1 Which of the following pairs of quantities are both scalar?

A Speed, velocity

B Work, charge

C Electric field strength, pressure

D Momentum, Young's modulus

2 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** $\dfrac{\rho\,hV}{g}$ **C** $\dfrac{\rho\,g}{hV}$ **D** $\rho\,g^2h$

3 A laser unit emits red light. Estimate the distance, expressed as a number of wavelengths, travelled by the light in one second.

A 5×10^8 **B** 5×10^{11} **C** 5×10^{14} **D** 5×10^{17}

4 What are the units of the constant c given in the equation $v^2 = cx + d$ if v is the velocity, x is a distance variable and d is a constant?

A s^{-2} **B** m s^{-1} **C** m s^{-2} **D** $\text{m}^2\,\text{s}^{-2}$

5 The resistance ***X*** of an unknown resistor is calculated by measuring the potential difference across it and the current through it. If the readings of the potential difference and current are (4.3 ± 0.1) mV and (1.58 ± 0.02) μA respectively, the resistance ***X*** should be quoted as

A $(2700 \pm 100)\ \Omega$

B $(2720 \pm 10)\ \Omega$

C $(2721 \pm 4)\ \Omega$

D $(2721.52 \pm 0.04)\ \Omega$

6 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 velocity of the ion

B the average force on the ion

C the change in momentum of the ion

D the change in kinetic energy of the ion

7 The probable maximum magnitude and the minimum magnitude for the resultant force of two forces are respectively 25 N and 5 N. The magnitude of the two forces are

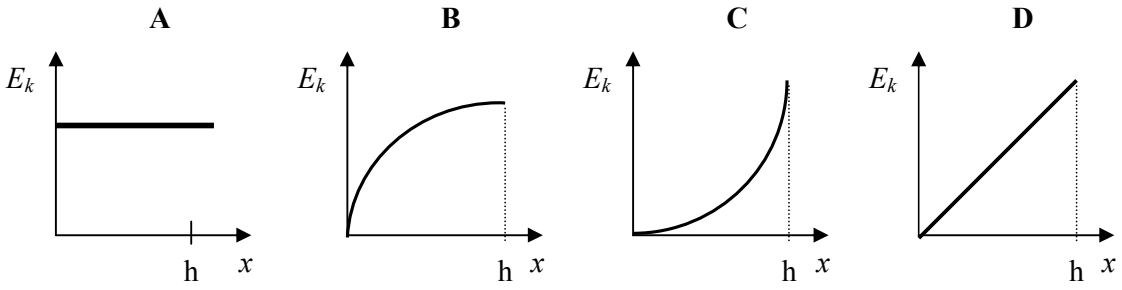
A 5 N and 20 N

B 10 N and 15 N

C 15 N and 30 N

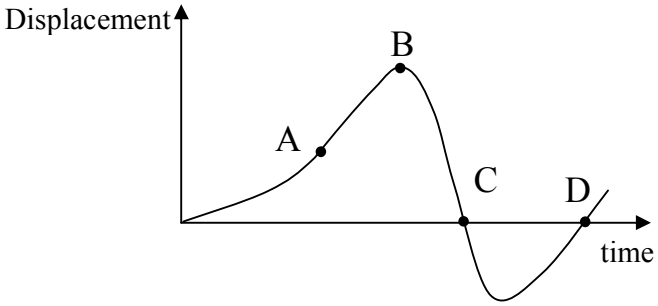
D 20 N and 30 N

8 A small steel sphere is released from rest at a height, h above the ground level.
Which of the following graphs most closely represents the variation of kinetic energy of the sphere, E_k with the distance it moves, x? (Ignore the air resistance)



9 A car is travelling along a straight road. The graph shows the variation with time of its displacement during part of the journey.

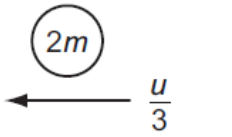
At which point on the graph does the car have its largest magnitude of velocity?

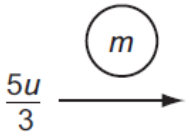


10 The diagram shows two spherical masses approaching each other head-on at an equal speed u. One has mass $2m$ and the other has mass m.

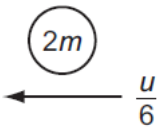
Which diagram, showing the situation after the collision, shows the result of an elastic collision?

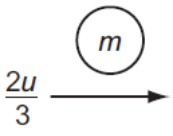
A



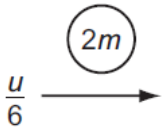


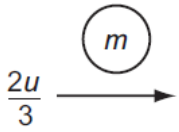
B



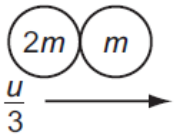


C





D



the spheres stick together

11 Which statement about Newton's laws of motion is correct?

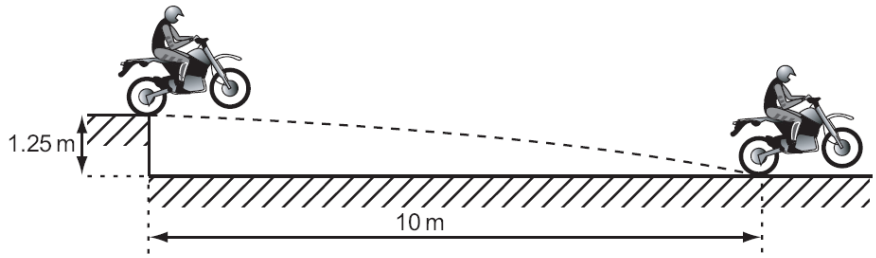
A The first law follows from the second law.

B The third law follows from the second law.

C Conservation of energy is a consequence of the third law.

D Conservation of linear momentum is a consequence of the first law.

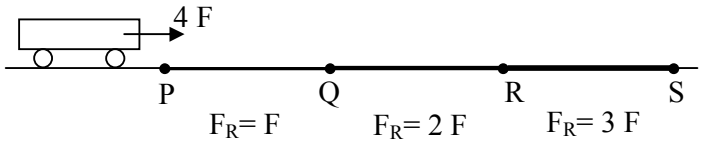
12 A motorcycle stunt-rider moving horizontally takes off from a point 1.25 m above the ground, landing 10 m away as shown in the figure below.



What was the speed at take-off?

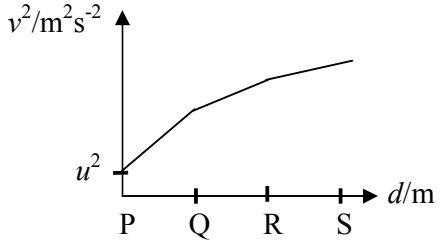
A 12.5 ms^{-1} **B** 20 ms^{-1} **C** 30 ms^{-1} **D** 40 ms^{-1}

13 A trolley of mass 2.0 kg is being pulled by a constant force of 4 F throughout the points P, Q, R and S. At point P it has a velocity of u ms^{-1}. From the point P to Q, Q to R and R to S, the trolley experiences frictional forces F_R of F, 2 F and 3 F respectively.

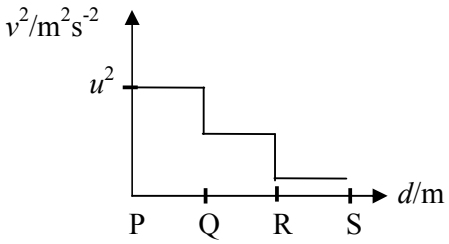


Which of the graphs below describes the velocity squared v^2/m^{2}s^{-2} against displacement of the trolley correctly?

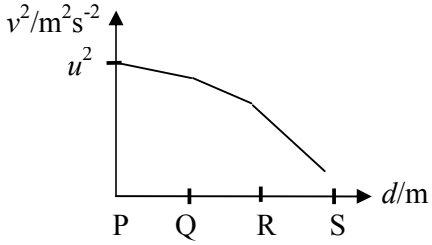
A



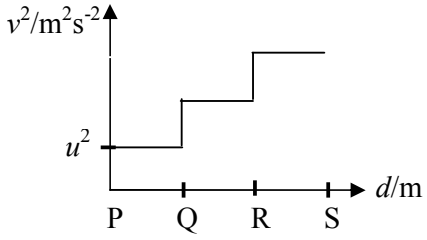
B



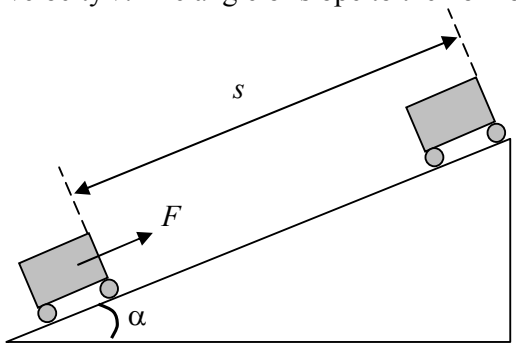
C



D



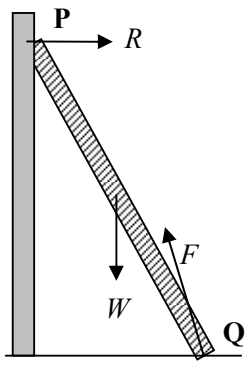
14 A constant force F, acting on a car of mass m, moves the car up the slope through a distance s at constant velocity v. The angle of slope to the horizontal is α.



Which expression gives the efficiency of the process?

A $\frac{mg\,s\sin\alpha}{Fv}$ **B** $\frac{mv}{Fs}$ **C** $\frac{mv^2}{2Fs}$ **D** $\frac{mg\sin\alpha}{F}$

15 The figure shows a uniform ladder **PQ** leaning in the equilibrium against a smooth, vertical wall. *R* is the normal reaction on the end **P** of the ladder, *W* the weight of the ladder and *F* the force exerted by the floor on the ladder at point **Q**.



What is the order of increasing magnitude of these three forces?

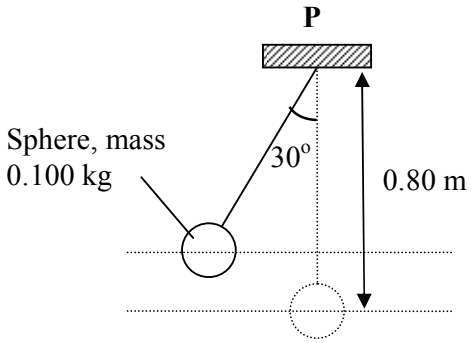
A *R, F, W*

B *R, W, F*

C *W, F, R*

D *F, R, W*

16 A small sphere of mass 0.100 kg is suspended by a light inextensible string from a fixed point **P**. The centre of the sphere is 0.80 m vertically below point **P**, as shown in the figure below.



The sphere is moved to one side, keeping the string taut, so that the string makes an angle of 30° with the vertical. What is the moment of the weight of the sphere about point P?

A 0.10 Nm **B** 0.39 Nm **C** 0.68 Nm **D** 0.79 Nm

17 Two wires X and Y of the same material are stretched by the same force without exceeding the elastic limit. X has twice the length and half the diameter of Y.

The ratio of $\frac{extension\ of\ X}{extension\ of\ Y}$ is

A ½ **B** 1 **C** 2 **D** 8

18 Which two substances are normally both crystalline?

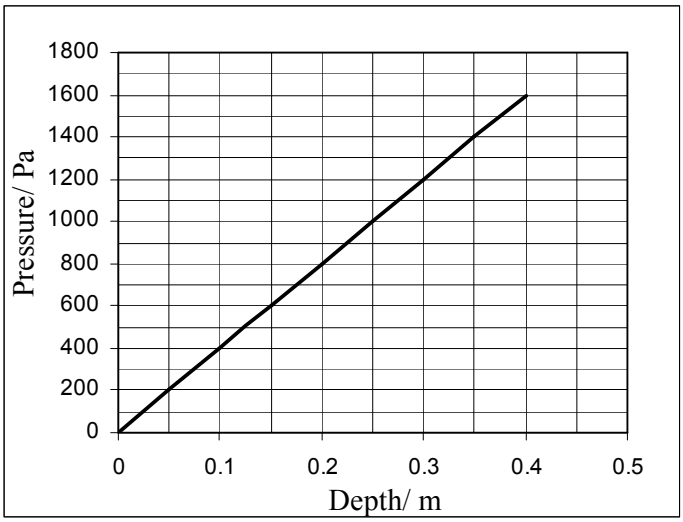
A diamond and rubber

B copper and glass

C diamond and glass

D copper and diamond

19 The graph shows how the pressure exerted by a liquid varies with depth below the surface.



What is the density of the liquid?

A 200 kg m^{-3} **B** 2000 kg m^{-3} **C** 400 kg m^{-3} **D** 4000 kg m^{-3}

20 In an experiment to demonstrate Brownian motion, smoke particles in a container are illuminated by a strong light source and observed through a microscope.
The particles are seen as small specks of light that are in motion.

What causes this motion?

A collisions between the smoke particles and air molecules

B collisions between the smoke particles and the walls of the container

C convection currents within the air as it is warmed by the light source

D kinetic energy gained by the smoke particles on absorption of light

21 A wave of frequency 400 Hz is travelling at a speed of 320 m s^{-1}.
Calculate the phase difference between two points 0.2 m apart on the wave.

A $\frac{\pi}{2}$ rad

B π rad

C 2π rad

D 0 rad

22 The intensity I, of a wave is the average energy transferred per unit time per unit area perpendicular to the direction of the wave propagation.

What is the relationship between the intensity I, and the amplitude A, of the wave given that k is a constant?

A $I = kA$

B $I = kA^2$

C $I = k/A$

D $I = k/A^2$

23 Which of the statements about stationary waves is incorrect?

A The waves are formed from two progressive waves.

B The waves are formed when the amplitudes of the waves are the same.

C The waves are formed when the progressive waves are reflected.

D The amplitudes at the nodes are the maximum.

24 Progressive waves of frequency 300 Hz are superimposed to produce a system of stationary waves in which adjacent nodes are 1.5 m apart.

What is the speed of the progressive waves?

A 100 ms^{-1}

B 200 ms^{-1}

C 450 ms^{-1}

D 900 ms^{-1}

25 When the light from two lamps falls on a screen, no interference pattern is obtained. Why is this so?

A The lamps are not point sources.

B The lamps emit light of different amplitudes.

C The light from the lamps is white.

D The light from the lamps is not coherent.

26 Which of the below statements is ***not true*** for the fringe spacing ***x***, in a Young's double-slit arrangement?

A increasing the wavelength increases ***x***

B increasing the double-slit separation increases ***x***

C increasing the distance between the double-slit and screen increases ***x***

D decreasing the frequency increases ***x***

27 A narrow beam of monochromatic light is incident normally on a diffraction grating and the 3rd order diffracted beams are formed at angles of 45° to the original direction.
What is the highest order of diffracted beam produced by the grating?

A 2

B 3

C 4

D 5

28 The *electric field strength* at a point is defined as the

A potential voltage per unit charge placed at that point.

B electric force per unit charge placed at that point.

C electric force per unit positive charge placed at that point.

D electric force per unit negative charge placed at that point.

29 What is the force, if any, experienced by a proton when it is in a uniform electric field strength of 2.7×10^{5} N C^{-1} ?

A 4.3×10^{-14} N

B 8.6×10^{-14} N

C 5.9×10^{-25} N

D 0 N i.e. no force

30 Two horizontal plates are set a distance 12 mm apart in a vacuum. The top plate is at a potential of positive 300 V and the bottom plate is at a potential of negative 300 V. At a point mid-way between the plates, the field is uniform. Calculate the magnitude of the electric field strength at this point.

A 0 N C^{-1}

B 60 N C^{-1}

C 5.0×10^{4} N A^{-1}

D 5.0×10^{4} N C^{-1}

31 Given that there is a current of 150 μA in the vacuum between the cathode and the anode of a cathode ray tube, calculate the number of electrons emitted per second from the cathode.

A 1.6×10^{-19} s^{-1}

B 9.4×10^{14} s^{-1}

C 1.6×10^{19} s^{-1}

D 9.4×10^{19} s^{-1}

32 A 100 kW generator supplies power at a potential difference of 10 kV through cables of total resistance 5 Ω. Calculate the power dissipated in the cables.

A 50 W

B 150 W

C 500 W

D 600 W

33 A light emitting diode (LED) is connected in series with a resistor to a 5.0 V power supply. Calculate the resistance of the series resistor required to give a current in the LED of 12 mA, with a voltage across it (LED) of 2.0 V.

A 170 Ω

B 250 Ω

C 420 Ω

D 580 Ω

34 The overhead wire used to supply power to a factory is made of copper of resistivity 1.72×10^{-8} Ω m, and has a cross-sectional area of 5.00×10^{-5} m^2.
Calculate the resistance of one kilometer length of the wire.

A 0.344×10^{-3} Ω

B 0.344 Ω

C 3.44 Ω

D 34.4 Ω

35 Which of the following statements is true of the electromotive force, *e.m.f.*?

A *e.m.f* is the energy per unit charge converted from electrical energy to other forms of energy.

B *e.m.f* is the energy per unit charge converted from other forms of energy to electrical energy.

C *e.m.f* is the potential difference across a resistor.

D *e.m.f* is the terminal potential difference across a battery.

36 A cell of *e.m.f.* 12 V and internal resistance 0.014 Ω delivers a current of 110 A when first connected to a particular motor. Calculate the resistance of the motor.

A 0.095 Ω

B 0.109 Ω

C 0.118 Ω

D 0.123 Ω

37 A bicycle has two lamps which are powered by a small dynamo having an internal resistance of 20 Ω. The lamps may be considered to have a constant resistance of 5.0 Ω each. At a particular speed, the dynamo generates an *e.m.f.* of 6.0 V.

What is the current in each of the lamps if the lamps are connected in parallel?

A 0.13 A

B 0.27 A

C 0.35 A

D 0.50 A

38 The diameter of an atom is typically in the order of ***A*** times the diameter of the nucleus. What is a possible value for ***A***?

A 10^3

B 10^5

C 10^7

D 10^9

39 Which of the statements is ***not true*** of isotopes?

A They have identical chemical properties.

B They have different nuclear properties.

C They have different physical properties.

D Mass, magnetic and radioactive tendencies are the same.

40 Which conclusion can be drawn from the results of the experiment showing the scattering of alpha particles by gold foil?

A electrons orbit the atomic nucleus in well defined paths

B nuclei of different isotopes contain different numbers of neutrons

C the atomic nucleus contains protons and neutrons

D the nucleus is very small compared to the size of the atom