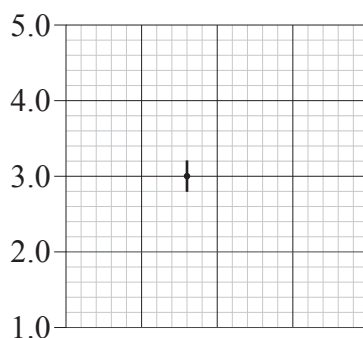


1. The length of a page of the examination paper is approximately 30 cm.

Which of the following gives the order of magnitude for the time taken for light to travel the length of the page?

- A. 10^{-7} s
- B. 10^{-8} s
- C. 10^{-9} s
- D. 10^{-10} s

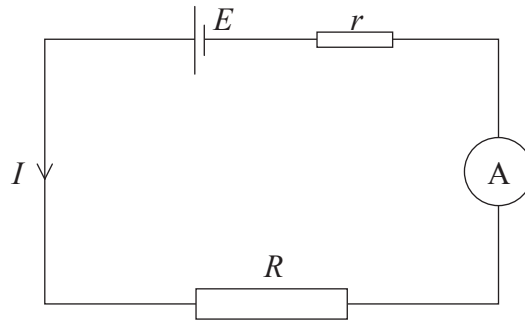
2. The grid below shows one data point and its associated error bar on a graph. The x -axis is not shown.



Which of the following is the correct statement of the y -value of the data point, with its uncertainty?

- A. 3 ± 0.2
- B. 3.0 ± 0.2
- C. 3.0 ± 0.20
- D. 3.00 ± 0.20

3. A resistor of resistance R is connected across the terminals of a battery of e.m.f. E and internal resistance r . The current I in the circuit is measured using an ammeter.



Which of the following assumptions is made in order that E , R , r and I are related by the equation below?

$$E = I(R + r)$$

- A. The resistor of resistance R obeys Ohm's law.
 - B. The resistance R is much greater than the internal resistance r .
 - C. The resistance of the ammeter is much less than the internal resistance r .
 - D. The resistance of the ammeter is much less than $(R + r)$.
4. The variation with speed v of the force F acting on an object is given by the expression

$$F = pv^2 + qv,$$

where p and q are constants.

What quantity should be plotted on the y -axis of a graph and what should be plotted on the x -axis in order to give a straight-line graph?

	y-axis	x-axis
A.	$\frac{F}{v}$	v
B.	$\frac{F}{v}$	v^2
C.	F	v
D.	F	v^2

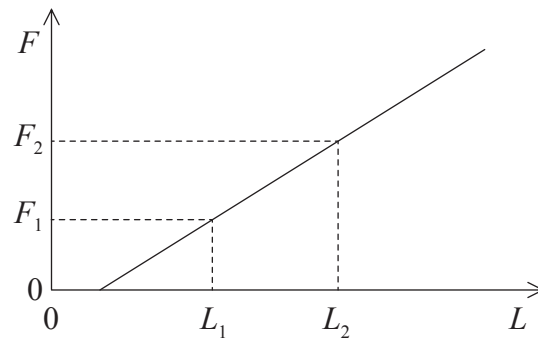
5. An object has initial speed u and acceleration a . After travelling a distance s , its final speed is v . The quantities u , v , a and s are related by the expression

$$v^2 = u^2 + 2as.$$

Which of the following includes the **two** conditions necessary for the equation to apply?

A.	a has constant direction	u and v are in the same direction
B.	a has constant direction	a , u and v are in the same direction
C.	a has constant magnitude	a has constant direction
D.	a has constant magnitude	u and v are in the same direction

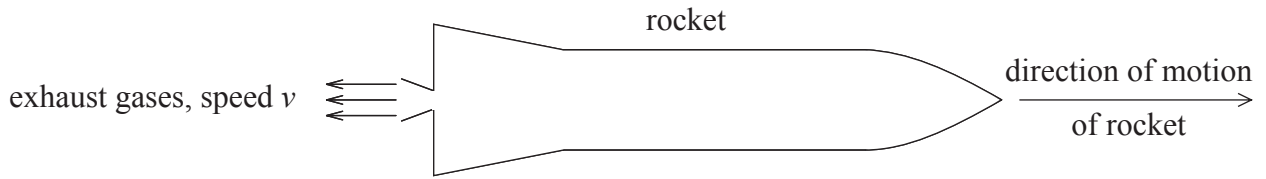
6. The graph below shows the variation with load F of the length L of a spring.



Which of the following expressions gives the force per unit extension (the spring constant) of the spring?

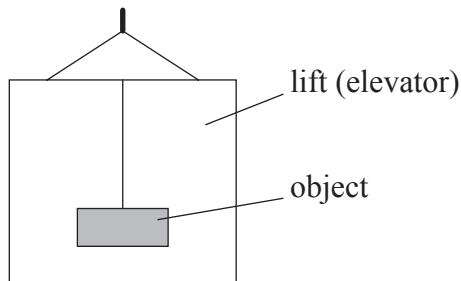
- A. $\frac{F_1}{L_1}$
- B. $\frac{F_2}{L_2}$
- C. $\frac{(F_2 - F_1)}{L_2}$
- D. $\frac{(F_2 - F_1)}{(L_2 - L_1)}$

7. A rocket is moving through space. The rocket engine ejects a mass m of exhaust gases in time t . The speed of the exhaust gases, relative to the rocket, is v as shown below.



Which of the following expressions is the magnitude of the force exerted on the rocket by the exhaust gases?

- A. mv
 - B. mv^2
 - C. mvt
 - D. $\frac{mv}{t}$
8. An object is suspended from the roof of a lift (elevator) as shown below.

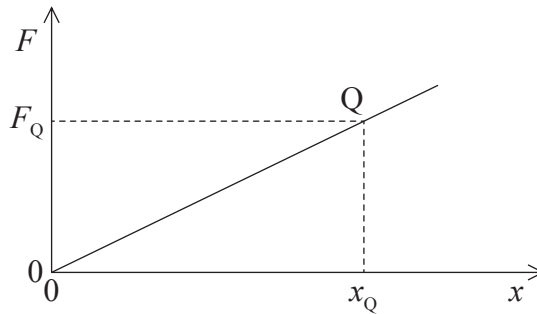


When the lift is moving upwards at **constant speed**, the weight of the object is W and its mass is M .

Which of the following correctly gives the mass and the weight of the object as the lift is **accelerating upwards**?

	Mass	Weight
A.	M	W
B.	M	greater than W
C.	greater than M	W
D.	greater than M	greater than W

9. The graph below shows the variation with displacement x of the force F acting on an object. The force F always acts in the same direction as the displacement.

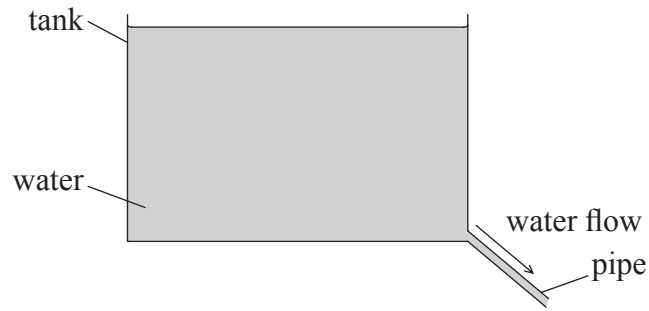


At point Q , the displacement is x_Q and the force is F_Q .

Which of the following gives the work done by the force on the body as the displacement increases from zero to x_Q and then returns to zero?

- A. Zero
- B. $\frac{1}{2}F_Qx_Q$
- C. F_Qx_Q
- D. $2F_Qx_Q$

10. Water flows out from a tank down a pipe, as shown below.



The pipe is always full of water.

Which of the following gives the change in the kinetic energy and in the gravitational potential energy of the water as the water flows down the pipe?

	kinetic energy	gravitational potential energy
A.	constant	decreases
B.	constant	increases
C.	increases	decreases
D.	increases	increases

11. Engine X is stated to be more **powerful** than engine Y.

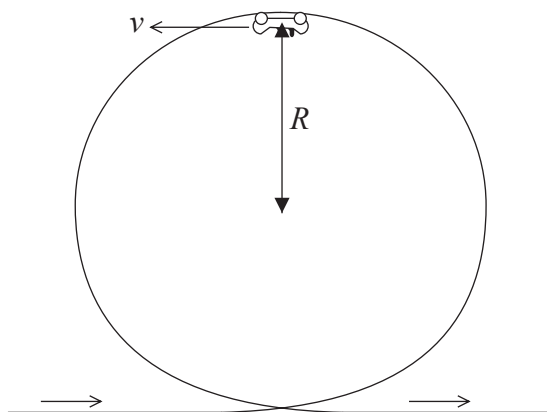
Which of the following is the correct comparison of the engines?

- A. Engine X produces a larger force than engine Y.
- B. Engine X produces more useful energy than engine Y.
- C. Engine X produces more useful energy per unit time than engine Y.
- D. Engine X produces more power for a longer time than engine Y.

12. A particle is moving around the circumference of a horizontal circle of radius r with constant speed v .

Which of the following is the acceleration of the particle?

- A. $\frac{v^2}{r}$ towards the centre of the circle
- B. $\frac{v^2}{r}$ away from the centre of the circle
- C. v^2r towards the centre of the circle
- D. v^2r away from the centre of the circle
13. In a fairground ride, a car of mass M travels on rails around a vertical loop of effective radius R . At the top of the loop, the speed of the car is v . The car stays in contact with the rails, as shown below.



The acceleration of free fall is g .

Which of the following is the correct expression for the force that the rails exert on the car?

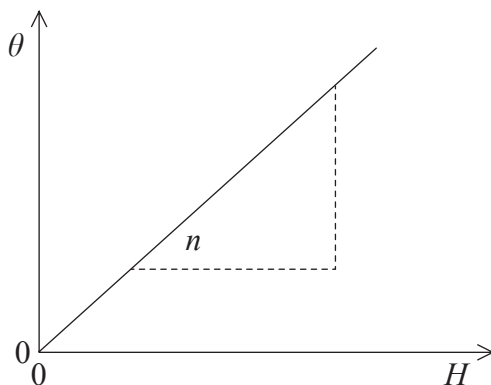
- A. $\frac{Mv^2}{R} - Mg$
- B. $\frac{Mv^2}{R}$
- C. Mg
- D. $\frac{Mv^2}{R} + Mg$

14. The length of the mercury column in a thermometer is L_{100} at 100°C and L_0 at 0°C .

Which of the following gives the temperature when the length of the mercury column is L_T ?

- A. $\frac{L_T}{L_{100}} \times 100^\circ\text{C}$
- B. $\frac{L_T}{(L_{100} - L_0)} \times 100^\circ\text{C}$
- C. $\frac{(L_{100} - L_T)}{(L_{100} - L_0)} \times 100^\circ\text{C}$
- D. $\frac{(L_T - L_0)}{(L_{100} - L_0)} \times 100^\circ\text{C}$

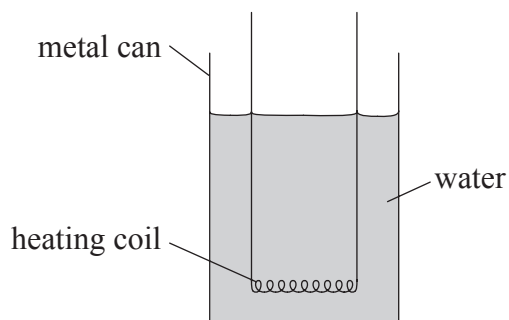
15. A metal block of mass M is heated. The graph shows the variation with thermal energy H supplied to the block of its temperature rise θ .



The gradient of the straight-line graph is n . The specific heat capacity of the metal is

- A. $\frac{1}{Mn}$.
- B. $\frac{1}{n}$.
- C. Mn .
- D. n .

16. A metal can containing water is heated using a heating coil as shown below.



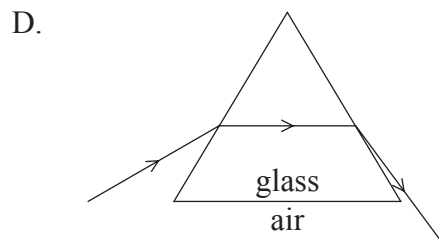
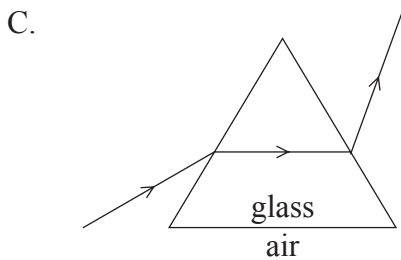
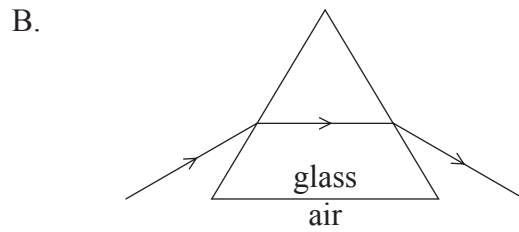
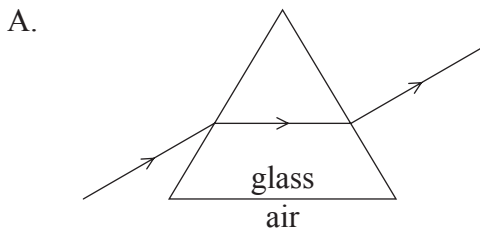
The water is boiling at a constant rate. The mass of water boiled away per unit time is M_1 for a heater power P_1 . When the heater power is increased to P_2 , the mass boiled away per unit time is M_2 . Heat losses to the atmosphere are **not** negligible.

Which of the following expressions gives the specific latent heat of vaporisation of the water?

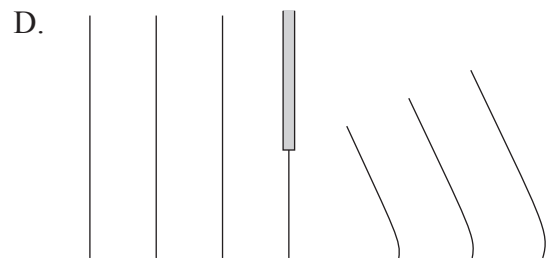
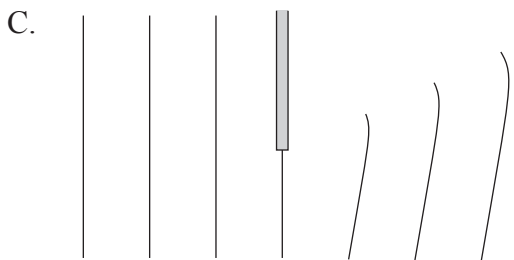
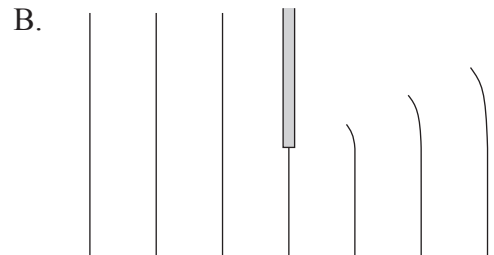
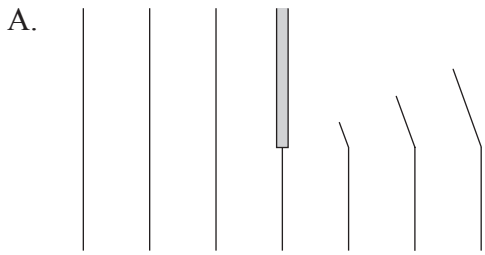
- A. $\frac{(P_2 + P_1)}{(M_2 + M_1)}$
- B. $\frac{(P_2 - P_1)}{(M_2 - M_1)}$
- C. $\frac{P_2}{M_2}$
- D. $\frac{P_1}{M_1}$
17. When the volume of a fixed mass of an ideal gas is reduced at constant temperature, the pressure of the gas increases.
- This pressure increase occurs because the atoms of the gas
- A. collide more frequently with each other.
- B. collide more frequently with the walls of the containing vessel.
- C. are spending more time in contact with the walls of the containing vessel.
- D. are moving with a higher mean speed.

18. Which of the following best describes the wave speed of a progressive wave travelling through a medium?
- A. The maximum speed of the vibrating particles of the medium
 - B. The average speed of the vibrating particles of the medium
 - C. The speed of the medium through which the wave travels
 - D. The speed of transfer of energy through the medium

19. Which of the following diagrams best shows the path of a ray of monochromatic light through a glass prism in air?

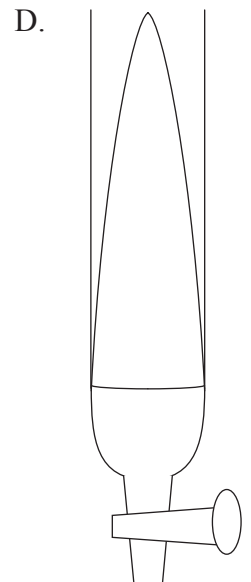
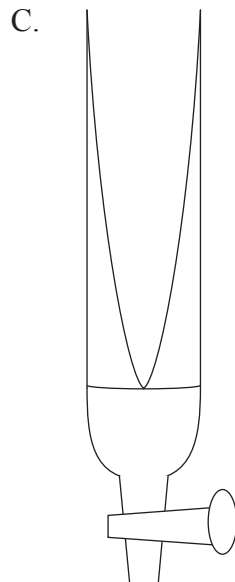
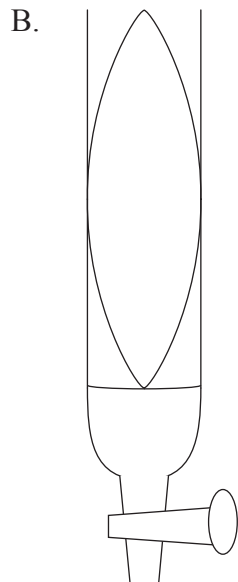
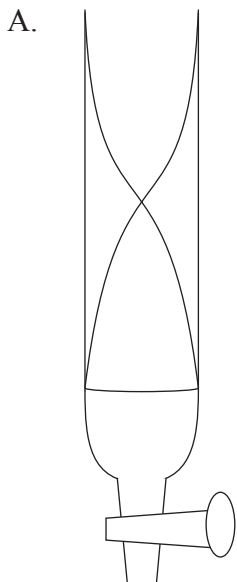


20. Plane parallel wavefronts are incident on an obstacle. Which of the following diagrams best shows the diffraction of the waves around the obstacle?

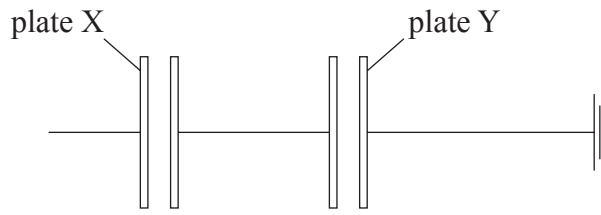


21. A vibrating tuning fork is held above the top of a tube that is filled with water. The water gradually runs out of the tube until a maximum loudness of sound is heard.

Which of the following best shows the standing wave pattern set up in the tube at this position?



22. Two pairs of uncharged parallel plates are placed in a vacuum and are connected as shown.



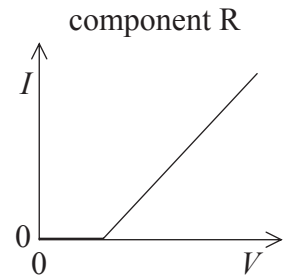
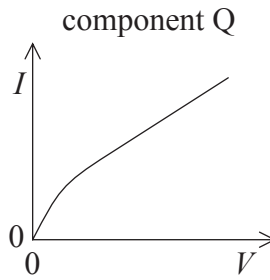
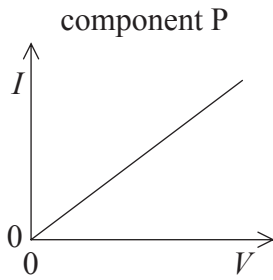
A negative charge of magnitude q is placed on plate X. Plate Y is connected to earth. Which **one** of the following diagrams shows the distribution of charge on the plates?

- A. B.
- C. D.

23. Which of the following is the correct value of the electronvolt, measured in SI Units?

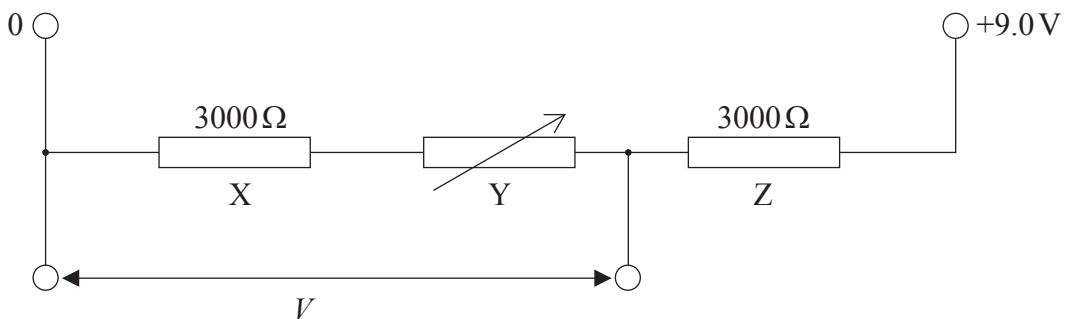
- A. $1.6 \times 10^{-19} \text{ N}$
 B. $1.6 \times 10^{-19} \text{ J}$
 C. $9.1 \times 10^{-31} \text{ N}$
 D. $9.1 \times 10^{-31} \text{ J}$

24. The graphs below are the current-voltage (I - V) characteristics of three electrical components P, Q and R.



Which component(s) has (have) constant resistance?

- A. P only
 - B. R only
 - C. P and Q only
 - D. P and R only
25. In the circuit below, resistors X, Y and Z are connected in series with a 9.0 V supply.



Resistors X and Z are fixed resistors of resistance $3000\ \Omega$. The resistance of resistor Y may be varied between zero and $3000\ \Omega$.

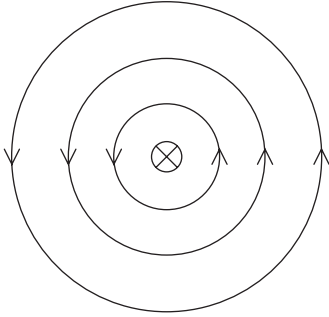
Which of the following gives the maximum range of potential difference V across the resistors X and Y?

- A. 0 to 6.0 V
- B. 3.0 V to 6.0 V
- C. 4.5 V to 6.0 V
- D. 4.5 V to 9.0 V

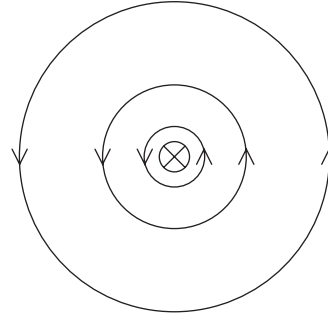
26. A long, straight current-carrying wire is placed normal to the plane of the page. The current in the wire is into the plane of the page.

Which of the following diagrams best represents the magnetic field around the wire?

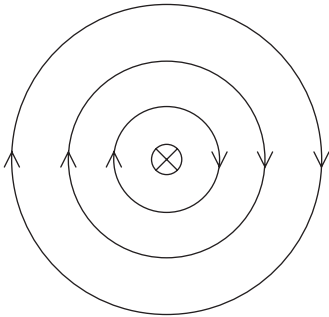
A.



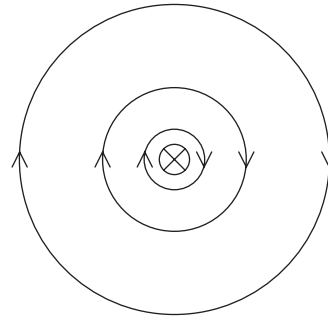
B.



C.



D.



27. A direct current (dc) motor is connected to a battery by means of two leads. What is the function of the commutator of the motor?

- A. To allow the motor to produce a uniform turning effect.
- B. To prevent too large a current in the coil of the motor.
- C. To reverse the direction of current in the leads to the motor.
- D. To reverse the direction of current in the coil of the motor.

28. Which of the following provides evidence for the existence of atomic energy levels?

- A. The absorption line spectra of gases
- B. The existence of isotopes of elements
- C. Energy release during fission reactions
- D. The scattering of α -particles by a thin metal film

29. Which of the following statements best describes the **random** nature of radioactive decay?
- A. The decaying nucleus emits either an α -particle, or a β -particle or a γ -ray photon.
 - B. The type of radiation emitted by the decaying nucleus cannot be predicted.
 - C. The time at which a particular nucleus will decay cannot be predicted.
 - D. The decay of a nucleus is unaffected by environmental conditions.

30. The graph below illustrates the variation with nucleon number (mass number) N of the binding energy per nucleon E of nuclei.

Which of the labelled nuclei is the most stable?

