CHAPTER 2: MOTION & ENERGY

Formulas & Constants

$\rho = \frac{m}{V}$	Average speed: $\bar{v} = \frac{d}{t} = \frac{v_f + v_i}{2}$	$a = \frac{v_f - v_i}{t}$	$v_f = v_i + g.t$ $v = g.t \ (v_i = 0)$	$d = ½ a.t^2 + v_i.t$ $d = ½ g.t^2 \ (v_i = 0)$	ΣE = constant (energy consrv.)
$F = m.a$	$w = m.g$	$W = F.d$	$P = W / t$	$KE = ½ m.v^2$	$PE = m.g.h$
$w = m.g$	$W = F.d$	$P = W / t$	$KE = ½ m.v^2$	$PE = m.g.h$	$V_f = \sqrt{2\,g.h}$
$F_{A\,on\,B} = F_{B\,on\,A}$	$R^2 = X^2 + Y^2$	$\tan\theta = Y / X$	$1\ m/s = 3.6\ km/h$	$g = 10\ m/s^2$	$1\ hp = ¾\ kW$

Key Terms & Definitions

Acceleration	تسارع	Horizontal	أفقي	Resultant	محصّلة
Action	فعل	Inertia	القصور الذاتي	Reaction	ردة فعل
Air resistance	مقاومة الهواء	Instantaneous	لحظي	Resolution	تحليل
Average	متوسط	Interaction	تفاعل	Speed	السرعة القياسية
Component	عنصر / مُكَوِّن/ مُرَكَّب	Kinetic energy	الطاقة الحركية	Static	سكوني
Direction	اتجاه	Mass	كتلة	Support force	قوة الدعم
Displacement	إزاحة	Magnitude	مقدار	Tension	توتر
Distance	مسافة	Mechanical	ميكانيكي	Terminal speed	السرعة الحدية
Dynamic	حركي	Motion	حركة	Vector	كمية متجهة
Energy	طاقة	Net force	قوة إجمالية / صافية	Velocity	السرعة المتجهة
Equilibrium	اتزان	Normal force	القوة العمودية	Vertical	رأسي أو عمودي
Force	قوة	Potential energy	طاقة الوضع	Volume	حجم
Free fall	سقوط حر	Power	قدرة	Weight	وزن
Friction	احتكاك	Projectile	قذيفة أو مقذوف	Work	شغل
Gravity	جاذبية	Projection	إسقاط		

Vectors

1. Scalar is a quantity that does not need:

A	value
B	magnitude
C	direction✓
D	unit

2. Vector is a quantity that needs:

A	direction only
B	magnitude only
C	unit only
D	magnitude and direction✓

3. Example of a scalar is:

A	velocity
B	distance✓
C	acceleration
D	force

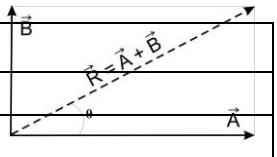
4. Example of a vector is:

A	velocity✓
B	distance
C	speed
D	time

5. For linear motion, the angle between the velocity and acceleration vectors is:

A	always 0^o
B	always 180^o
C	0^o or 180^o✓
D	always 90^o

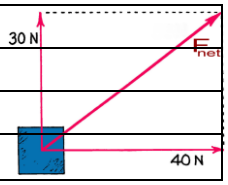
6. Adding two perpendicular vectors ($\vec{A}$) and ($\vec{B}$) gives a resultant ($\vec{R}$) with magnitude:



A	$R = \sqrt{A^2 + B^2}$✓
B	$R = A^2 + B^2$
C	$R = \sqrt{A + B}$
D	$R = 1 / \sqrt{A^2 + B^2}$

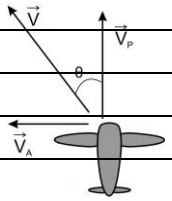
7. Two perpendicular forces, $F_1 = 40$ N and $F_2 = 30$ N, act on a brick. The magnitude of the net force (F_{net}) on the brick is:

A	70 N
B	50 N✓
C	0 N
D	10 N



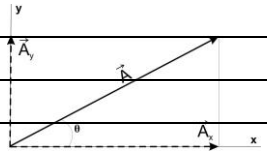
8. If an airplane heading north with speed v_P = 400 km/h faces a westbound wind (ريح نحو الغرب) of speed v_A = 300 km/h, the resultant velocity of the plane ($\vec{v}$) is:

A	500 km/h, north-west✓
B	700 km/h, north-east
C	500 km/h, north-east
D	700 km/h, north-west



9. Decomposing (or resolving) a vector ($\vec{A}$) into two components in perpendicular directions (A_x and A_y) gives :

A	$A_x + A_y = A$
B	$A_x + A_y = A^2$
C	$A_x^2 + A_y^2 = A$
D	$A_x^2 + A_y^2 = A^2$✓



Linear Motion, Velocity, Acceleration

10. To calculate an object's average speed we need to know the:

A	acceleration and time
B	velocity and time
C	distance and time ✓
D	velocity and distance

11. A horse gallops (يجري) a distance of 10 kilometers in 30 minutes. Its average speed is:

A	15 km/h
B	20 km/h✓
C	30 km/h
D	40 km/h

12. A car maintains for 10 seconds a constant velocity of 100 km/h due east. During this interval its acceleration is:

A	0 km/h^2✓
B	1 km/h^2
C	10 km/h^2
D	100 km/h^2

13. While an object near Earth's surface is in free fall, its _____ increases:

A	velocity ✓
B	acceleration
C	mass
D	height

14. The speed at a specific moment is called _____ speed:

A	average
B	instantaneous ✓
C	initial
D	final

15. Acceleration is the rate of change in:

A	force
B	distance
C	speed
D	velocity✓

16. If the speed is constant, the acceleration must be:

A	constant
B	zero
C	negative
D	unknown✓

17. A car moves along a straight road with constant acceleration. If its initial and final speeds are v_i = 10 m/s, v_f = 20 m/s, its average speed is:

A	12 m/s
B	15 m/s ✓
C	10 m/s
D	20 m/s

18. If an object in linear motion moves a distance of 20 m in 5 seconds, its average speed is:

A	4 m/s✓
B	5 m/s
C	10 m/s
D	20 m/s

19. If an object is in linear motion, and its speed changes from 10 m/s to 20 m/s in 10 seconds, its acceleration is:

A	20 m/s^2
B	10 m/s^2
C	5 m/s^2
D	1 m/s^2✓

20. If your average speed is 80 km/h on a 4-hour trip, the total distance you cover is:

A	40 km
B	80 km
C	120 km
D	320 km✓

21. If you travel 300 km in 4 hours, your average speed is:

A	50 km/h
B	75 km/h ✓
C	80 km/h
D	100 km/h

Free Fall

22. If air resistance on a falling rock can be neglected, we say that this rock is:

A	heavy
B	at terminal speed
C	in free fall✓
D	light

23. If a stone drops in a free fall from the edge of a high cliff, its speed after 5 seconds is:

A	10 m/s
B	40 m/s
C	50 m/s✓
D	100 m/s

24. If a stone drops in a free fall from the edge of a high cliff, the distance it covers after 4 seconds is:

A	40 m
B	80 m ✓
C	120 m
D	160 m

25. If an object in free fall has an initial speed of 10 m/s, its speed after 10 seconds is:

A	80 m/s
B	90 m/s
C	100 m/s
D	110 m/s✓

26. Neglecting air resistance, if a player throws a ball straight up with a speed of 30 m/s, the ball will reach its maximum height after:

A	6 seconds
B	5 seconds
C	4 seconds
D	3 seconds✓

27. If an object is in free fall, the distance it travels every seconds is:

A	the same as the previous (السابق) second
B	more than the previous second✓
C	less than the previous second
D	undefined

28. If an object is in free fall, its speed every seconds is:

A	the same as the previous (السابق) second
B	more than the previous second✓
C	less than the previous second
D	undefined

Newton's 1st Law of Motion; Inertia; Equilibrium

29. If no external forces act on a moving object, it will:

A	continue moving at the same speed
B	continue moving at the same velocity✓
C	move slower and slower until it finally stops
D	make a sudden stop

30. If an object is in mechanical equilibrium, we can say that:

A	a nonzero net force acts on it
B	it has constant velocity✓
C	it has small acceleration
D	it has large acceleration

31. Inertia means that:

A	an object at rest tries to remain at rest, and a moving object tries to stop
B	an object at rest tries to move, and a moving object tries to stop
C	an object at rest tries to move, and a moving object tries to keep moving
D	an object at rest tries to remain at rest, and a moving object tries to keep moving✓

32. The SI unit of inertia is the:

A	kilogram
B	newton
C	joule
D	none of these✓

33. If two equal forces act on a moving cart in opposite directions, we can say about it that:

A	it has acceleration
B	it is in static equilibrium
C	it is in dynamic equilibrium✓
D	nonzero net force acts on it

34. If two equal forces act on a stationary (ساكن) book in opposite directions, we can say about it that:

A	it has acceleration
B	it is in static equilibrium✓

C	it is in dynamic equilibrium
D	a nonzero net force acts on it

35. If you stand at rest on a pair of identical bathroom scales, the readings on the two scales will always be:

A	each equal to your weight
B	each equal to half your weight ✓
C	each equal to double your weight
D	different from each other

36. A man weighing 800 N stands at rest on two bathroom scales so that his weight is distributed evenly between them. The reading on each scale is:

A	400 N ✓
B	200 N
C	1600 N
D	800 N

37. A 80-kg painter stands on a 20-kg painting staging (سقالة دهان) that hangs on two ropes. If the staging is at rest and both ropes have the same tension, the tension in each rope is:

A	200 N
B	500 N✓
C	800 N
D	1000 N

Force; Support Force; Friction

38. The support force is on an object results from the _____ of atoms in the surface:

A	compression✓
B	speed
C	acceleration
D	energy

39. The support force on a 2-kg book lying on a level table is:

A	1 N
B	2 N
C	10 N
D	20 N✓

40. In the following, check the correct statement:

A	force is a vector, mass is a scalar✓
B	force is a vector, weight is a scalar
C	mass is a vector, weight is a scalar
D	force is a vector, mass is a vector

41. Two forces act on an object: $\vec{F}_1$ = (6 N, east); $\vec{F}_2$ = (8 N, west). The net force ($\Sigma\vec{F}$) on it is:

A	(14 N, east)
B	(14 N, west)
C	(2 N, west)✓
D	(-2 N, west)

42. Two forces act on an object: $\vec{F}_1$ = (10 N, up); $\vec{F}_2$ = (10 N, down). The net force ($\Sigma\vec{F}$) on it is:

A	(20 N, up)
B	(20 N, down)
C	(10 N, up)
D	zero✓

43. Two forces act on a crate and the crate is in equilibrium. These two forces are:

A	(100 N, right), (100 N, left) ✓
B	(100 N, right), (50 N, left)
C	(50 N, right), (100 N, left)
D	(100 N, right), (100 N, right)

44. If the force of friction on a moving object is 10 N, the force needed to keep it at constant velocity is:

A	0 N
B	5 N
C	10 N✓
D	more than 10 N

45. When an object falling through air stops gaining speed, we say that it has reached its _____ speed:

A	average
B	instantaneous
C	final
D	terminal✓

46. Air drag depends on a falling object's:

A	size and speed✓
B	size and density
C	density and speed
D	none of these

Mass; Weight

47. Mass is a measure of an object's:

A	inertia✓
B	volume
C	density
D	speed

48. Mass is an object's quantity of:

A	energy

B	matter✓
C	dimensions
D	momentum

49. The SI unit for weight is the:

A	newton✓
B	kilogram
C	gram
D	pound

50. Two identical barrels (برميل), one filled with oil and one with cotton, should have:

A	same mass and different inertia
B	same inertia and different weight
C	same volume and different mass✓
D	same weight and different density

51. If the Earth's gravitational pull is 6 times that of the Moon, an object taken to the Moon will have:

A	same mass and less weight✓
B	same weight and less mass
C	same mass and same weight
D	less mass and less weight

Newton's 2nd Law

52. An object's acceleration is directly proportional to the:

A	net force✓
B	average speed
C	mass
D	inertia

53. If an object's mass decreases while a constant force is applied to it, its acceleration:

A	decreases
B	increases✓
C	remains constant
D	changes according to volume

54. If the net force acting on an object decreases, its acceleration:

A	decreases✓
B	increases
C	remains constant
D	changes direction

55. The net force on an 50-kg crate is 100 N, its acceleration is:

A	0.5 m/s^2
B	1 m/s^2
C	2 m/s^2✓
D	5 m/s^2

56. A 1-kg falling ball encounters 10 N of air resistance. The net force on the ball is:

A	0 N✓
B	4 N
C	6 N
D	10 N

Newton's 3rd Law

57. The number of forces involved (الداخلة) in an interaction between two objects is:

A	0
B	1
C	2✓
D	3

58. A force is defined (تعريفها) as:

A	part of an interaction between two objects✓
B	a push from an object on itself
C	a pull from an object on itself
D	a push and a pull on the same object

59. Newton's 3rd law states that, for two objects X and Y, whenever X exerts a force on Y, then:

A	Y exerts double that force on X
B	Y moves in the opposite direction
C	Y exerts half that force on X
D	Y exerts an equal but opposite force on X✓

60. In an interaction between two objects, the action and reaction forces are:

A	perpendicular
B	in opposite directions✓
C	in the same direction
D	on the same object

61. When a man pushes on a wall with force F, the wall pushes back on him with force of magnitude:

A	zero
B	F/2
C	F✓
D	2 F

62. When a cannon shoots a cannonball with acceleration a_b, the cannon recoils (يرتد) with acceleration a_c such that:

A	$a_c = a_b$
B	a_c is much larger than a_b
C	a_c is much smaller than a_b✓
D	$a_c = 0$

63. When a cannon shoots a cannonball with force F_b, the cannon recoils (يرتد) with force F_c such that:

A	$F_c = F_b$✓
B	F_c is much larger than F_b
C	F_c is much smaller than F_b
D	$F_c = 0$

64. When a cannon shoots a cannonball, the cannon's recoil (ارتداد) is much slower than the cannonball because:

A	the force on the cannon is much less
B	the mass of the cannon is much greater✓
C	the cannon's mass is more distributed (موزع)
D	there is more air resistance

65. When a man stretches a spring with a 100-N force (within its elasticity range), the spring pulls him back with:

A	0 N
B	50 N
C	100 N✓
D	200 N

Work; Energy

66. Work is produced only if there is:

A	force and motion✓
B	force and elevation (ارتفاع)
C	force and time
D	time and elevation

67. Work is proportional to:

A	(force) and (1/distance)
B	(force) and (distance)✓
C	(1/force) and (distance)
D	(force) and $(distance)^2$

68. The SI unit of work is:

A	newton
B	watt
C	joule✓
D	ampere

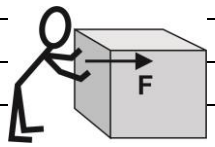
69. A joule is equivalent to:

A	N/m^2
B	m/N
C	N/m
D	N.m✓

70. A cart moves 10 m in the same direction as a 20-N force acting on it. The work done by this force is:

A	200 J✓
B	2 J
C	0.5 J
D	20 J

71. A man does 2000-J work in pushing a crate a distance of 10 m on a frictionless floor. The force applied by the man is:



A	20 N
B	200 N✓
C	2000 N
D	20000 N

Power

72. An engine (محرك) can do 100,000-J work in 10 s. The power of this engine is:

A	1 MW
B	100 kW
C	1000 W
D	10 kW✓

73. An engine (محرك) can do 75-kJ work in 10 s. The power of this engine in horsepower is:

A	10 hp✓
B	1 hp
C	0.1 hp
D	100 hp

74. The SI unit of power is:

A	newton
B	watt✓
C	joule
D	ampere

75. A watt is equivalent to:

A	$kg.m^3/s^2$
B	$kg^2.m^2/s^3$
C	$kg.m^2/s^3$✓
D	$kg^2.m^2/s$

76. Of the following quantities, the ones that have the same unit are:

A	work and energy✓

B	work and power
C	energy and power
D	work and pressure

Mechanical Energy

77. Mechanical energy results from an object's:

A	position only
B	position and/or motion✓
C	motion only
D	neither position nor motion

78. Mechanical energy consists of:

A	kinetic energy and power
B	potential energy and power
C	potential and kinetic energy✓
D	power and work

Potential Energy

79. Of the following, the form of energy that is NOT potential is the energy of:

A	a moving car✓
B	a stretched bow (قوس مشدود)
C	a compressed spring (زنبرك مضغوط)
D	water in a high reservoir (خزان)

80. Potential energy is the energy stored in an object because of its:

A	speed
B	position✓
C	charge
D	mass

81. A 20-kg box rests on a 2-m high shelf. Its potential energy relative to the ground is:

A	100 J
B	200 J
C	400 J✓
D	800 J

82. The mass of a box of 200-J potential energy when resting on a 2-m-high shelf is:

A	10 kg✓
B	20 kg
C	40 kg
D	80 kg

83. If a 5-kg box sitting on a shelf of height (h) has 100-J potential energy relative to the ground, h equals:

A	1 m
B	2 m✓
C	4 m
D	8 m

84. Three 5-kg rocks are raised to a height of 5 m, with $Rock_1$ raised with a rope, $Rock_2$ raised on a ramp (منحدر), and $Rock_3$ raised with an lift (مصعد). The rock that attains the most potential energy is:

A	$Rock_1$
B	$Rock_2$
C	$Rock_3$
D	all the same✓

Kinetic Energy

85. Kinetic energy is the energy stored in an object because of its:

A	motion✓
B	position
C	charge
D	mass

86. The kinetic energy of a 1000-kg car traveling at a speed of 20 m/s is:

A	50 kJ
B	100 kJ
C	200 kJ✓
D	400 kJ

87. The mass of a bicycle of 4000-J kinetic energy traveling at 10 m/s is:

A	40 kg
B	50 kg
C	60 kg
D	80 kg✓

88. The speed of a 40-kg bicycle of 1620-J kinetic energy is:

A	9 m/s✓
B	3 m/s
C	27 m/s
D	90 m/s

89. If an object's speed doubles, its kinetic energy:

A	remains the same
B	doubles
C	triples
D	quadruples✓

90. If an object's mass doubles while moving at a constant speed, its kinetic energy:

A	remains the same
B	doubles✓
C	triples
D	quadruples

91. The kinetic energy of a car traveling at 20 m/s is 500 kJ. If it travels at 40 m/s, its kinetic energy becomes:

A	500 kJ
B	1000 kJ
C	2000 kJ✓
D	4000 kJ

92. The work done by the engine of a 1000-kg car to move it from rest to a speed of 20 m/s is:

A	50 kJ
B	100 kJ
C	200 kJ✓
D	400 kJ

93. The force exerted by the engine of a 1000-kg car to move it from rest to a speed of 20 m/s within 100 m is:

A	1000 N
B	2000 N✓
C	4000 N
D	5000 N

Conservation of Energy

94. The total energy of an object of mass (m), falling at height (h) with speed (v) can be written as:

A	$E = ½ mv^2 + 2 mgh$
B	$E = ½ mv^2 + mgh$✓
C	$E = mv^2 + ½ mgh$
D	$E = ½ mv^2 + ½ mgh$

95. As an object falls, its potential energy _____ and its kinetic energy _____.

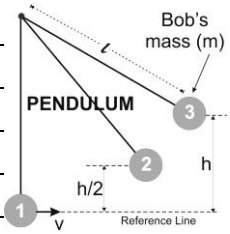
A	increases, decreases
B	decreases, decreases
C	decreases, increases✓
D	increases, increases

96. The ram of pile-driver (مِدَكّ) falls from a height of 20 m. Its speed just before touching ground is:

A	2 m/s
B	5 m/s
C	10 m/s
D	20 m/s✓

97. A simple pendulum's bob has speed (v) at its lowest point (1); its highest point (3) has height (h).
If h = 20 cm, v equals:

A	2 m/s✓
B	5 m/s
C	10 m/s
D	20 m/s



98. When a simple pendulum's bob of mass m = 0.5 kg is at its highest point (3), its height is h = 40 cm. Its kinetic energy at its lowest point (1) is:

A	0 J
B	2 J✓
C	5 J
D	10 J

99. When a simple pendulum's bob of mass m = 0.5 kg is at its highest point (3), its height is h = 40 cm. Its kinetic energy at point (2) of height ½ h is:

A	5 J
B	2 J
C	1 J✓
D	0 J

100. When a simple pendulum's bob of mass m = 0.5 kg is at its highest point (3), its height is h = 40 cm. Its total energy at point (2) of height ½ h is:

A	5 J
B	2 J✓
C	1 J
D	0 J