# Rahul Science Academy

IIT JEE / NEET / CET Classes

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# PHYSICS (07)

**SYLLABUS :** Force, Inertia and Newton's Laws of Motion

**Date :** _____

**1.** A man getting down a running bus falls forward because

(a) Due to inertia of rest, road is left behind and man reaches forward

(b) Due to inertia of motion upper part of body continues to be in motion in forward direction while feet come to rest as soon as they touch the road

(c) He leans forward as a matter of habit

(d) Of the combined effect of all the three factors stated in (a), (b) and (c)

**2.** A car is moving with uniform velocity on a rough horizontal road. Therefore, according to Newton's first law of motion

(a) No force is being applied by its engine

(b) A force is surely being applied by its engine

(c) An acceleration is being produced in the car

(d) The kinetic energy of the car is increasing

**3.** A person is sitting in a travelling train and facing the engine. He tosses up a coin and the coin falls behind him. It can be concluded that the train is

(a) Moving forward and gaining speed

(b) Moving forward and losing speed

(c) Moving forward with uniform speed

(d) Moving backward with uniform speed

**4.** A body of mass 2 kg is hung on a spring balance mounted vertically in a lift. If the lift moves up with an acceleration equal to the acceleration due to gravity, the reading on the spring balance will be

(a) 2 kg (b) $(2\times g)$kg

(c) $(4\times g)$kg (d) 4 kg

**5.** The linear momentum $p$ of a body moving in one dimension varies with time according to the equation $p = a + bt^2$ where $a$ and $b$ are positive constants. The net force acting on the body is

(a) A constant

(b) Proportional to $t^2$

(c) Inversely proportional to $t$

(d) Proportional to $t$

**6.** A particle moves in the $xy$ -plane under the action of a force $F$ such that the components of its linear momentum $p$ at any time $t$ are $p_x = 2\cos t$, $p_y = 2\sin t$. The angle between $F$ and $p$ at time $t$ is

(a) 90° (b) 0°

(c) 180° (d) 30°

| RESPONSE GRID | 1. ⓐⓑⓒⓓ 2. ⓐⓑⓒⓓ 3. ⓐⓑⓒⓓ 4. ⓐⓑⓒⓓ 5. ⓐⓑⓒⓓ 6. ⓐⓑⓒⓓ |
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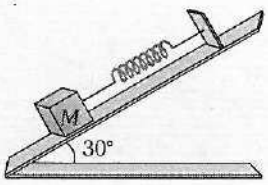
**7.** A body of mass $5kg$ is suspended by a spring balance on an inclined plane as shown in figure. The spring balance measure

(a) $50\,N$

(b) $25\,N$

(c) $500\,N$

(d) $10\,N$




**8.** A cricket ball of mass 250 $g$ collides with a bat with velocity 10 $m/s$ and returns with the same velocity within 0.01 second. The force acted on bat is

(a) $25\,N$ (b) $50\,N$

(c) $250\,N$ (d) $500\,N$

**9.** An army vehicle of mass 1000 $kg$ is moving with a velocity of 10 $m/s$ and is acted upon by a forward force of 1000 $N$ due to the engine and a retarding force of 500 $N$ due to friction. What will be its velocity after 10 $s$

(a) $5\ m/s$ (b) $10\ m/s$

(c) $15\ m/s$ (d) $20\ m/s$

**10.** A ball of mass $m$ moves with speed $v$ and it strikes normally with a wall and reflected back normally, if its time of contact with wall is $t$ then find force exerted by ball on wall

(a) $\frac{2mv}{t}$ (b) $\frac{mv}{t}$

(c) $mvt$ (d) $\frac{mv}{2t}$

**11.** A block of mass $5kg$ is moving horizontally at a speed of 1.5 $m/s$. A perpendicular force of $5N$ acts on it for 4 sec. What will be the distance of the block from the point where the force started acting

(a) $10\ m$ (b) $8\ m$

(c) $6\ m$ (d) $2\ m$

**12.** A solid disc of mass $M$ is just held in air horizontally by throwing 40 stones per sec vertically upwards to strike the disc each with a velocity 6 $ms^{-1}$. If the mass of each stone is 0.05kg what is the mass of the disc $(g = 10ms^{-2})$

(a) 1.2kg (b) 0.5kg

(c) 20kg (d) $3kg$

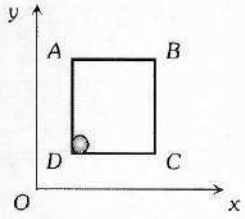
**13.** A solid sphere of mass 2 $kg$ is resting inside a cube as shown in the figure. The cube is moving with a velocity $v = (5t\,\hat{i} + 2t\,\hat{j})\ m/s$. Here $t$ is the time in second. All surface are smooth. The sphere is at rest with respect to the cube. What is the total force exerted by the sphere on the cube. (Take $g = 10\ m/s^2$)

(a) $\sqrt{29}N$

(b) $29N$

(c) $26N$

(d) $\sqrt{89}\,N$




| RESPONSE GRID | 7. ⓐⓑⓒⓓ 8. ⓐⓑⓒⓓ 9. ⓐⓑⓒⓓ 10. ⓐⓑⓒⓓ 11. ⓐⓑⓒⓓ 12. ⓐⓑⓒⓓ 13. ⓐⓑⓒⓓ |
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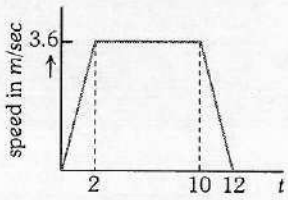
**14.** A lift is going up. The total mass of the lift and the passenger is 1500 *kg*. The variation in the speed of the lift is as given in the graph. The tension in the rope pulling the lift at $t = 11^{th}$ *sec* will be

(a) 17400 *N*

(b) 14700 *N*

(c) 12000 *N*

(d) Zero




**15.** If in a stationary lift, a man is standing with a bucket full of water, having a hole at its bottom. The rate of flow of water through this hole is $R_0$. If the lift starts to move up and down with same acceleration and then that rates of flow of water are $R_u$ and $R_d$, then

(a) $R_0 > R_u > R_d$ (b) $R_u > R_0 > R_d$

(c) $R_d > R_0 > R_u$ (d) $R_u > R_d > R_0$

**16.** The time period of a simple pendulum measured inside a stationary lift is found to be *T*. If the lift starts accelerating upwards with an acceleration $g/3$, the time period is

(a) $T\sqrt{3}$ (b) $T\sqrt{3}/2$

(c) $T/\sqrt{3}$ (d) $T/3$

**17.** A body of mass 0.05 kg is observed to fall with an acceleration of 9.5 $ms^{-2}$. The opposing force of air on the body is, $(g = 9.8 ms^{-2})$

(a) 0.015 *N* (b) 0.15 *N*

(c) 0.030 *N* (d) Zero

**18.** A student attempts to pull himself up by tugging on his hair. He will not succeed

(a) As the force exerted is small

(b) The frictional force while gripping, is small.

(c) Newton's law of inertia is not applicable to living beings.

(d) As the force applied is internal to the system

**19.** In an air collision between an aeroplane and a bird, the force experienced by the bird as compared to that of the aeroplane is

(a) Very high (b) Equal

(c) Less (d) Zero

**20.** When a horse pulls a wagon, the force that causes the horse to move forward is the force

(a) The ground exerts on it

(b) It exerts on the ground

(c) The wagon exerts on it

(d) It exerts on the wagon

**21.** A bird is sitting in a large closed cage which is placed on a spring balance. It records a weight of 25 *N*. The bird (mass m = 0.5 *kg*) flies upward in the cage with an acceleration of $2 m/s^2$. The spring balance will now record a weight of

(a) 24 *N* (b) 25 *N*

(c) 26 *N* (d) 27 *N*

**22.** A book is lying on the table. What is the angle between the action of the book on the table and the reaction of the table on the book

(a) 0° (b) 30°

(c) 45° (d) 180°

| RESPONSE GRID | | | | | |
|---|---|---|---|---|---|
| | **14.** ⓐⓑⓒⓓ | **15.** ⓐⓑⓒⓓ | **16.** ⓐⓑⓒⓓ | **17.** ⓐⓑⓒⓓ | **18.** ⓐⓑⓒⓓ |
| | **19.** ⓐⓑⓒⓓ | **20.** ⓐⓑⓒⓓ | **21.** ⓐⓑⓒⓓ | **22.** ⓐⓑⓒⓓ | |

**23.** A gardener waters the plants by a pipe of diameter 1 mm. The water comes out at the rate or 10 $cm^3/sec$. The reactionary force exerted on the hand of the gardener is

(a) Zero (b) $1.27 \times 10^{-2}$ N

(c) $1.27 \times 10^{-4}$ N (d) 0.127 N

**24.** At a certain instant of time the mass of a rocket going up vertically is 100 kg. If it is ejecting 5 kg of gas per second at a speed of 400 m/s, the acceleration of the rocket would be (taking $g = 10$ m/s$^2$)

(a) 20 m/s$^2$ (b) 10 m/s$^2$

(c) 2 m/s$^2$ (d) 1 m/s$^2$

**25.** A ball of mass 400 gm is dropped from a height of 5 m. A boy on the ground hits the ball vertically upwards with a bat with and average force of 100 N so that it attains a vertical height of 20 m. The time for which the ball remains in contact with the bat is [$g = 10$ m/s$^2$]

(a) 0.12 s (b) 0.08 s

(c) 0.04 s (d) 12 s

**NUMERICAL VALUE TYPE QUESTIONS**

Questions from 26 to 30 are numerical value type according to the new pattern for JEE Main by NTA.

**26.** A body of mass $2kg$ has an initial velocity of 3 meters per second along $OE$ and is subjected to a force of 4 $N$ in a direction perpendicular to $OE$. The distance of the body from $O$ after 4 seconds will be

**27.** A 10 $kg$ stone is suspended with a rope of breaking strength 30 $kg$ wt. The minimum time in second for which the stone can be raised through a height 10 $m$ starting from rest is (taking $g = 10 N/kg$ )

**28.** A sphere is accelerated upwards by a cord whose braking strength is four times its weight. The maximum acceleration with which the sphere can move up without breaking the cord is $a \times g$. Find the value of $a$.

**29.** At a certain instant of time the mass of a rocket going up vertically is 100 kg. If it is ejecting 5 kg of gas per second at a speed of 400 $m/s$, the acceleration of the rocket in $m/s^2$ would be (taking $g = 10 m/s^2$)

**30.** Five persons $A$, $B$, $C$, $D$ and $E$ are pulling a cart of mass 100 kg on a smooth surface and cart is moving with acceleration 3 $m/s^2$ in east direction. When person $A$ stops pulling, it moves with acceleration 1 $m/s^2$ in the west direction. When person $B$ stops pulling, it moves with acceleration 24 $m/s^2$ in the north direction. The magnitude of acceleration of the cart when only $A$ and $B$ pull the cart keeping their directions same as the old directions, is:

| RESPONSE GRID | | | | | |
|---|---|---|---|---|---|
| | 23. ⓐⓑⓒⓓ | 24. ⓐⓑⓒⓓ | 25. ⓐⓑⓒⓓ | 26. ○○ | 27. ○○ |
| | 28. ○○ | 29. ○○ | 30. ○○ | | |

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# PHYSICS (08)

**SYLLABUS :** Law of Conservation of Linear Momentum, and its Applications, Impulse

**Date :** _____

**1.** A shell of mass 10 *kg* is moving with a velocity of $10\ ms^{-1}$ when it blasts and forms two parts of mass 9 *kg* and 1 *kg* respectively. If the 1st mass is stationary, the velocity of the 2nd is

(a) 1 *m/s* (b) 10 *m/s*

(c) 100 *m/s* (d) 1000 *m/s*

**2.** A body of mass 1000 *kg* is moving horizontally with a velocity $50\ m/s$. A mass of 250 *kg* is added. Find the final velocity

(a) 40 *m/s* (b) 20 *m/s*

(c) $30\sqrt{2}\ m/s$ (d) 50 *m/s*

**3.** Newton's second and third laws of motion lead to the conservation of

(a) Linear momentum

(b) Angular Momentum

(c) Potential energy

(d) Kinetic energy

**4.** A bullet of mass 10 *g* moving with 300 *m/s* hits a block of ice of mass 5 *kg* and drops dead. The velocity of ice is

(a) 50 *cm/s* (b) 60 *cm/s*

(c) 40 *cm/s* (d) 30 *cm/s*

**5.** A batsman hits back a ball of mass 0.15 kg straight in the direction of the bowler without changing its initial speed of $10\ ms^{-1}$. If the ball moves linearly, then the impulse imparted on it (in *Ns*) is

(a) 3.0 (b) 2.0

(c) 1.5 (d) 1.9

**6.** A player kicks a football of mass 0.5 *kg* and the football begins to move with a velocity of 10 *m/s*. If the contact between the leg and the football lasts for $\frac{1}{50}$ *sec*, then the force acted on the football should be

(a) 2500 *N* (b) 1250 *N*

(c) 250 *N* (d) 625 *N*

**7.** A stationary body of mass 3 kg explodes into three equal pieces. Two of the pieces fly off in two mutually perpendicular directions, one with a velocity of $3\hat{i}\ ms^{-1}$ and the other with a velocity of $4\hat{j}\ ms^{-1}$ If the explosion occurs in $10^{-4}\ s$, the average force acting on the third piece in newton is

(a) $(3\hat{i}+4\hat{j})\times10^{-4}$ (b) $(3\hat{i}-4\hat{j})\times10^{-4}$

(c) $(3\hat{i}+4\hat{j})\times10^{4}$ (d) $-(3\hat{i}+4\hat{j})\times10^{4}$

| RESPONSE GRID | | | | | |
|---|---|---|---|---|---|
| 1. (a)(b)(c)(d) | 2. (a)(b)(c)(d) | 3. (a)(b)(c)(d) | 4. (a)(b)(c)(d) | 5. (a)(b)(c)(d) |
| 6. (a)(b)(c)(d) | 7. (a)(b)(c)(d) | | | |

**8.** A shell at rest at the origin explodes into three fragments of masses 1*kg*, 2*kg* and *m kg*. The 1*kg* and 2*kg* pieces fly off with speeds of $5ms^{-1}$ along *x*-axis and $6ms^{-1}$ along *y*-axis respectively. If the *m kg* piece flies off with a speed of $6.5ms^{-1}$, the total mass of the shell must be

(a) 4 *kg* (b) 5 *kg*

(c) 3.5 *kg* (d) 4.5 *kg*

**9.** A body of mass *M* at rest explodes into three pieces, two of which of mass *M*/4 each are thrown off in perpendicular directions with velocities of 3 *m/s* and 4 *m/s* respectively. The third piece will be thrown off with a velocity of

(a) 1.5 *m/s* (b) 2.0 *m/s*

(c) 2.5 *m/s* (d) 3.0 *m/s*

**10.** A stationary bomb explodes into three pieces. One piece of 2*kg* mass moves with a velocity of $8ms^{-1}$ at right angles to the other piece of mass 1*kg* moving with a velocity of $12ms^{-1}$. If the mass of the third piece is 0.5*kg*, then its velocity is

(a) $10\ ms^{-1}$ (b) $20\ ms^{-1}$

(c) $30\ ms^{-1}$ (d) $40\ ms^{-1}$

**11.** A shell of mass 5*M*, acted upon by no external force and initially at rest, bursts into three fragments of masses *M*, 2*M* and 2*M* respectively. The first two fragments move in opposite directions with velocities of magnitudes 2*V* and *V* respectively. The third fragment will

(a) Move with a velocity *V* in a direction perpendicular to the other two

(b) Move with a velocity 2*V* in the direction of velocity of the first fragment

(c) Be at rest

(d) Move with a velocity *V* in the direction of velocity of the second fragment

**12.** A rocket of mass 100 *kg* burns 0.1 *kg* of fuel per sec. If velocity of exhaust gas is 1 *km/sec*, then it lifts with an acceleration of

(a) $1000\ ms^{-2}$ (b) $100\ ms^{-2}$

(c) $10\ ms^{-2}$ (d) $1\ ms^{-2}$

**13.** In a rocket of mass 1000 *kg* fuel is consumed at a rate of 40 *kg/s*. The velocity of the gases ejected from the rocket is $5\times10^4 m/s$. The thrust on the rocket is

(a) $2\times10^3\ N$

(b) $5\times10^4\ N$

(c) $2\times10^6\ N$

(d) $2\times10^9\ N$

**14.** A train is moving with velocity 20 *m/sec.* on this dust is falling at the rate of 50 *kg/minute*. The extra force required to move this train with constant velocity will be

(a) 16.66 *N* (b) 1000 *N*

(c) 166.6 *N* (d) 1200 *N*

**15.** A nuclide at rest emits an α-particle. In this process

(a) α-particle moves with large velocity and the nucleus remains at rest

(b) Both α-particle and nucleus move with equal speed in opposite directions

(c) Both move in opposite directions but nucleus with greater speed

(d) Both move in opposite directions but α-particle with greater speed

| RESPONSE GRID | 8. ⓐⓑⓒⓓ 9. ⓐⓑⓒⓓ 10. ⓐⓑⓒⓓ 11. ⓐⓑⓒⓓ 12. ⓐⓑⓒⓓ<br>13. ⓐⓑⓒⓓ 14. ⓐⓑⓒⓓ 15. ⓐⓑⓒⓓ |
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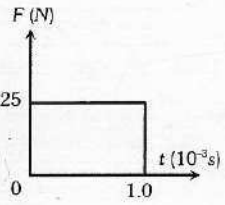
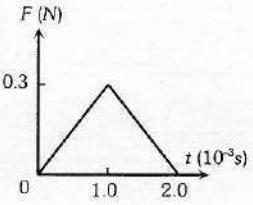
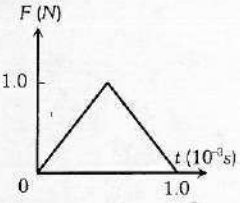
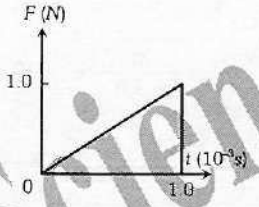
**16.** Figures I, II, III and IV depict variation of force with time

(I) 


(II) 


(III) 

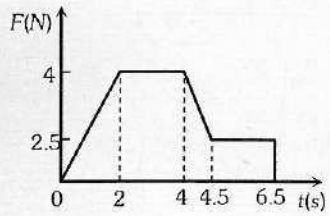

(IV) 


The impulse is highest in the case of situations depicted. Figure

(a) I and II (b) III and I

(c) III and IV (d) IV only

**17.** A body of 2 kg has an initial speed $5ms^{-1}$. A force acts on it for some time in the direction of motion. The force time graph is shown in figure. The final speed of the body.




(a) 9.25 $ms^{-1}$ (b) 5 $ms^{-1}$

(c) 14.31 $ms^{-1}$ (d) 4.25 $ms^{-1}$

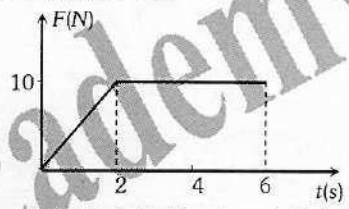
**18.** A body of mass 3kg is acted on by a force which varies as shown in the graph below. The momentum acquired is given by

(a) Zero

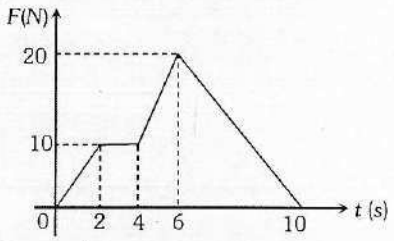
(b) 5 N-s

(c) 30 N-s

(d) 50 N-s




**19.** A particle of mass 2 kg is initially at rest. A force acts on it whose magnitude changes with time. The force time graph is shown below




The velocity of the particle after 10 s is

(a) 20 $ms^{-1}$ (b) 10 $ms^{-1}$

(c) 75 $ms^{-1}$ (d) 50 $ms^{-1}$

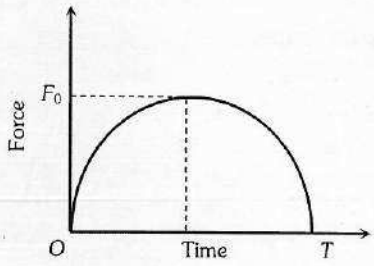
**20.** A particle of mass m, initially at rest, is acted upon by a variable force F for a brief interval of time T. It begins to move with a velocity u after the force stops acting. F is shown in the graph as a function of time. The curve is a semicircle.

(a) $u = \frac{\pi F_0^2}{2m}$

(b) $u = \frac{\pi T^2}{8m}$

(c) $u = \frac{\pi F_0 T}{4m}$

(d) $u = \frac{F_0 T}{2m}$




| RESPONSE GRID | 16. ⓐⓑⓒⓓ | 17. ⓐⓑⓒⓓ | 18. ⓐⓑⓒⓓ | 19. ⓐⓑⓒⓓ | 20. ⓐⓑⓒⓓ |
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**21.** A particle moves in the $x$-$y$ plane under the action of a force $\vec{F}$ such that the value of its linear momentum $(\vec{P})$ at any time $t$ is $P_x = 2\cos t, p_y = 2\sin t$. The angle $\theta$ between $\vec{F}$ and $\vec{P}$ at a given time $t$. will be

(a) $\theta = 0°$ (b) $\theta = 30°$

(c) $\theta = 90°$ (d) $\theta = 180°$

**22.** An explosive of mass 9 $kg$ is divided in two parts. One part of mass 3 $kg$ moves with velocity of 16 $m/s$. The kinetic energy of other part will be

(a) 192 $J$ (b) 162 $J$

(c) 150 $J$ (d) 200 $J$

**23.** A shell of mass 200 g is fired by a gun of mass 100 kg. If the muzzle speed of the shell is 80 $m/s$, then the recoil speed of the gun is

(a) 16 cm $s^{-1}$ (b) 8 cm $s^{-1}$

(c) 8 m $s^{-1}$ (d) 16 m $s^{-1}$

**24.** A 100 kg gun fires a ball of 1 kg horizontally from a cliff of height 500 m. It falls on the ground at a distance of 400 m from the bottom of the cliff. The recoil velocity of the gun is (Take g=10 $ms^{-2}$)

(a) 0.2 m $s^{-1}$ (b) 0.4 m $s^{-1}$

(c) 0.6 m $s^{-1}$ (d) 0.8 m $s^{-1}$

**25.** A bullet is fired from a gun. The force on the bullet is given by $F = 600 - 2 \times 10^5 t$, Where $F$ is in newtons and t in seconds. The force on the bullet becomes zero as soon as it leaves the barrel. What is the average impulse imparted to the bullet ?

(a) 9 Ns (b) Zero

(c) 0.9 Ns (d) 1.8 Ns

## NUMERICAL VALUE TYPE QUESTIONS

Questions from 26 to 30 are numerical value type according to the new pattern for JEE Main by NTA.

**26.** A machine gun has a mass of 10 $kg$. It fires 30 $g$ bullets at the rate of 6 bullets per second with a speed of 400 $m/s$. What force must be applied to the gun in newton to keep it in position?

**27.** A hunter has a machine gun that can fire 50 $g$ bullets with a velocity of 150 $m/s$. A 60 $kg$ tiger springs at him with a velocity of 10 $m/s$. How many bullets must the hunter fire per second into the tiger in order to stop him in his track.

**28.** A car of mass 1000 $kg$ travelling at 32 $m/s$ dashes into the rear of a truck of mass 8000 $kg$, moving in the same direction with a velocity of 4 $m/s$. After the collision, the car bounces with a velocity of 8 $m/s$. What is the velocity of the truck in $m/s$ after the impact?

**29.** A disc of mass 10 $g$ is kept floating horizontally by throwing 10 marbles per second against it from below. If mass of each marble is 5 $g$. The velocity with which marbles are striking the disc is $v \times 10^{-2} m/s$. Find the value of $v$. Assume that marbles strike the disc normally and rebound downwards with the same speed.

**30.** While launching a rocket of mass $2 \times 10^4$ $kg$ a force of $5 \times 10^5$N is applied for 20 $s$. The velocity attained by the rocket at the end of 20 $s$ is $v \times 10^2 m/s$. Find the value of $v$.

| RESPONSE GRID | | | | | |
|---|---|---|---|---|---|
| | 21. ⓐⓑⓒⓓ | 22. ⓐⓑⓒⓓ | 23. ⓐⓑⓒⓓ | 24. ⓐⓑⓒⓓ | 25. ⓐⓑⓒⓓ |
| | 26. ○○ | 27. ○○ | 28. ○○ | 29. ○○ | 30. ○○ |