**Name:** _____ **Class:** _____

# JURONG PIONEER JUNIOR COLLEGE

## JC2 Preliminary Examination 2024

**PHYSICS** **8867/01**
**Higher 1** **17 September 2024**

Paper 1 Multiple Choice **1 hour**

Additional Material: Multiple Choice Answer Sheet

**READ THESE INSTRUCTIONS FIRST**

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your name, class and index number on the Answer Sheet in the spaces provided.

There are **thirty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

**Read the instructions on the Answer Sheet very carefully.**

Each correct answer will score one mark.
A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
The use of an approved scientific calculator is expected, where appropriate.

**Data**

| | |
|---|---|
| speed of light in free space | $c = 3.00 \times 10^8$ m s$^{-1}$ |
| elementary charge | $e = 1.60 \times 10^{-19}$ C |
| unified atomic mass constant | $u = 1.66 \times 10^{-27}$ kg |
| rest mass of electron | $m_e = 9.11 \times 10^{-31}$ kg |
| rest mass of proton | $m_p = 1.67 \times 10^{-27}$ kg |
| the Avogadro constant | $N_A = 6.02 \times 10^{23}$ mol$^{-1}$ |
| gravitational constant | $G = 6.67 \times 10^{-11}$ N m$^2$ kg$^{-2}$ |
| acceleration of free fall | $g = 9.81$ m s$^{-2}$ |

**Formulae**

| | |
|---|---|
| uniformly accelerated motion | $s = ut + \frac{1}{2}at^2$ |
| | $v^2 = u^2 + 2as$ |
| resistors in series | $R = R_1 + R_2 + ...$ |
| resistors in parallel | $1/R = 1/R_1 + 1/R_2 + ...$ |

**1** What is a reasonable estimate of the cross-sectional area of the wire in a paper clip?

**A** $1 \times 10^{-3}$ m$^2$

**B** $8 \times 10^{-5}$ m$^2$

**C** $8 \times 10^{-7}$ m$^2$

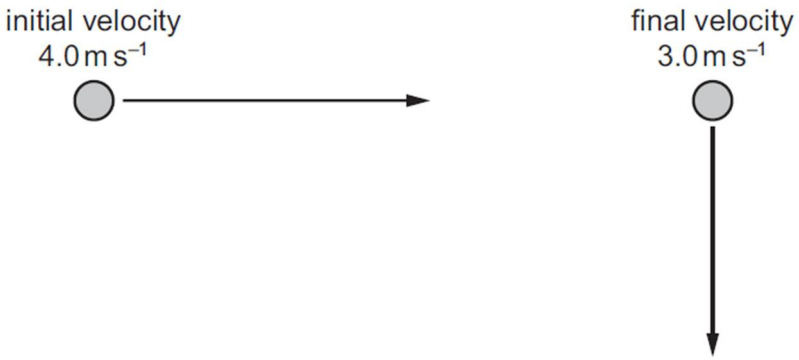
**D** $1 \times 10^{-9}$ m$^2$

**2** The table shows the abbreviations for multiples and sub-multiples and their corresponding powers of ten.

What power of ten is **not** stated correctly?

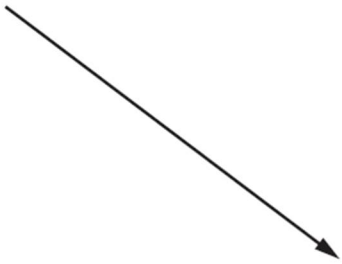
| | | |
|---|---|---|
| **A** | pico | $10^{-12}$ |
| **B** | nano | $10^{-6}$ |
| **C** | mega | $10^{6}$ |
| **D** | tera | $10^{12}$ |

**3** An object is moving with an initial velocity of 4.0 m $s^{-1}$ to the right. The velocity of the object changes so that its final velocity is 3.0 m $s^{-1}$ downwards, as shown.

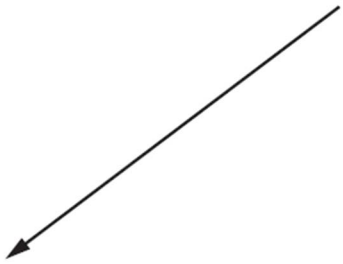



Which arrow represents the change in velocity of the object?

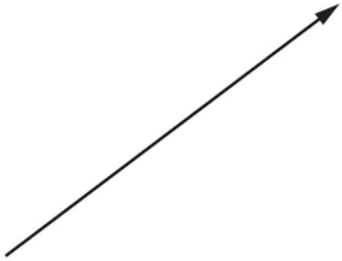
**A**



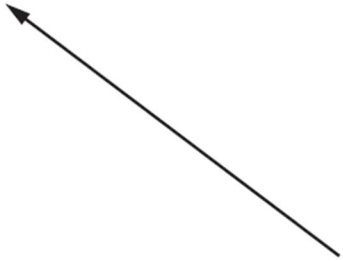
**B**



**C**



**D**



**4** A photographer wishes to check the time for which the shutter on a camera stays open when a photograph is being taken. It is found that before the shutter opens, the ball falls 2.50 m from rest. During the time that the shutter remains open, the ball falls a further 0.12 m.

What is the time that the shutter remains open?

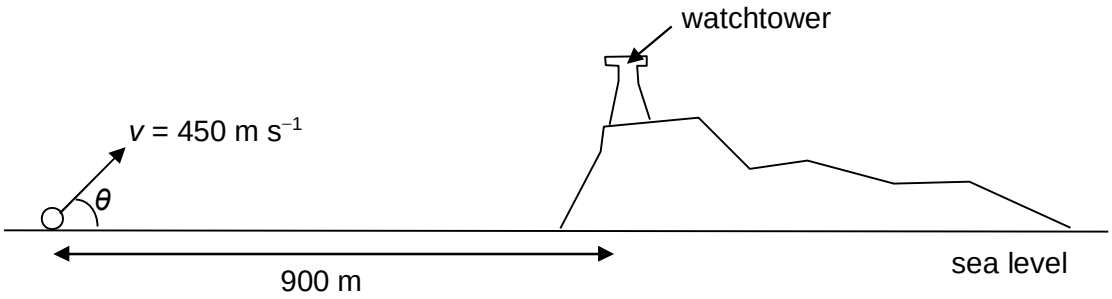
**A** 0.017 s

**B** 0.156 s

**C** 0.714 s

**D** 0.731 s

**5** A cannon ball is fired at a speed of 450 m $s^{-1}$ at sea level at an angle of $\theta = 31.6°$ with respect to the horizontal as shown below. The cannon ball hits the top of a watchtower located 900 m away.




Ignoring air resistance, how high is the top of the watchtower above sea level?

**A** 527 m

**B** 542 m

**C** 580 m

**D** 1390 m

**6** Suppose you are carrying a ball and running on a level road, and wish to throw the ball up while running and catch it as it comes down.

Ignoring air resistance, which of the following will allow you to achieve the above act?

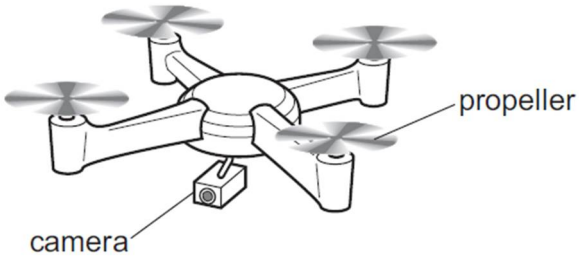
**A** Throw the ball at an angle of about 45° above the horizontal and maintain the same speed of running.

**B** Throw the ball at an angle of about 45° above the horizontal but run slower in order to catch it.

**C** Throw the ball vertically up in the air and maintain the same speed of running.

**D** Throw the ball vertically up in the air and stop immediately in your path to catch it.

**7** A camera drone of mass 1.2 kg hovers at a fixed point above the ground. The drone has four propellers.




In a time of 1.0 s, each propeller pushes a mass of 0.40 kg of air vertically downwards. Assume that the air above the propellers is stationary.

What is the speed of the air leaving each propeller?

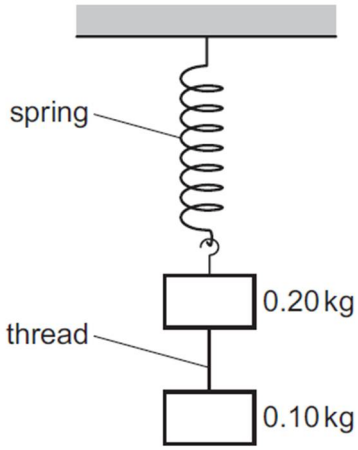
**A** 0.75 m $s^{-1}$

**B** 3.0 m $s^{-1}$

**C** 7.4 m $s^{-1}$

**D** 29 m $s^{-1}$

**8** A mass of 0.20 kg is suspended from the lower end of a light spring. A second mass of 0.10 kg is suspended from the first mass by a thread. The arrangement is allowed to come into static equilibrium and then the thread is cut.




Immediately after the thread is cut, what is the upward acceleration of the 0.20 kg mass?

**A** 4.9 m $s^{-2}$

**B** 6.5 m $s^{-2}$

**C** 9.8 m $s^{-2}$

**D** 15 m $s^{-2}$

**9** Two asteroids deep in space are involved in an inelastic collision.

Which of the quantities, kinetic energy and momentum, are conserved?

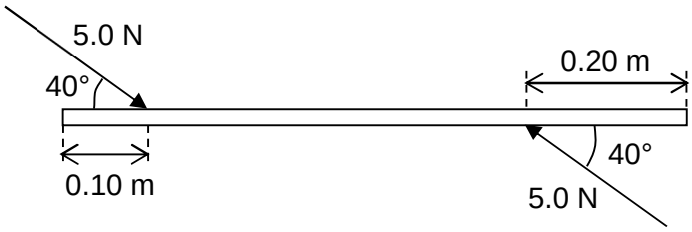
**A** Kinetic energy and momentum are both conserved.

**B** Kinetic energy is conserved but momentum is not conserved.

**C** Kinetic energy is not conserved and momentum is conserved.

**D** Neither kinetic energy nor momentum is conserved.

**10** Two forces of magnitude 5.0 N act on a plank of length 0.90 m. The forces are parallel and act in opposite directions as shown.




What is the torque of the couple?

**A** 1.9 N m

**B** 2.3 N m

**C** 2.9 N m

**D** 3.4 N m

**11** A wire that obeys Hooke's law is of length $x_1$ when it is in equilibrium under a tension $T_1$. Its length becomes $x_2$ when the tension is increased to $T_2$.

What is the extra energy stored in the wire as a result of this process?

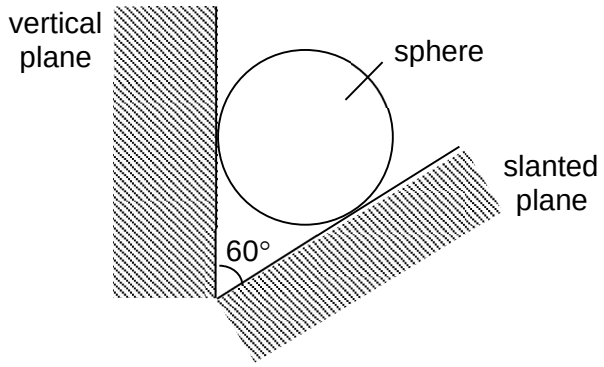
**A** $\frac{1}{2}(T_2 - T_1)(x_2 + x_1)$

**B** $\frac{1}{2}(T_2 + T_1)(x_2 - x_1)$

**C** $(T_2 + T_1)(x_2 - x_1)$

**D** $(T_2 - T_1)(x_2 + x_1)$

**12** A uniform sphere of weight 15 N is placed in between two smooth planes as shown.




What is the magnitude of the force exerted by the vertical plane on the sphere?

**A** 0 N

**B** 7.5 N

**C** 8.7 N

**D** 26 N

**13** A car of mass 800 kg travelling at $30\ \text{m s}^{-1}$ is brought to rest in 50 m.

What is the average retarding force acting on the car?

**A** 240 N

**B** 480 N

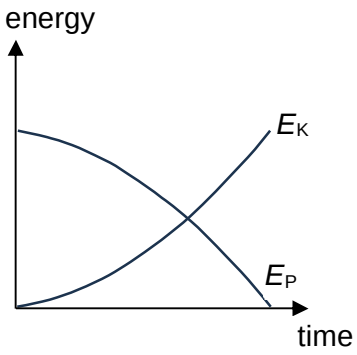
**C** 7200 N

**D** 7900 N

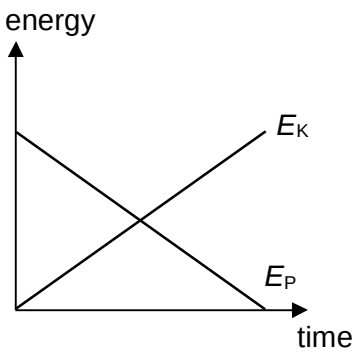
**14** An object is dropped from the top of a high building and falls freely to the ground.

Which graph best represents the variation with time of both its potential energy, $E_p$ and kinetic energy, $E_K$?

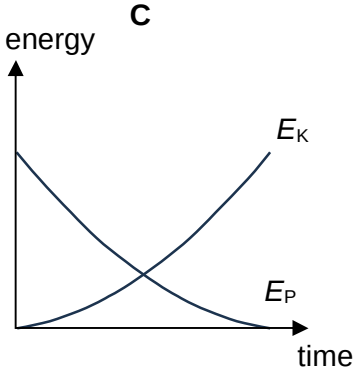
**A**



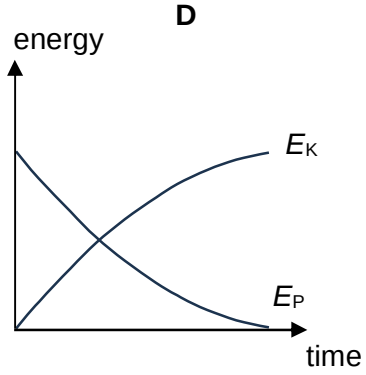

**B**




**C**




**D**




**15** A skier of mass 60 kg skies down a slope from rest and reaches the bottom with a speed of 20 m $s^{-1}$. The vertical height of the slope is 50 m and the effective distance the skier moves along the slope is 200 m.

What is the average frictional force acting on his ski if he skies down the slope under the influence of gravity only?

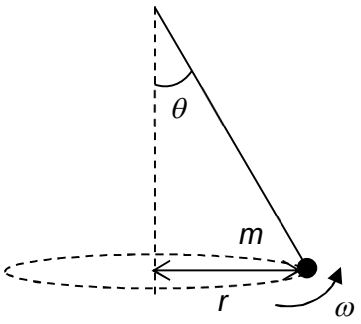
**A** 87 N

**B** 150 N

**C** 240 N

**D** 2100 N

**16** A bob of mass *m* hangs from a light string. The bob is set into motion so that it moves in a horizontal circle of radius *r* with angular velocity $\omega$. The string makes an angle of $\theta$ with the vertical as shown.




Which of the following is equal to tan $\theta$?

**A** $rg$

**B** $r\omega^2$

**C** $\frac{g}{r\omega^2}$

**D** $\frac{r\omega^2}{g}$

**17** An aircraft flies in a vertical circular path of radius 1000 m at a constant speed. The passengers feel weightless when the aircraft is at the top of the circular path.

What is the speed of the aircraft?

**A** 99 m $s^{-1}$

**B** 140 m $s^{-1}$

**C** 200 m $s^{-1}$

**D** 9800 m $s^{-1}$

**18** A block is resting on a weighing scale in a car. When the car is moving with constant velocity, the weighing scale gives a reading of $W$ in newtons. When the car drives over a hump of radius $r$, the weighing scale reads $\frac{W}{3}$ at the highest point of the hump.

What is the velocity of the car at this point?

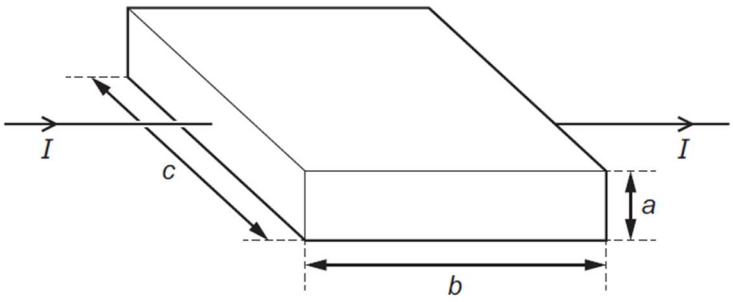
**A** $\sqrt{\frac{gr}{3}}$

**B** $\sqrt{\frac{2gr}{3}}$

**C** $\sqrt{gr}$

**D** $\sqrt{\frac{4gr}{3}}$

**19** The diagram shows a metal block.




A current $I$ passes through the block, with sides of length $a$, $b$ and $c$, as shown. The resistivity of the metal is $\rho$.

What is the resistance of the block?

**A** $\frac{\rho a}{bc}$

**B** $\frac{\rho b}{ac}$

**C** $\frac{\rho bc}{a}$

**D** $\frac{\rho ac}{b}$

**20** A semiconductor diode with the forward characteristic shown in Fig. 20.1 is connected in series with a variable, low voltage d.c. power supply, a meter of negligible internal resistance and a 50 Ω resistor as shown in Fig. 20.2.

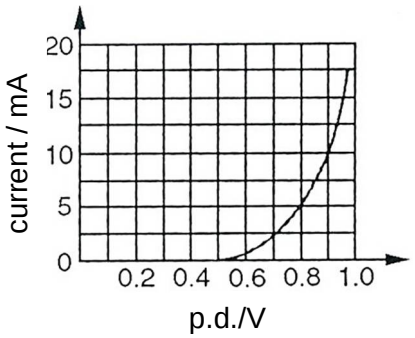



**Fig. 20.1**

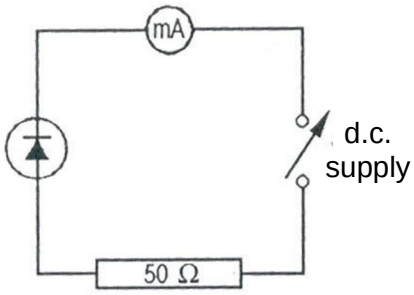



**Fig. 20.2**

What is the potential difference across the supply when the meter reads 5 mA?

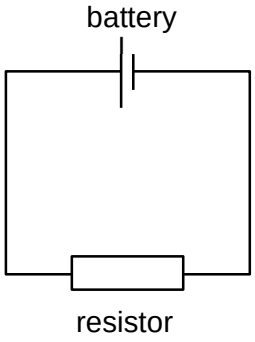
**A** 0.25 V

**B** 0.75 V

**C** 1.05 V

**D** 1.25 V

**21** A battery is connected in series with a resistor as shown. The electromotive force of the battery is *E*. Power *P* is dissipated in the resistor. Power *p* is dissipated in the battery itself.




What is the current in the circuit?

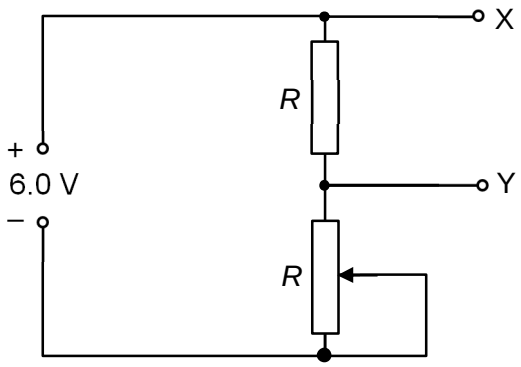
**A** $\frac{P}{E}$

**B** $\frac{P+p}{E}$

**C** $\frac{P}{E^2}$

**D** $\frac{P+p}{E^2}$

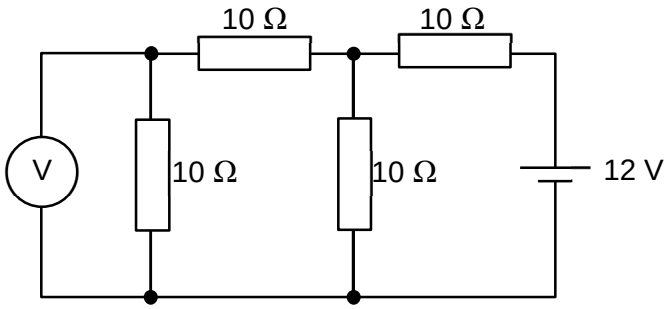
**22** A potential divider has a constant supply of 6.0 V as shown.




What is the maximum and minimum potential difference between X and Y?

| | maximum p.d / V | minimum p.d. / V |
|---|---|---|
| **A** | 3.0 | 0 |
| **B** | 6.0 | 0 |
| **C** | 3.0 | 3.0 |
| **D** | 6.0 | 3.0 |

**23** In the circuit shown, the voltmeter has infinite resistance.




What is the voltmeter reading?

**A** 2.4 V

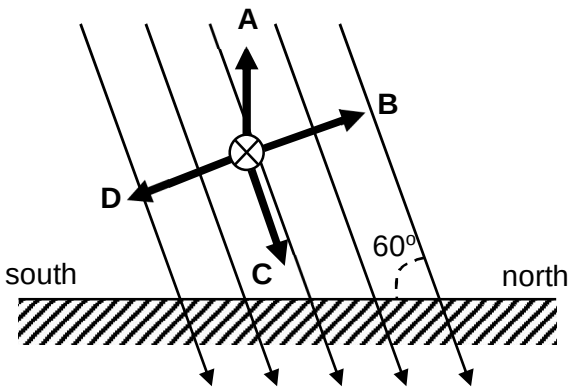
**B** 3.6 V

**C** 4.8 V

**D** 6.0 V

**24** A horizontal power cable carries a steady current in an east-to-west direction.

Which arrow shows the direction of the force on the cable caused by the Earth's magnetic field, in a region where this field is at 60° to the horizontal?




**25** What is the acceleration of a particle of mass $m$ and charge $2e$, moving with uniform speed $v$ at an angle of 30° to a magnetic field of flux density $B$?

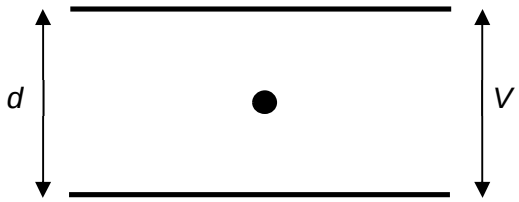
**A** $\frac{Bev}{m}$

**B** $\frac{2Bev}{m}$

**C** $\frac{Bev}{2m}$

**D** $\frac{Bev}{\sqrt{2}m}$

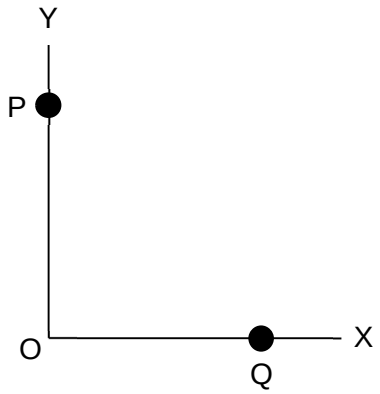
**26** A charged oil drop is balanced halfway between two horizontal plates separated by a distance *d* when a potential difference *V* is applied between the plates.




When *d* is doubled and *V* remains unchanged, what is the motion of the oil drop and its acceleration?

| | motion of oil drop | acceleration |
|---|---|---|
| **A** | upwards | *2g* |
| **B** | upwards | *0.5g* |
| **C** | downwards | *2g* |
| **D** | downwards | *0.5g* |

**27** The diagram shows a flat surface with lines OX and OY at right angles to each other.




Which current in a straight conductor will produce a magnetic field at O in the direction YO?

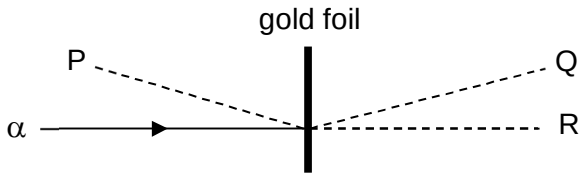
**A** at P into the plane of the diagram

**B** at P out of the plane of the diagram

**C** at Q into the plane of the diagram

**D** at Q out of the plane of the diagram

**28** In an experiment on $\alpha$-particle scattering, $\alpha$-particles are directed normally onto a gold foil and detectors are placed at positions P, Q and R as shown in the diagram below.




What is the distribution of $\alpha$-particles as recorded at P, Q and R respectively?

| | P | Q | R |
|---|---|---|---|
| **A** | none | none | all |
| **B** | most | some | none |
| **C** | most | some | few |
| **D** | few | some | most |

**29** Which equation correctly shows an $\alpha$-particle causing a nuclear reaction?

**A** ${}^{14}_{7}\mathrm{N} + {}^{4}_{2}\mathrm{He} \rightarrow {}^{17}_{8}\mathrm{O} + {}^{1}_{1}\mathrm{n}$

**B** ${}^{17}_{8}\mathrm{O} + {}^{4}_{2}\mathrm{He} \rightarrow {}^{20}_{9}\mathrm{F} + {}^{1}_{1}\mathrm{p}$

**C** ${}^{17}_{8}\mathrm{O} + {}^{0}_{-1}\mathrm{e} \rightarrow {}^{13}_{5}\mathrm{B} + {}^{4}_{2}\mathrm{He}$

**D** ${}^{14}_{7}\mathrm{N} + {}^{1}_{1}\mathrm{p} \rightarrow {}^{11}_{6}\mathrm{C} + {}^{4}_{2}\mathrm{He}$

**30** A sample of radioactive material consists of 200 g of nuclide P and 100 g of nuclide Q.

Nuclide P has a half-life of 2 days and nuclide Q has a half-life of 4 days.

What is the total mass of nuclides P and Q after 12 days?

**A** 3.1 g

**B** 12.5 g

**C** 15.6 g

**D** 18.8 g