Physical Quantities & Units

TOPIC QUESTIONS (2)

Level	AS Level
Subject	Physics
Exam Board	CIE
Paper Type	Multiple Choice

Time Allowed : 1 Hour 20 Minutes

1. What is a reasonable estimate of the diameter of an alpha particle?
A 10^{-15}m B 10^{-12}m C 10^{-9}m D 10^{-6}m

2. A series of measurements of the acceleration of free fall g is shown in the table.
Which set of results is precise but not accurate?

	g / m s^{-2}				
A	9.81	9.79	9.84	9.83	9.79
B	9.811	0.12	9.89	8.94	9.42
C	9.45	9.21	8.99	8.76	8.51
D	8.45	8.46	8.50	8.41	8.47

3. A mass m has acceleration a. It moves through a distance s in time t. The power used in accelerating the mass is equal to the product of force and velocity. The percentage uncertainties are 0.1 % in m, 1 % in a, 1.5 % in s, 0.5 % in t.
What is the percentage uncertainty in the average power?
A 2.1 % B 2.6 % C 3.1 % D 4.1 %

4. Five energies are listed.

5 kJ 5 mJ 5 MJ 5 nJ
Starting with the smallest first, what is the order of increasing magnitude of these energies?

A 5 kJ → 5 mJ → 5 MJ → 5 nJ
B 5 nJ → 5 kJ → 5 MJ → 5 mJ
C 5 nJ → 5 mJ → 5 kJ → 5 MJ
D 5 mJ → 5 nJ → 5 kJ → 5 MJ

5. Which of the following correctly expresses the volt in terms of SI base units?

A A Ω B W A^{-1} C kg m^2 $s^{-1}A^{-1}$ D kg $m^2s^{-3}A^{-1}$

6. Which is an S*I* base unit?

a. current

b. gram

c. kelvin

d. volt

7. Which pair contains one vector and one scalar quantity?

A	displacement	acceleration
B	force	kinetic energy
C	momentum	velocity
D	power	speed

8. When a constant braking force is applied to a vehicle moving at speed *v*, the distance *d* moved by the vehicle in coming to rest is given by the expression

$$d = kv^2$$

where k is a constant.

When d is measured in metres and v is measured in metres per second, the constant has a valueof k_1.

What is the value of the constant when the distance is measured in metres, and the speed ismeasured in kilometres per hour?

A $0.0772\,k_1$ B $0.278\,k_1$ C $3.60\,k_1$ D $13.0\,k_1$

9. What is a reasonable estimate of the average gravitational force acting on a fully grown womanstanding on the Earth?

A 60 N B 250 N C 350 N D 650 N

10. Which definition is correct and uses only quantities rather than units?

A Density is mass per cubic metre.

B Potential difference is energy per unit current.

C Pressure is force per unit area.

D Speed is distance travelled per second.

11. Decimal sub-multiples and multiples of units are indicated using a prefix to the unit. For example,the prefix milli (m) represents 10^{-3}.

Which row gives the sub-multiples or multiples represented by pico (p) and giga (G)?

	pico (p)	giga (G)
A	10^{-9}	10^{9}
B	10^{-9}	10^{12}
C	10^{-12}	10^{9}
D	10^{-12}	10^{12}

12. Which definition is correct and uses only quantities rather than units?

a. Density is mass per cubic metre.

b. Potential difference is energy per unit current.

c. Pressure is force per unit area.

d. Speed is distance travelled per second.

13. Stress has the same SI base units as

A $\frac{\text{force}}{\text{mass}}$.

B $\frac{\text{force}}{\text{length}}$.

C $\frac{\text{force}}{\text{area}}$.

D energy.

14. To check calculations, the units are put into the following equations together with the numbers.

Which equation must be incorrect?

A force = 300 J / 6 m

B power = 6000 J × 20 s

C time = 6 m / 30 m s^{-1}

D velocity = 4 m s^{-2} × 30 s

15. In making reasonable estimates of physical quantities, which statement is not correct?

A The frequency of sound can be of the order of GHz.

B The wavelength of light can be of the order of 600 nm.

C The Young modulus can be of the order of 10^{11} Pa.

D Beta radiation is associated with one unit of negative charge.

16. A metal sphere of radius *r* is dropped into a tank of water. As it sinks at speed *v*, it experiences a drag force *F* given by $F = krv$, where *k* is a constant.

What are the S*I* base units of *k*?

A kg m^2 s^{-1} B kg m^{-2} s^{-2} C kg m^{-1} s^{-1} D kg m s^{-2}

17. Which row shows a base quantity with its correct SI unit?

	quantity	unit
A	current	A
B	mass	g
C	temperature	°C
D	weight	N

18. The frictional force F on a sphere falling through a fluid is given by the formula

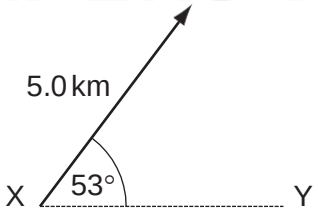
$$F = 6\pi a\eta v$$

where a is the radius of the sphere, η is a constant relating to the fluid and v is the velocity of the sphere.

What are the units of η?

A $kg\,m\,s^{-1}$ B $kg\,m^{-1}\,s^{-1}$ C $kg\,m\,s^{-3}$ D $kg\,m^{3}\,s^{-3}$

19. What is the component of this displacement vector in the direction XY?



A 3.0 km B 4.0 km C 5.0 km D 6.6 km

20. The SI unit for potential difference (the volt) is given, in base units, by

A $kg\,m\,A^{-1}\,s^{-3}$.

B $m^{2}\,A^{-1}\,s^{-2}$.

C $kg\,m^{2}\,s^{-2}$.

D $kg\,m^{2}\,A^{-1}\,s^{-3}$.

21. A student uses a digital ammeter to measure a current. The reading of the ammeter is found to fluctuate between 1.98 A and

Which product-pair of metric prefixes has the greatest magnitude?

A pico × mega B nano × kilo
C micro × giga D milli × tera

22. In the expressions below a is acceleration,
F is force, m is mass, t is time, v is velocity. Which expression represents energy?

A Ft B Fvt C $\frac{2mv}{t}$ D $\frac{at^2}{2}$

23. Which row of the table shows a physical quantity and its correct unit?

	physical quantity	unit
A	electric field strength	$kg\,m\,s^{-2}C^{-1}$
B	specific heat capacity	$kg^{-1}m^2s^{-2}K^{-1}$
C	tensile strain	$kgm^{-1}s^{-2}$
D	the Young modulus	$kgm^{-1}s^{-3}$

24. The measurement of a physical quantity may be subject to random errors and to systematic errors.
Which statement is correct?
A Random errors can be reduced by taking the average of several measurements.
B Random errors are always caused by the person taking the measurement.
C A systematic error cannot be reduced.
D A systematic error results in a different reading each time the measurement is taken.

25. An experiment is done to measure the resistance of a wire. The current in the wire is 1.0 ± 0.2 A and the potential difference across the wire is 8.0 ± 0.4 V.
What is the resistance of the wire and its uncertainty? A (8.0 ± 0.2) Ω B (8.0 ± 0.6) Ω
C (8 ± 1) Ω D (8 ± 2) Ω

26. Which is a pair of SI base units?
A ampere joule B coulomb second
C kilogram Kelvin D metre newton

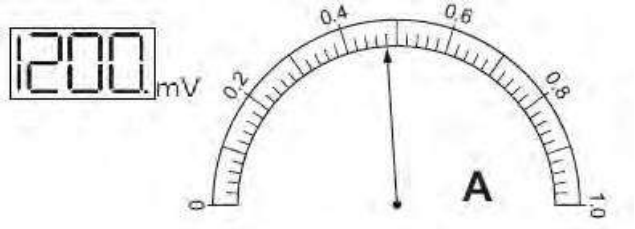
27. What is the ratio ? $\frac{1\mu m}{1Gm}$

A 10^{-3} B 10^{-9} C 10^{-12} D 10^{-15}

28. Which formula could be correct for the speed v of ocean waves in terms of the density ρ of seawater, the acceleration of free fall g, the depth h of the ocean and the wavelength λ?

A $v = \sqrt{g\lambda}$ B $v = \sqrt{\frac{g}{h}}$ C $v = \sqrt{\rho gh}$ D $v = \sqrt{\frac{g}{\rho}}$

29. The resistance of an electrical component is measured. The following meter readings are obtained.



What is the resistance?
A 2.5 Ω B 2.7 Ω C 2500 Ω D 2700 Ω

30. The equation relating pressure and density is p = ρgh
How can both sides of this equation be written in terms of base units?

A $[N\,m^{-1}] = [kg\,m^{-3}]\,[m\,s^{-1}]\,[m]$
B $[N\,m^{-2}] = [kg\,m^{-3}]\,[m\,s^{-2}]\,[m]$
C $[kg\,m^{-1}\,s^{-2}] = [kg\,m^{-3}]\,[m\,s^{-2}]\,[m]$
D $[kg\,m^{-1}\,s^{-1}] = [kg\,m^{-1}]\,[m\,s^{-2}]\,[m]$

31. The table contains some quantities, together with their symbols and units.

quantity	symbol	unit
gravitational field strength	g	$N\,kg^{-1}$
density of liquid	ρ	$kg\,m^{-3}$
vertical height	h	m
volume of part of liquid	V	m^3

Which expression has the units of energy?

A $g\rho hV$ B $\frac{\rho hV}{g}$ C $\frac{\rho g}{hV}$ D $\rho g^2 h$

32. Which statement, involving multiples and sub-multiples of the base unit metre (m), is correct?

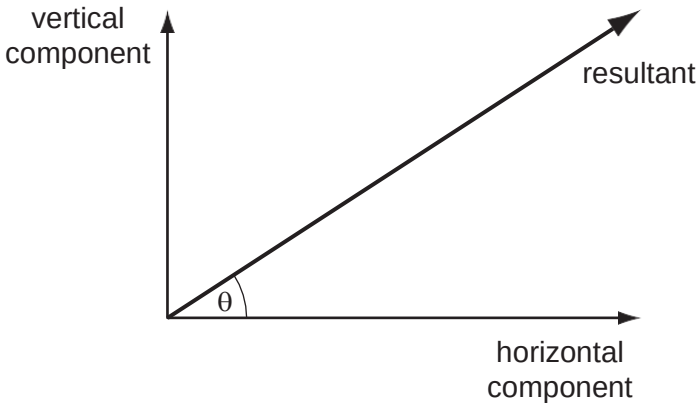
A $1\,pm = 10^{-9}\,m$

B $1\,nm = 10^{-6}\,m$

C $1\,mm = {}^{6}\mu m$

D $1\,km = {}^{6}\,mm$

33. The diagram shows a resultant force and its horizontal and vertical components.



The horizontal component is 20.0 N and θ = 30°. What is the vertical component?

A 8.7 N B 10.0 N C 11.5 N D 17.3 N

34. At temperatures close to 0 K, the specific heat capacity c of a particular solid is given by $c = bT^3$, where T is the thermodynamic temperature and b is a constant characteristic of the solid.

What are the units of constant b, expressed in SI base units?

A $m^2 s^{-2} K^{-3}$

B $m^2 s^{-2} K^{-4}$

C $kg\ m^2 s^{-2} K^{-3}$

D $kg\ m^2 s^{-2} K^{-4}$

35. The table shows the x-component and y-component of four force vectors.

Which force vector has the largest magnitude?

	x-component / N	y-component / N
A	2	9
B	3	8
C	4	7
D	5	6

36. Five energies are listed.

5 kJ

5 mJ

5 MJ

5 nJ

Starting with the smallest first, what is the order of increasing magnitude of these energies?

A 5 kJ → 5 mJ → 5 MJ → 5 nJ

B 5 nJ → 5 kJ → 5 MJ → 5 mJ

C 5 nJ → 5 mJ → 5 kJ → 5 MJ

D 5 mJ → 5 nJ → 5 kJ → 5 MJ

37. Which of the following correctly expresses the volt in terms of SI base units?

A $A\,\Omega$

B $W\,A^{-1}$

C $kg\,m^2\,s^{-1}\,A^{-1}$

D $kg\,m^2\,s^{-3}\,A^{-1}$

38. The equation relating pressure and density is $p = \rho gh$.

How can both sides of this equation be written in terms of base units?

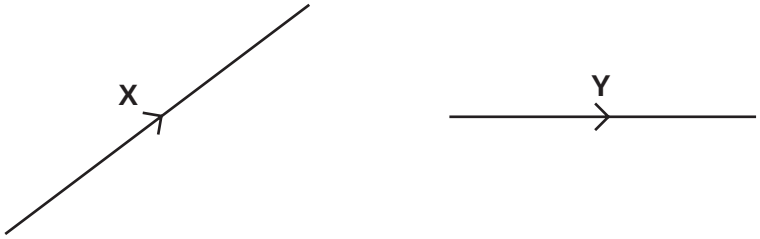
A $[N\,m^{-1}] = [kg\,m^{-3}]\,[m\,s^{-1}]\,[m]$

B $[N\,m^{-2}] = [kg\,m^{-3}]\,[m\,s^{-2}]\,[m]$

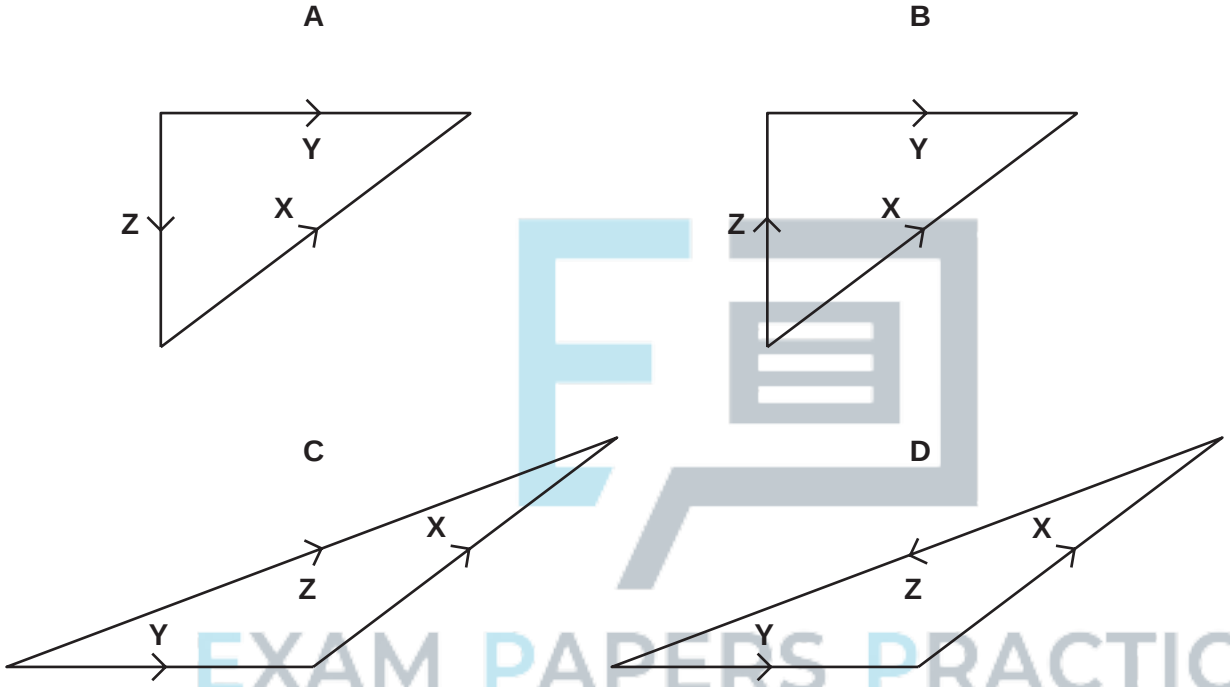
C $[kg\,m^{-1}\,s^{-2}] = [kg\,m^{-3}]\,[m\,s^{-2}]\,[m]$

D $[kg\,m^{-1}\,s^{-1}] = [kg\,m^{-1}]\,[m\,s^{-2}]\,[m]$

39. The diagram shows two vectors X and Y.



In which vector triangle does the vector Z show the magnitude and direction of vector X-Y?



40. Which is a pair of SI base units?

A	ampere	joule
B	coulomb	second
C	kilogram	kelvin
D	metre	newton

41. Physical quantities can be classed as vectors or as scalars.

Which pair of quantities are both vectors?

A kinetic energy and elastic force

B momentum and time

C velocity and electric field strength

D weight and temperature

42. The units of all physical quantities can be expressed in terms of SI base units.

Which pair contains quantities with the same base units?

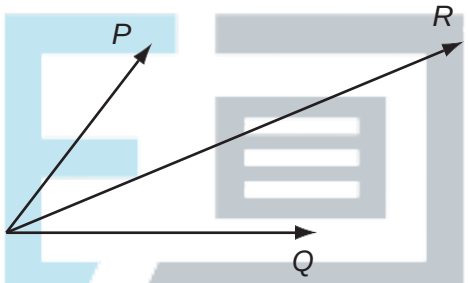
A force and momentum

B pressure and Young modulus

C power and kinetic energy

D mass and weight

43. Two physical quantities *P* and *Q* are added. The sum of *P* and *Q* is *R*, as shown.



Which quantity could be represented by *P* and by *Q*?

A kinetic energy

B power

C speed

D velocity

44. Three of these quantities have the same unit.

Which quantity has a different unit?

A $\frac{\text{energy}}{\text{distance}}$

B force

C power × time

D rate of change of momentum

45. When a force F moves its point of application through a displacement s in the direction of the force, the work W done by the force is given by

$$W = Fs.$$

How many vector quantities and scalar quantities does this equation contain?

A one scalar quantity and two vector quantities

B one vector quantity and two scalar quantities

C three scalar quantities

D three vector quantities

46. What is a possible unit for the product VI, where V is the potential difference across a resistor and I is the current through the same resistor?

A newton per second (N s^{-1})

B newton second (N s)

C newton metre (N m)

D newton metre per second (N m s^{-1})

47. What is the unit watt in terms of SI base units?

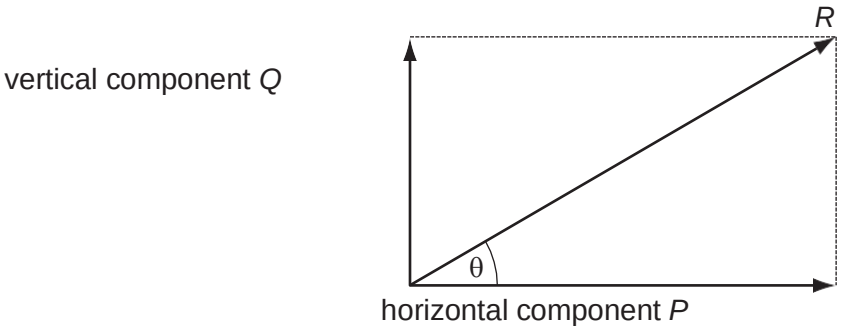
A J s^{-1} B $\text{m}^2\,\text{kg}\,\text{s}^{-1}$ C $\text{m}^2\,\text{kg}\,\text{s}^{-3}$ D N m s^{-1}

48. For which quantity is the magnitude a reasonable estimate?

A frequency of a radio wave 500 pHzB mass of an atom 500 µg C the Young modulus of a metal 500 kPaD wavelength of

green light 500 nm

49. A vector has magnitude R and perpendicular components P and Q, as shown in the diagram.



Which row correctly describes the perpendicular components?

	vertical component	horizontal component
A	Q	$\sin\theta$
B	$R\cos\theta$	P
C	$R\cos\theta$	$R\sin\theta$
D	$R\sin\theta$	$R\cos\theta$

50. A thermometer can be read to an accuracy of 0.5 °C. This thermometer is used to measure a temperature rise from 40 °C to 100 °C.
What is the percentage uncertainty in the measurement of the temperature rise?
A 0.5 % **B** 0.8 % **C** 1.3 % **D** 1.7%

51. The product of pressure and volume has the same SI base units as

A energy.

B force.

C $\frac{\text{force}}{\text{area}}$.

D $\frac{\text{force}}{\text{length}}$.

52. An ion is accelerated by a series of electrodes in a vacuum. A graph of the power supplied to the ion is plotted against time.

What is represented by the area under the graph between two times?

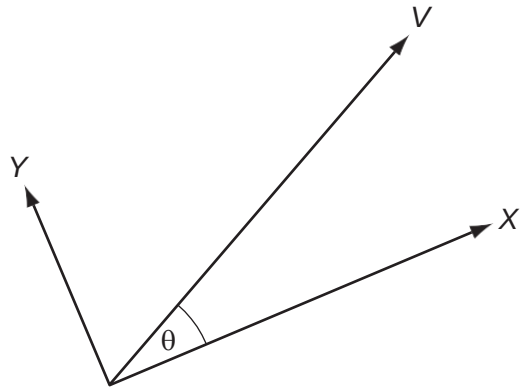
A the change in kinetic energy of the ion

B the average force on the ion

C the change in momentum of the ion

D the change in velocity of the ion

53. A vector quantity *V* is resolved into two perpendicular components *X* and *Y*. The angle between *V* and component *X* is θ.



The angle between component *X* and the vector *V* is increased from 0° to 90°.

How do the magnitudes of *X* and *Y* change as the angle θ is increased in this way?

	X	*Y*
A	increase	increase
B	increase	decrease
C	decrease	increase
D	decrease	decrease

54. What is the unit of resistivity?

A $\Omega\,m^{-2}$ B $\Omega\,m^{-1}$ C Ω D $\Omega\,m$

55. The drag force *F* acting on a moving sphere obeys an equation of the form $F = kAv^2$, where *A* represents the sphere's frontal area and *v* represents its speed.

What are the base units of the constant *k*?

A $kg\,m^5\,s^{-4}$ B $kg\,m^{-2}\,s^{-1}$ C $kg\,m^{-3}$ D $kg\,m^{-4}\,s^2$

56. Which pair includes a vector quantity and a scalar quantity?

A	displacement;	acceleration
B	force;	kinetic energy
C	power;	
D	work;	potential energy

57. For which quantity is the magnitude a reasonable estimate?

A	frequency of a radio wave	500 pHz
B	mass of an atom	500 μg
C	the Young modulus of a metal	500 kPa
D	wavelength of green light	500 nm

58. The following physical quantities can be either positive or negative.

s : displacement of a particle along a straight line

θ : temperature on the Celsius scale

q : electric charge

V : readings on a digital voltmeter

Which of these quantities are vectors?

A s, θ, q, V

B s, q, V

C θ, V

D s only

59. Which pair of units are both SI base units?

A ampere, degree celsius

B ampere, kelvin

C coulomb, degree celsius

D coulomb, kelvin

60. The prefix 'centi' indicates x 10^{-2}.

Which line in the table correctly indicates the prefixes micro, nano and pico?

	x 10^{-12}	x 10^{-9}	x 10^{-6}
A	nano	micro	pico
B	nano	pico	micro
C	pico	nano	micro
D	pico	micro	nano

61. When a beam of light is incident on a surface, it delivers energy to the surface. The intensity ofthe beam is defined as the energy delivered per unit area per unit time.

What is the unit of intensity, expressed in SI base units?

A $kg\,m^{-2}\,s^{-1}$ B $kg\,m^{2}\,s^{-3}$ C $kg\,s^{-2}$ D $kg\,s^{-3}$

62. Which pair contains one vector and one scalar quantity?

A displacement : acceleration

B force : kinetic energy

C momentum : velocity

D power : speed

63. Which of the following could be measured in the same units as force?

A energy / distance

B energy x distance

C energy / time

D momentum x distance

64. The notation μs is used as an abbreviation for a certain unit of time.

What is the name and value of this unit?

	name	value
A	microsecond	10^{-6} s
B	microsecond	10^{-3} s
C	millisecond	10^{-6} s
D	millisecond	10^{-3} s

65. A student measures a current as 0.5 A.

Which of the following correctly expresses this result?

A 50 mA **B** 50 MA **C** 500 Ma **D** 500 MA