1}{8}$

$\dfrac{\omega_1}{\omega_2} = 8$

28. An electromagnetic wave is propagating in medium, where $\mu_r = \varepsilon_r = 2$. If speed of light in medium is $x \times 10^7$ m/s. Find out x.

Ans. 15

Sol. $n = \sqrt{\mu_r \varepsilon_r} = 2$

$v = \dfrac{C}{n} = \dfrac{3 \times 10^8}{2} = 15 \times 10^7$ m/s

$x = 15$

29. $V_m = 20 \sin [100 \pi t + \frac{\pi}{4}]$

$V_c = 80 \sin [10^4 \pi t + \frac{\pi}{6}]$

For amplitude modulation wave findout percentage modulation index.

Ans. 25

Sol. $m\% = \dfrac{A_m}{A_c} \times 100 = \dfrac{20}{80} \times 100 = 25\%$

30. In AC series R-L-C resonance circuit Resistance R = 6.28 ohm, frequency 10 MHz and self inductance L = 2 × 10^{-4} Henry is given. Find Quality factor of circuit.

Ans. 2000

Sol. $Q = \dfrac{x_L}{R} = \dfrac{\omega L}{R} = \dfrac{2\pi f L}{R}$

$Q = \dfrac{2\pi \times 10^6 \times 10 \times 2 \times 10^{-4}}{6.28} = 2000$

$Q = 2000$