Work

1. A force $\vec{F} = (2\hat{i} - \hat{j} + 4\hat{k})$ N displaces a particle upto $\vec{d} = (3\hat{i} + 2\hat{j} - \hat{k})$ m, calculate work done.

(1) Zero (2) 8 J (3) 4 J (4) 12 J

2. A body of mass m is displaced from point A(3, 1, 2) to point B(4, 3, 3) under the effect of a force $\vec{F} = (3\hat{i} + 2\hat{j} + 4\hat{k})$ N, calculate W.D. by the force.

(1) 57 J (2) 11 J (3) 0 (4) 22 J

3. A force $\vec{F} = (3x^2 + 2x - 7)$ N acts on a 2 kg body as a result of which the body gets displaced from x = 0 to x = 5m. The work done by the force will be-

(1) 35 J (2) 70 J (3) 115 J (4) 270 J

4. A person of mass m is standing on one end of a plank of mass M and length L and floating in water. The person moves from one end to another and stops. Work done by normal force is -

(1) MgL (2) mgL (3) $\frac{mMgL}{M+m}$ (4) 0

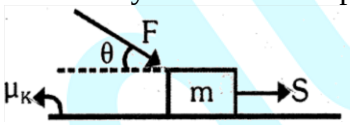
5. A 2 kg mass lying on a table is displaced in the horizontal direction through 50 cm. The work done by the normal reaction will be -

(l) 0 (2) 100 joule (3) 100 erg (4) 10 joule

6. A body of mass M tied to a string is lowered at a constant acceleration of (g/4) through a vertical distance h. The work done by the string will be ..... .

(1) $\frac{3}{4}$ Mgh (2) $\frac{1}{4}$ Mgh (3) $\frac{-3}{4}$ Mgh (4) $\frac{-1}{4}$ Mgh

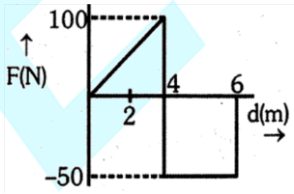
7. Find work done by friction for displacement 'S' ?



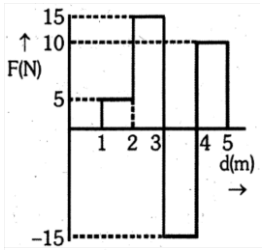
(1) $\mu_k(mg + F\sin\theta).S$ (2) $-\mu_k(mg + F\sin\theta).S$

(3) $\mu_k(mg - F\sin\theta).S$ (4) $-\mu_k(mg - F\sin\theta).S$

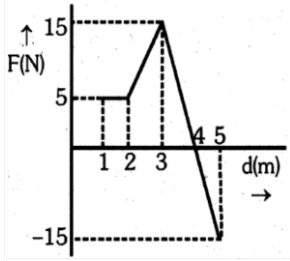
8. Calculate the work done for following F-d curves

(A) 

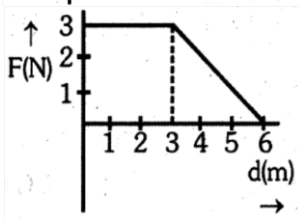
(P) 100 L

(B) 

(Q) 13.5 J

(C) 

(R) 15 J

(D) 

(1) (A – P); (B – Q); (C – Q); (D – R) (2) (A – P); (B – R); (C – R); (D – Q)
(3) (A – P); (B – P); (C – Q); (D – R) (4) (A – P); (B – P); (C – R); (D – Q)

9. A force $F = KX^2$ acts on a particle at an angle of 60° with the x-axis the work done in displacing the particle from x_1 to x_2 will be –

(1) $\frac{kx^2}{2}$ (2) $\frac{k}{2}\left(x_2^2 - x_1^2\right)$ (3) $\frac{k}{6}\left(x_2^3 - x_1^3\right)$ (4) $\frac{k}{3}\left(x_2^3 - x_1^3\right)$

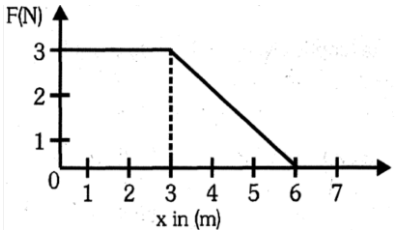
10. The work done against gravity in taking 10 kg. mass at 1 m height in 1 s will be –
(1) 49 J (2) 98 J (3) 196 J (4) None of these

11. A force of 10N displaces an object by 10m. If work done is 50J then direction of force make an angle with direction of displacement :-
(1) 120° (2) 90° (3) 60° (4) None of these

12. A body of mass 6 kg under a force which causes displacement in it given 'S = $\frac{t^2}{4}$' meters where 't' is time. The work done by the force in 2 seconds is :-
(1) 12 J (2) 9 J (3) 6 J (4) 3 J

13. A force acts $\vec{F} = (5\hat{i} + 4\hat{j})$ N on a body and produced a displacement $\vec{S} = (-6\hat{i} + 5\hat{j} + 3\hat{k})$ m. The work done will be
(1) 30 J (2) 40 J (3) 10 J (4) 20 J

14. A force F acting on an object varies with distance x as shown here. The work done by the force in moving the object from x = 0 to x = 6m is :-



(1) 18.0 J (2) 13.5 J (3) 4.5 J (4) 9.0 J

15. A stone of mass m is tied to a string of length λ at one end and by holding second end it is whirled into a horizontal circle, then work done will be :-

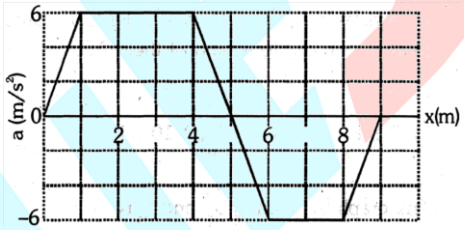
(1) 0 (2) $\left(\frac{mv^2}{l}\right)2\pi l$ (3) $(mg)\cdot 2\pi\lambda$ (4) $\left(\frac{mv^2}{l}\right)l$

16. A particle is moved from a position $\vec{r}_1 = (3\hat{i}+2\hat{j}-6\hat{k})$ meter to a position $\vec{r}_2 = (14\hat{i}+13\hat{j}-9\hat{k})$ meter under the action of a force $\vec{F} = (4\hat{i}+\hat{j}+3\hat{k})$ N.

The work done is equal to :-

(1) 32 J (2) 64 J (3) 96 J (4) 46 J

17. Figure given the acceleration of a 2.0 kg body as it moves from rest along x axis while a variable force acts on it from x = 0m to x = 9m. The work done by the force on the body when it reaches
(i) x = 4m and
(ii) x = 7 m shall be as given below



(1) 21 J and 33 J respectively (2) 21 J and 15 J respectively
(3) 42 J and 60 J respectively (4) 42 J and 30 J respectively

KINETIC ENERGY & WORK ENERGY THEORM

18. A force acts on a 30g particle in such a way that the position of the particle as a function of time is given by $x = 3t - 4t^2 + t^3$, where x is in meters and t is in seconds. The work done during the first 4 second is :-

(1) 5.28 J (2) 450 mJ (3) 490 mJ (4) 530 mJ

19. A constant force F is applied to a body of mass m moving with initial velocity u. If after the body undergoes a displacement S, its velocity becomes v, then the total work done is :-

(1) $m[v^2 + u^2]$ (2) $\frac{m}{2}[u^2 + v^2]$ (3) $\frac{m}{2}[v^2 - u^2)$ (4) $m[v^2 - u^2)$

20. If the momentum of a body is increased n time, its kinetic energy increases.

(1) n times (2) 2n times (3) $\sqrt{n}$ times (4) n^2 times

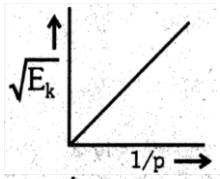
21. If K.E. increases by 3%. Then momentum will increase by :-

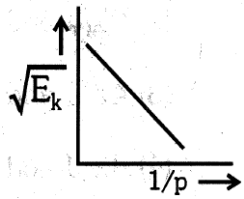
(1) 1.5% (2) 9% (3) 3% (4) 2%

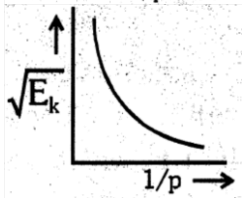
22. If K.E. body is increased by 100%. Then% change in 'P'.
(1) 50% (2)41.4% (3) 10% (4) 20%

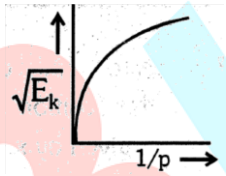
23. 2 particles of mass 1 Kg and. 5 kg have same momentum, calculate ratio of their K.E.
(1) 5 : 1 (2) 25 : 1 (3) 1 : 1 (4) 10 : 1

24. The graph between $\sqrt{E_k}$ and $\frac{1}{p}$ is (E_k = kinetic energy and p = momentum) –

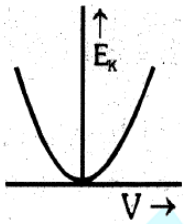
(1) 

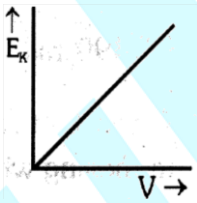
(2) 

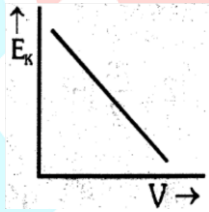
(3) 

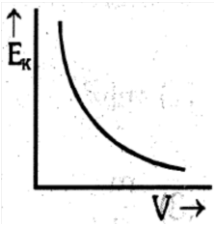
(4) 

25. The graph between kinetic energy E_k and velocity V is-

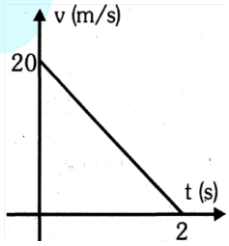
(1) 

(2) 

(3) 

(4) 

26. Velocity-time graph of a particle of mass 2 kg moving in a straight line is as shown in figure. Work done by all the forces on the particle is :



(1) 400 J (2) –400 J (3) –200 J (4) 200 J

27. The kinetic energy of a body becomes four times of its initial value. The new linear momentum will be :-
(1) Four times the initial value (2) Thrice the initial value
(3) Twice the initial value (4) Same as the initial value

28. A 0.5 kg ball is thrown up with an initial speed 14m/sand reaches a maximum height of 8.0 m. How much energy is dissipated by air drag acting on the ball during the ascent ?
(1) 19.6 J (2) 4.9 J (3) 10 J (4) 9.8 J

29. If the kinetic energy of a body is double of its initial kinetic energy, then the momentum of the body will be :-

(1) $2\sqrt{2}$ times (2) $\sqrt{2}$ times (3) $\frac{1}{\sqrt{2}}$ times (4) none of these

30. A ball of mass 2 kg and another of mass 4 kg are dropped together from a 60 feet tall building. After a fall of 30 feet each towards earth, their respective kinetic energies will be in the ratio of:

(1) 1 : 4 (2) 1 : 2 (3) 1 : $\sqrt{2}$ (4) $\sqrt{2}$: 1

31. Two bodies of mass 1 kg and 4 kg have equal K.E. then the ratio of their momentum is :-

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

32. If the kinetic energy is increased by 300%, the momentum will increase by :-

(1) 100% (2) 200% (3) 150% (4) 300%

33. If the kinetic energy of a body increases by 4% the momentum :

(1) increases by 2% (2) increases by 4% (3) increases by 8% (4) increases by 16%

CONSERVATIVE FORCE POTENTIAL ENERGY & LAW OF CONSERVATION OF ENERGY

34. Which of the following statements is true for work done by conservative forces :-

(1) It does not depend or path

(2) It is equal to the difference of initial and final potential energy function

(3) It can be recovered completely

(4) All of the above

35. Which of the following statement is incorrect for a conservative field?

(1) Work done in going from initial to final position is equal to change in kinetic energy of the particle.

(2) Work done depends on path but not on initial and final positions.

(3) Work done does not depend on path but depends only on initial and final positions

(4) Work done on a particle in the field for a round trip is zero.

36. As shown in the diagram a particle is to be carried from point A to C via paths (I), (II) and (III) in gravitational field, which of the following statements is correct :-

(1) Work done Is same for all the paths (2) Work done is minimum for path (II)

(3) Work done is maximum for path (I) (4) None of the above

37. The relation between conservative force and potential energy U is given by :-

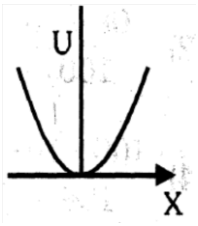
(1) $\vec{F} = \frac{dU}{dx}$ (2) $\vec{F} = \int U\,dx$ (3) $\vec{F} = -\frac{dU}{dx}$ (4) $F = \frac{dU}{dx}$

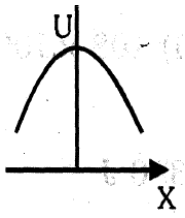
38. Which of the following is a non conservative force:-

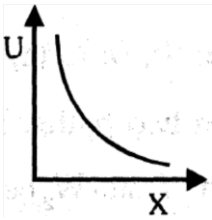
(1) Electric force (2) Gravitational force

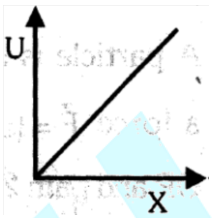
(3) Spring force (4) Viscous force

39. The graph between potential energy U and displacement X in the state of stable equilibrium will be-

(1) 

(2) 

(3) 

(4) 

40 . A particle moves in a potential region given by $U = 8x^2 - 4x + 400$ J. Its state of equilibrium will be-

(1) x = 25 m (2) x = 0·25 m (3) x = 0·025 m (4) x = 2·5 m

41. For the path PQR in a conservative force field the amounts work done in carrying a body from P to Q and from Q to R are 5 Joule and 2 joule respectively. The work done in carrying the body from P to R will be-

(1) 7 J (2) 3 J (3) $\sqrt{21}$ J (4) zero

42. The mass of a bucket full of water is 15 kg. It is being pulled up from a 15m deep well. Due to a hole in the bucket 6 kg water flows out of the bucket. The work done in drawing the bucket out of the well will be ($g = 10m/s^2$)-

(1) 900 J (2) 1500 J (3) 1800 J (4) 2100 J

43. A uniform chain of length Land mass M is lying on a smooth table and $\frac{2}{3}$ of its length is hanging down over the edge of the table. If g is the acceleration due to gravity, the work done to pull the hanging part on the table is :-

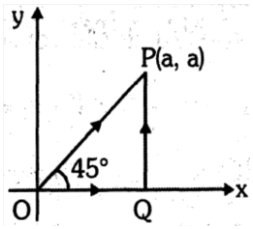
(1) MgL (2) $\frac{MgL}{3}$ (3) $\frac{MgL}{9}$ (4) $\frac{2MgL}{9}$

44. A 10 kg satellite completes one revolution around the earth at a height of 100 km in 108 minutes. The work done by the gravitational force of earth will be-

(l) $108 \times 100 \times 10$ J (2) $\frac{108\times10}{100}$ J

(2) 0 J (4) $\frac{100\times10}{108}$ J

45. A particle is moved from (0, 0) to (a, a) under a force $\vec{F} = (3\hat{i} + 4\hat{j})$ from two paths. Path 1 is OP and path 2 is QQP. Let W_1 and W_2 be the work done by this force in these two paths. Then :



(1) $W_1 = W_2$ (2) $W_1 = 2W_2$

(3) $W_2 = 2W_1$ (4) $W_2 = 4W_1$

46. A spring of force constant 800 N/m has an extension of 5 cm. The work

done in extending it from 5 cm to 15 cm is :-

(1) 16 J (2) 8 J (3) 32 J (4) 24 J

47. If a spring extends by x on loading then energy stored by the spring is :- (T is tension in the spring, K = spring const.)

(1) $\frac{T^2}{2x}$ (2) $\frac{T^2}{2k}$ (3) $\frac{2k}{T^2}$ (4) $\frac{2T^2}{k}$

48. A body of mass 2 kg falls from a height of 20 m. What is the loss in potential energy :-

(1) 400 J (2) 300 J (3) 200 J (4) 100 J

49. In stretching a spring by 2 cm energy stored is given by U, then stretching by 10 cm energy stored will be:-

(1) U (2) 5 U (3) $\frac{U}{25}$ (4) 25 U

50. If the potential energy of two molecules is give by,

$U = \frac{A}{r^{12}} - \frac{B}{r^6}$

then at equilibrium position, its potential energy is equal to :

(1) $\frac{A^2}{4B}$ (2) $-\frac{B^2}{4A}$ (3) $\frac{2B}{A}$ (4) 3 A

51. A 2 g ball of glass is released from the edge of a hemispherical cup whose radius is 20 cm. How much work is done on the ball by the gravitational force during the ball's motion to the bottom of the cup?

(1) 1.96 mJ (2) 3.92 mJ (3) 4.90 mJ (4) 5.88 mJ

52. 4 J of work is required to stretch a spring through 10 cm beyond its unstretched length. The extra work required to stretch it through additional 10 cm shall be

(1) 4 J (2) 8 J (3) 12 J (4) 16 J

53. A particle in a certain conservative force field has a potential energy given by $U = \frac{20xy}{z}$. The force exerted on it is

(1) $\left(\frac{20y}{z}\right)\hat{i} + \left(\frac{20x}{z}\right)\hat{j} + \left(\frac{20xy}{z^2}\right)\hat{k}$ (2) $-\left(\frac{20y}{z}\right)\hat{i} - \left(\frac{20x}{z}\right)\hat{j} + \left(\frac{20xy}{z^2}\right)\hat{k}$

(3) $-\left(\frac{20y}{z}\right)\hat{i} - \left(\frac{20x}{z}\right)\hat{j} - \left(\frac{20xy}{z^2}\right)\hat{k}$ (4) $\left(\frac{20y}{z}\right)\hat{i} + \left(\frac{20x}{z}\right)\hat{j} - \left(\frac{20xy}{z^2}\right)\hat{k}$

54. A body is dropped from a height h. When loss in its potential energy is U then its velocity is v. The mass of the body is -

(1) $\frac{U^2}{2v}$ (2) $\frac{2v}{U}$ (3) $\frac{2v}{U^2}$ (4) $\frac{2U}{v^2}$

55. A ball of mass 1 kg is released from the tower of Pisa. The kinetic energy generated in it after falling through 10m will be-

(1) 10 J (2) 9.8 J (3) 0.98 J (4) 98 J

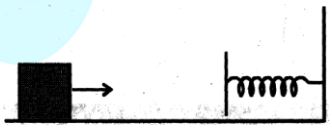
56. A stone is projected vertically up to reach maximum height 'h'. The ratio of its kinetic energy to potential energy, at a height $\frac{4h}{5}$ will be :-

(1) 5 : 4 (2) 4 : 5 (3) 1 : 4 (4) 4 : 1

57. A block of mass 16 kg is moving on a frictionless horizontal surface with velocity 4 m/s and comes to rest after pressing a spring. lf the force constant of the spring is 100 N/m then the compression in the spring will be -

(1) 3.2 m (2) 1.6 m (3) 0.6 m (4) 6.1 m

58. A mass of 0.5 kg moving with a speed of 1.5 m/s on a horizontal smooth surface, collides with a nearly weightless spring of force constant k = 50 N/m. The maximum compression of the spring would be :-



(1) 0.12 m (2) 1.5 m (3) 0.5 m (4) 0.15 m

59. A projectile is fired at 30º with momentum p, neglecting friction, the change in kinetic energy, when it returns back to the ground, will be:-·

(1) zero (2) 30% (3) 60% (4) 100%

60. An electric motor produces a tension of 4500N in a load lifting cable and rolls it at the rate of 2 m/s. The power of. the motor is-

(1) 9 kW (2) 15 kW (3) 225 kW (4) 9×10^3 hp

61. A motor of l.00 hp is moving a car with a constant velocity of 72 km/hour. The forward force exerted by the engine on the car is-

(1) 3.73×10^3 N (2) 3.73×10^2 N (3) 3.73×10^1 N (4) None of the above

62. A crane lifts 300 kg weight from earth's surface upto a height of 2m in 3 seconds. The average power generated by it will be -

(1) 1960 W (2) 2205 W (3) 4410 W (4) 0 w

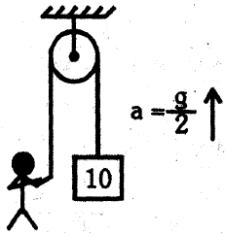
63. Two men with weight in the ratio 5 : 3 run up a staircase in times in the ratio 11 : 9. The ratio of Power of first to that of second is -

(1) $\frac{15}{11}$ (2) $\frac{11}{15}$ (3) $\frac{11}{9}$ (4) $\frac{9}{11}$

64. A car is moving with a speed of 40 Km/hr. If the car engine generates 7 kilowatt power, then the resistance in the path of motion of the car will be-

(1) 360 newton (2) 630 newton (3) Zero (4) 280 newton

65. Calculate power generated by tension in the string in first 2 seconds of motion :-



(1) 250 W (2) 500 W (3) 750 W (4) 1000 W

66. A body of mass m starting from rest from origin moves along x-axis with constant power (P). Calculate relation between velocity / distance :-

(1) $x \propto v^{1/2}$ (2) $x \propto v^2$ (3) $x \propto v$ (4) $x \propto v^3$

67. A pump is used to deliver water at a certain rate from a given pipe. To obtain n times water from the same pipe in the same time, by what factor, the force of the motor should be increased?

(1) n times (2) n^2 times (3) n^3 times (4) $\frac{1}{n}$ times

68. A body of mass 4 kg is moving up an inclined plane rising 1 in 40 with velocity 40 m/sec if efficiency is 50% the calculate power required.

(1) 38.4 W (2) 55 W (3) 78.4 W (4) 108 W

69. A 1.0 hp motor pumps out water from a well of depth 20 m and fills a water tank of volume 2238 liters at a height of 10 m from the ground. The running time of the motor to fill the empty water tank is ($g = 10\ m/s^2$)

(1) 5 minutes (2) l0 minutes (3) l5 minutes (4) 20 minutes

70. Water is falling on the blades of a turbine at a rate of 100 kg/s from a certain spring. If the height of the spring be 100 meters, the power transferred to the turbine will be :-

(1) 100 kW (2) 10 kW (3) 1 kW (4) 1000 kW

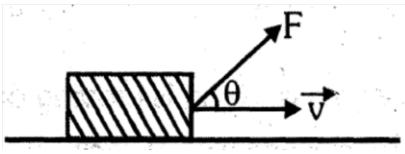
71. If the force applied is F and the velocity gained is v, then the average power developed is :-

(1) $\frac{F}{v}$ (2) $\frac{v}{F}$ (3) $\frac{Fv}{2}$ (4) Fv^2

72. What average horsepower is developed by an 80 kg man while climbing in 10 s flight of stairs that rises 6 m vertically ?

(1) 0.63 hp (2) 1.26 hp (3) 1.8 hp (4) 2.1 hp

73. A constant force $\vec{F}$ is acting on a body of mass m with constant velocity $\vec{v}$ as shown in the figure. The power P exerted is



(1) $Fv\cos\theta$ (2) $\frac{F\cos\theta}{mg}$ (3) $\frac{Fmg\cos\theta}{v}$ (4) $\frac{mg\sin\theta}{F}$

ANSWER KEY

EXERCISE-I (Conceptual Questions)

1.	(1)	**2.**	(2)	**3.**	(3)	**4.**	(4)	**5.**	(1)	**6.**	(3)	**7.**	(2)
8.	(2)	**9.**	(3)	**10.**	(2)	**11.**	(3)	**12.**	(4)	**13.**	(3)	**14.**	(2)
15.	(1)	**16.**	(4)	**17.**	(4)	**18.**	(1)	**19.**	(3)	**20.**	(4)	**21.**	(1)
22.	(2)	**23.**	(1)	**24.**	(3)	**25.**	(1)	**26.**	(2)	**27.**	(3)	**28.**	(4)
29.	(2)	**30.**	(2)	**31.**	(2)	**32.**	(1)	**33.**	(1)	**34.**	(4)	**35.**	(2)
36.	(1)	**37.**	(3)	**38.**	(4)	**39.**	(1)	**40.**	(2)	**41.**	(1)	**42.**	(3)
43.	(4)	**44.**	(3)	**45.**	(1)	**46.**	(2)	**47.**	(2)	**48.**	(1)	**49.**	(4)
50.	(2)	**51.**	(2)	**52.**	(3)	**53.**	(2)	**54.**	(4)	**55.**	(4)	**56.**	(3)
57.	(2)	**58.**	(4)	**59.**	(1)	**60.**	(1)	**61.**	(1)	**62.**	(1)	**63.**	(1)
64.	(2)	**65.**	(3)	**66.**	(4)	**67.**	(2)	**68.**	(3)	**69.**	(3)	**70.**	(1)
71.	(3)	**72.**	(1)	**73.**	(1)								