

CTG 2.....

Data

speed of light in free space,	c	=	$3.00 \times 10^8 \text{ m s}^{-1}$
elementary charge,	e	=	$1.60 \times 10^{-19} \text{ C}$
the Planck constant,	h	=	$6.63 \times 10^{-34} \text{ J s}$
unified atomic mass constant,	u	=	$1.66 \times 10^{-27} \text{ kg}$
rest mass of electron,	m_e	=	$9.11 \times 10^{-31} \text{ kg}$
rest mass of proton,	m_p	=	$1.67 \times 10^{-27} \text{ kg}$
acceleration of free fall,	g	=	9.81 m s^{-2}

Formulae

uniformly accelerated motion,	s	=	$ut + \frac{1}{2}at^2$
	v^2	=	$u^2 + 2as$
work done on/by a gas,	W	=	$p\Delta V$
hydrostatic pressure,	p	=	$\rho g h$
resistors in series,	R	=	$R_1 + R_2 + \dots$
resistors in parallel,	$\frac{1}{R}$	=	$\frac{1}{R_1} + \frac{1}{R_2} + \dots$

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

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

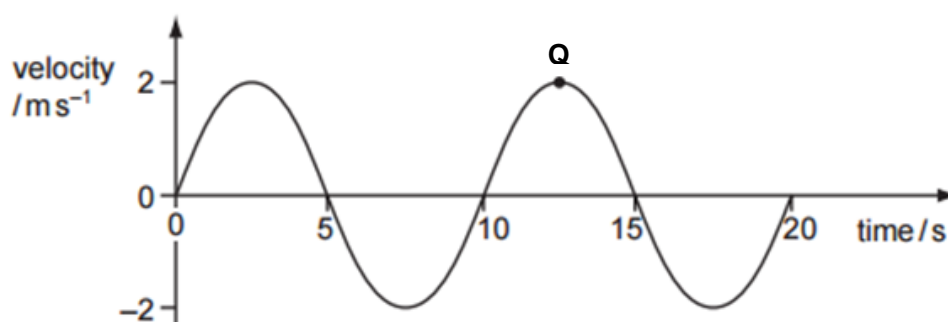
2 A student takes 6 readings of the diameter of a rod. The measurements are recorded as 5.9 mm, 6.0 mm, 6.1 mm, 5.8 mm, 6.0 mm and 6.2 mm.

The actual diameter of the rod is 5.0 mm. Which of the following best describes the errors in the readings?

- A Low random error and high systematic error
- B Low random error and low systematic error
- C High random error and high systematic error
- D High random error and low systematic error

3 A particle moves in the manner shown by the velocity-time graph.

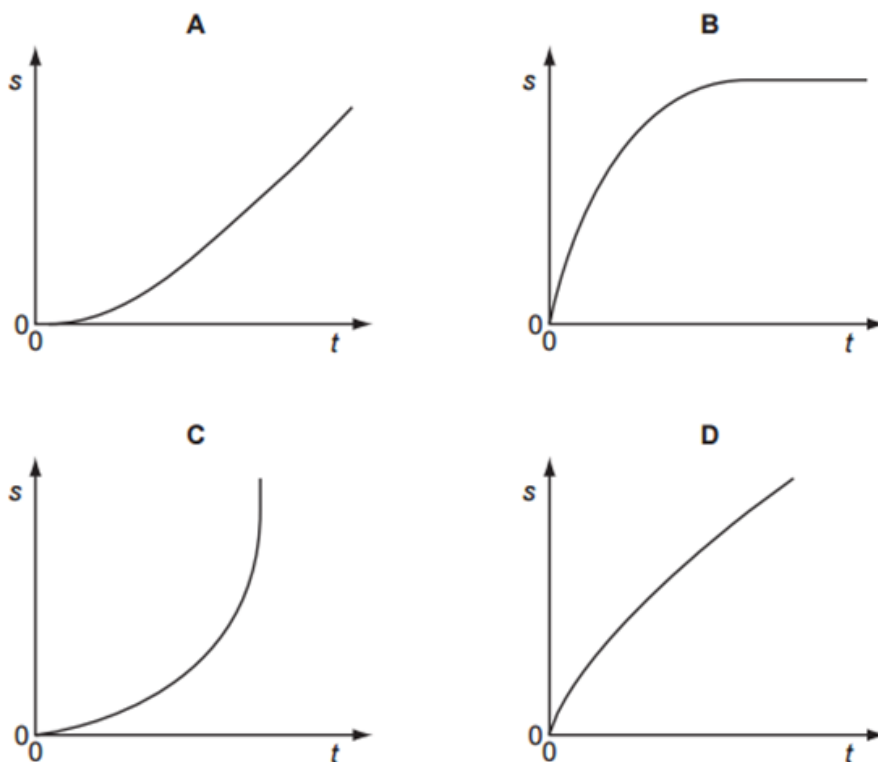
The displacement of the particle has been measured so that it is zero at $t = 0.0 \text{ s}$. Point Q refers to a point in its motion.



Which row of the table is correct?

	times for maximum displacement /s		acceleration at point Q / m s^{-2}
A	2.5	12.5	2.0
B	5.0	15.0	2.0
C	2.5	12.5	0.0
D	5.0	15.0	0.0

- 4 A tennis ball is released at rest from the top of a tall building and undergoes freefall. Which graph best represents the variation of distance s fallen with time t ? (Assume the effect of air resistance cannot be neglected).

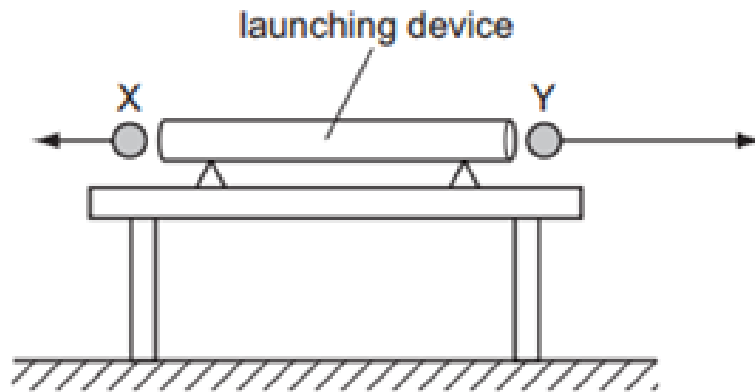


- 5 A bullet is fired horizontally with speed v from a rifle. For a short time t after leaving the rifle, the only force affecting its motion is gravity. The acceleration of free fall is g .

Which expression gives the value of $\frac{\text{the horizontal distance travelled in time } t}{\text{the vertical distance travelled in time } t}$?

- A $\frac{vt}{g}$ B $\frac{v}{gt}$ C $\frac{2vt}{g}$ D $\frac{2v}{gt}$

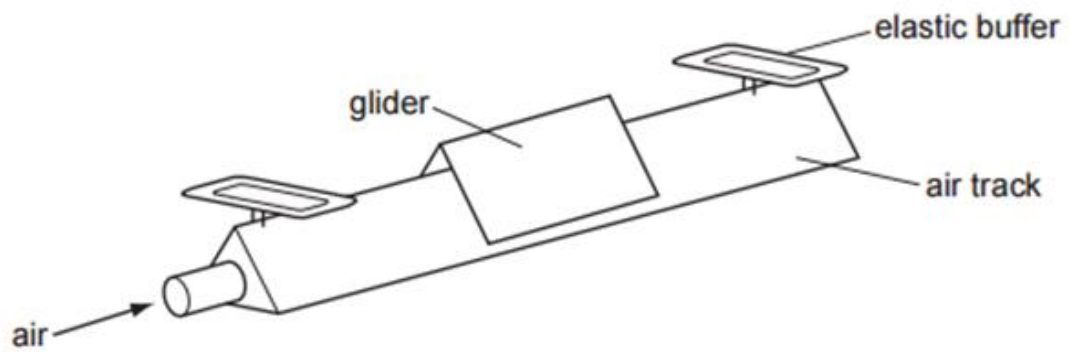
- 6 A double-ended launching device fires two identical steel balls **X** and **Y** at exactly the same time. The diagram shows the initial velocities of the balls. They are both launched horizontally, but **Y** has greater speed.



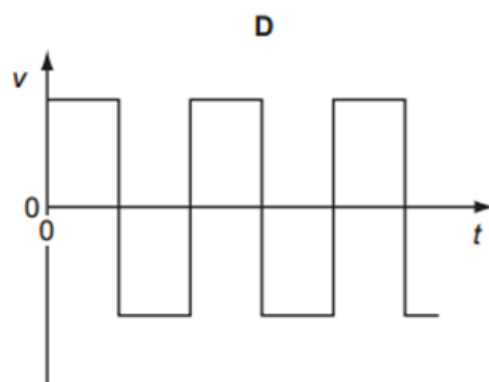
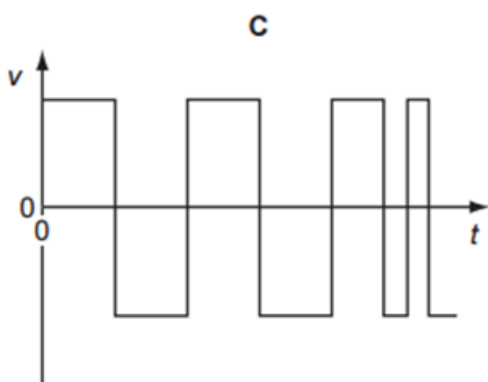
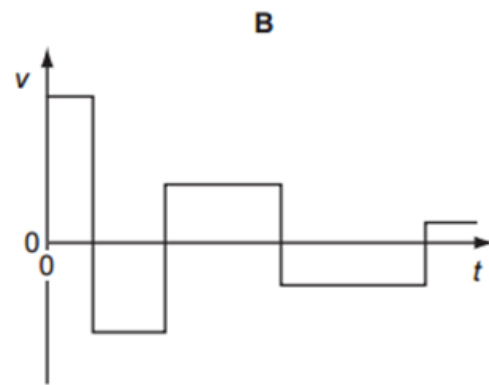
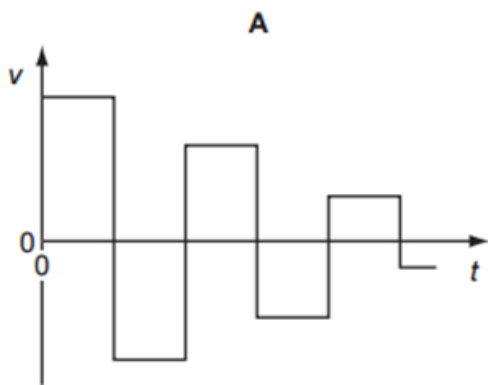
Which statement explains what an observer would see?

- A Both **X** and **Y** reach the ground simultaneously, because air resistance will cause both to have the same final speed.
- B Both **X** and **Y** reach ground simultaneously, because their gravitational accelerations are the same.
- C **X** reaches the ground before **Y**, because **X** lands nearer to the launcher.
- D **Y** reaches the ground before **X**, because **Y** has greater initial speed.

- 7 A small glider moves along a frictionless horizontal air track as shown below.



At each end of the air track, there is a perfectly elastic buffer. Assuming that the mass of glider is negligible as compared to the mass of elastic buffer, which graph represents the variation with time t of the velocity v of the glider as it moves between the two buffers?



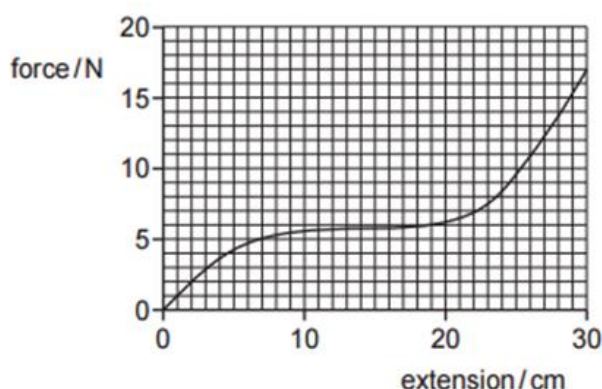
- 8 A group of students uses a small truck travelling over a frictionless surface to investigate the principle of conservation of momentum. Sand is dropped vertically into the truck as it passes **X**.



How does the velocity of the truck change when the sand is added to the truck at **X**?

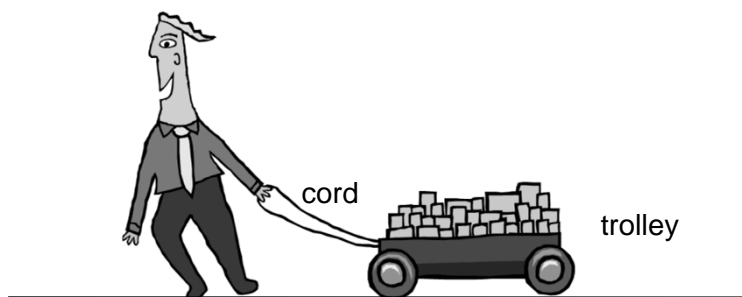
- A** Decreases
B Increases
C Stays the same
D Cannot be determined
- 9 An object of mass 20 kg is travelling at a constant speed of 6.0 m s^{-1} . It collides with an object of mass 12 kg travelling at a constant speed of 15 m s^{-1} in the opposite direction. The objects stick together. What is the speed of the objects immediately after the collision?
- A** 1.9 m s^{-1} **B** 9.0 m s^{-1} **C** 9.4 m s^{-1} **D** 21 m s^{-1}
- 10 A force F is applied to a freely moving object. At one instant of time, the object has velocity v and acceleration a . Which quantities must be in the same direction?
- A** a and v only
B a and F only
C v and F only
D v , F and a

- 11 A rubber band is stretched by hanging weights on it and the force-extension graph is plotted from the results.



What is the best estimate of the elastic potential energy stored in the rubber band when it is extended by 30 cm?

- A 2.0 J B 2.6 J C 5.1 J D 200 J
- 12 A person pulls a loaded trolley such that both move at constant velocity.

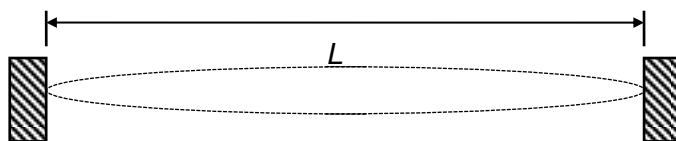


Which of the following statements about work done is correct?

- A Work done on the trolley by the cord is zero because the trolley is moving at constant velocity.
- B Work done on the person by the ground is positive.
- C Work done on the person by the cord is positive.
- D Work done on the trolley by the ground is positive.
- 13 An aircraft moving through air at velocity v experiences a resistive force F given by the expression $F = k v^2$, where k is a constant. What is the power required to keep the aircraft moving at this constant velocity?
- A $k v$ B $k v^2$ C $k v^3$ D $k v^4$

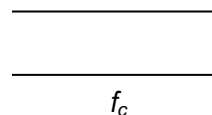
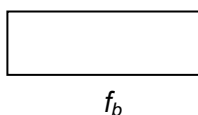
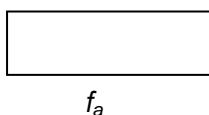
- 14** Wind powered generators have been known to operate at a 45 % efficiency. If such a generator generates 1000 MW of electrical power, what is the input power?
- A** 1000 MW **B** 1200 MW **C** 1450 MW **D** 2200 MW
- 15** A point source of sound emits energy uniformly in all directions at a constant rate and a detector placed 3.0 m from the source measures an intensity of 3.0 W m^{-2} . The power of the source is then doubled. What intensity would the detector measure if it is placed at a distance 5.0 m from the source?
- A** 4.3 W m^{-2} **B** 3.6 W m^{-2} **C** 2.5 W m^{-2} **D** 2.2 W m^{-2}
- 16** The principle of superposition applies only if
- A** the waves travel with the same speed.
- B** the sources of the waves are coherent.
- C** the waves have the same frequency.
- D** the waves are of the same kind.
- 17** When a two-slit arrangement was set up to produce interference fringes on a screen, using a monochromatic source of green light, the fringes were found to be too close together for convenient observation. It would be possible to increase the separation of the fringes by
- A** decreasing the distance between the slits and the screen.
- B** increasing the distance between the source and the slits.
- C** increasing the distance between the two slits.
- D** replacing the light source with a monochromatic source of red light.

- 18 A wire of length L is stretched between two supports and plucked. The speed of transverse waves on the wire is c .



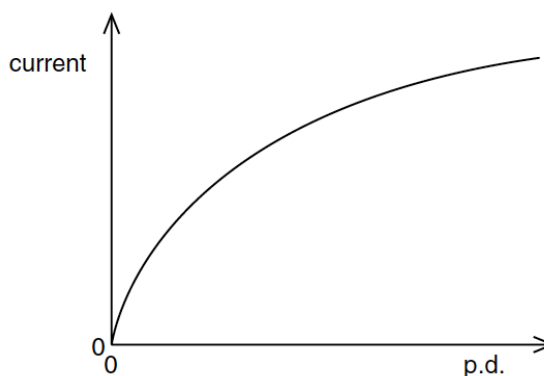
Which one of the following expressions, in which n is a positive integer values, will give the frequencies of all stationary waves which can form on the wire?

- A $\frac{nc}{L}$ B $\frac{nc}{2L}$ C $\frac{2nc}{L}$ D $\frac{(n+1)c}{2L}$
- 19 Three air filled pipes of equal length are shown below. The frequencies of the fundamental vibrations are f_a , f_b and f_c respectively.



What is the ratio of $f_a : f_b : f_c$?

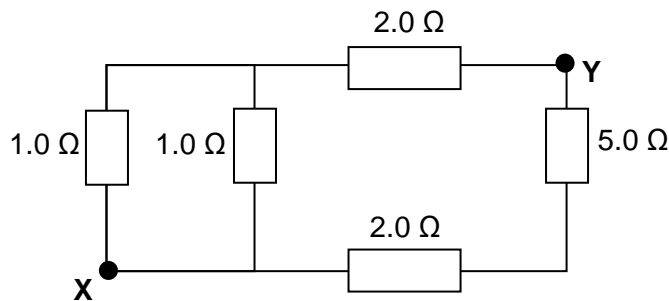
- A 1: 2: 1 B 1: 2: 3 C 2: 1: 2 D 3: 2: 1
- 20 The graph shows the variation with potential difference (p.d.) across a filament lamp of the current flowing through it.



Which statement best explains the shape of this graph?

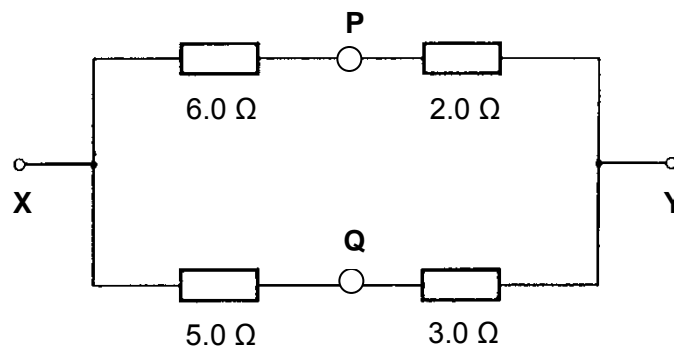
- A As the filament temperature rises, electrons can pass more easily through the filament.
- B It takes time for the filament to reach its working temperature.
- C The power output of the filament is proportional to the square of the current through it.
- D The resistance of the filament increases with a rise in temperature.

- 21 Which of the following statements regarding the variation of overall electrical resistivity of a thermistor with temperature is true?
- A Overall electrical resistivity increases with an increase in temperature because fewer electrons are available for conduction.
 - B Although scattering of electrons by lattice ions increases with temperature, overall electrical resistivity decreases due to significant increase in free electrons.
 - C Overall electrical resistivity increases due to an increase in the scattering of electrons by lattice ions with temperature, reducing the net drift velocity of electrons.
 - D Overall electrical resistivity can be increased by applying a greater potential difference across the thermistor.
- 22 Five resistors are connected as shown in the figure below.



What is the equivalent resistance between **X** and **Y**?

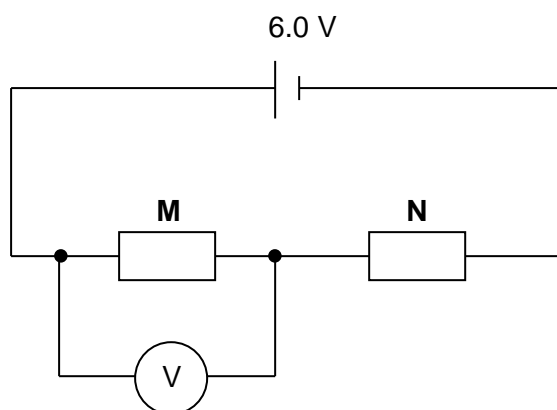
- A 0.47 Ω
 - B 0.68 Ω
 - C 1.45 Ω
 - D 1.84 Ω
- 23 In the circuit shown, a potential difference of 8.0 V is applied across **XY**. **X** is at a higher potential relative to **Y**.



What is the potential at **P** if **Q** is earthed?

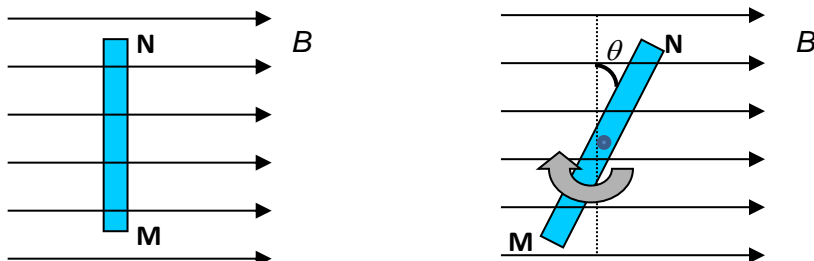
- A - 1.0 V
- B + 1.0 V
- C - 5.0 V
- D + 5.0 V

- 24** In the circuit shown below, resistors **M** and **N**, of resistances $2R$ and R respectively, are connected to a 6.0 V battery of negligible internal resistance. When a voltmeter is connected across **M**, it gives a reading of 3.0 V .



What is the reading of the voltmeter when it is connected across **N**?

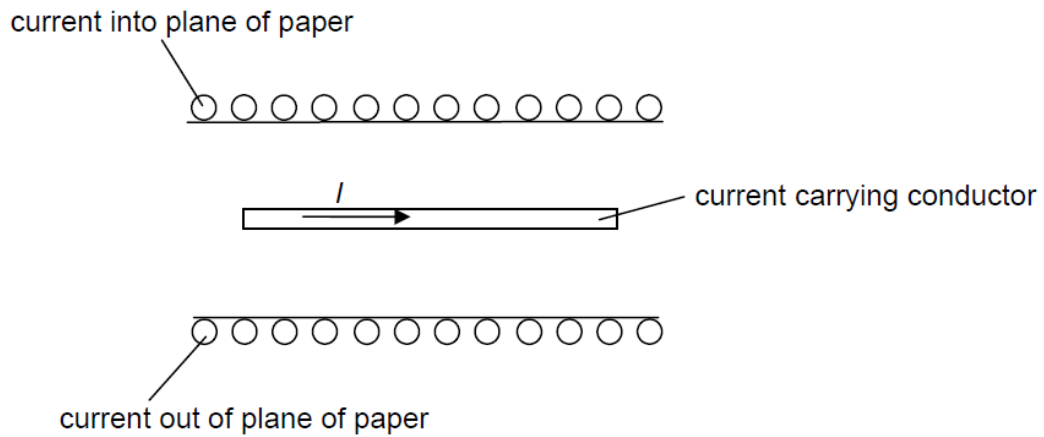
- A** 0.25 V **B** 1.5 V **C** 2.0 V **D** 4.0 V
- 25** A uniform straight conductor, with constant current flow from **M** to **N**, is initially placed perpendicular to a uniform magnetic field as shown in the diagram on the left below. This conductor is then rotated about an axis through its centre that is perpendicular to the magnetic field as shown in the diagram on the right below.



What would be the minimum angle of rotation θ required (in clockwise direction) if the induced force acting on the rod is to be reduced by 35% ?

- A** 32° **B** 41° **C** 49° **D** 58°

- 26 The figure below shows a cross-section through a solenoid.



What happens to the current carrying conductor when it is placed along the central axis of the solenoid?

- A The conductor moves upwards.
 - B The conductor moves downwards.
 - C The conductor moves in the direction out of the plane of paper.
 - D The conductor remains stationary.
- 27 A solid state pulsed laser has energy of 400 mJ per pulse. If its wavelength is 1.06×10^{-6} m, how many photons are in each pulse?
- A 6.12×10^{17}
 - B 2.13×10^{18}
 - C 3.12×10^{21}
 - D 2.11×10^{25}
- 28 Which of the following statements is true when photoelectric effect occurs?
- A The maximum speed with which electrons are emitted is proportional to the intensity of the incident light.
 - B The number of electrons emitted per second is proportional to the intensity of the incident light.
 - C The maximum energy of the emitted electrons increases with the wavelength of the incident light.
 - D The wavelength of the incident light must be longer than a certain threshold value.

- 29** An atom **X** is excited to an energy level E_2 from its ground state E_0 by collision with another atom. Which of the following statements must be true?
- A** The electrons in **X** lose energy just after the collision.
 - B** The atom **X** emits a radiation of energy $(E_2 - E_0)$.
 - C** The colliding atom loses energy to excite **X**.
 - D** All of the above.
- 30** What is the de Broglie wavelength of an electron which has a velocity of $3.25 \times 10^7 \text{ m s}^{-1}$?
- A** $7.00 \times 10^{-7} \text{ m}$
 - B** $4.46 \times 10^{-10} \text{ m}$
 - C** $2.24 \times 10^{-11} \text{ m}$
 - D** $1.28 \times 10^{-22} \text{ m}$

END OF PAPER