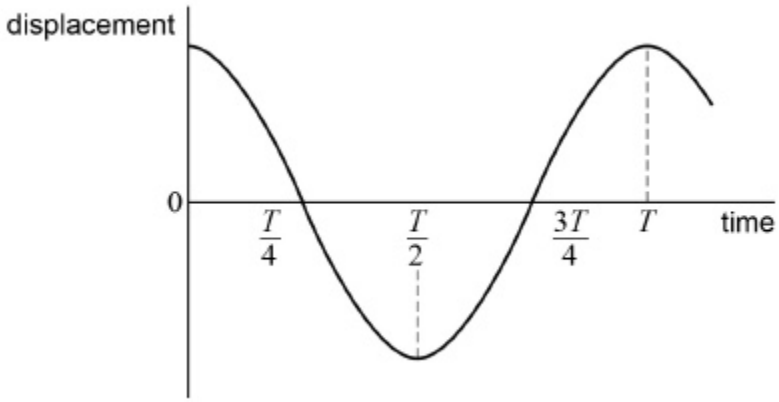
1 The graph shows how the displacement of a particle performing simple harmonic motion varies with time.



Which statement is **not** correct?

A The speed of the particle is a maximum at time $\frac{T}{4}$ ⬭

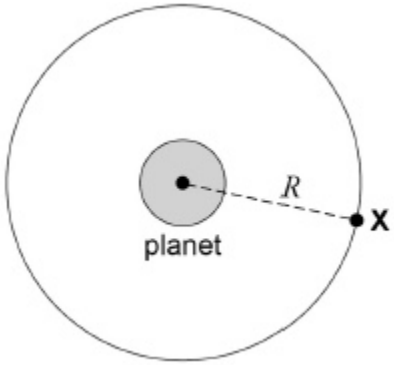
B The potential energy of the particle is zero at time $\frac{3T}{4}$ ⬭

C The acceleration of the particle is a maximum at time $\frac{T}{2}$ ⬭

D The restoring force acting on the particle is zero at time T ⬭

(Total 1 mark)

2 A satellite **X** of mass m is in a concentric circular orbit of radius R about a planet of mass M.



What is the kinetic energy of **X**?

A $\frac{GMm}{2R}$ ⬭

B $\frac{GMm}{R}$ ⬭

C $\frac{2GMm}{R}$ ⬭

D $\frac{4GMm}{R}$ ⬭

(Total 1 mark)

3 Cobalt-60 has a half-life of 5.27 years.

What is the total activity of 1.0 g of cobalt-60?

A 4.2×10^{13} Bq ⬭

B 2.2×10^{14} Bq ⬭

C 2.5×10^{15} Bq ⬭

D 1.3×10^{21} Bq ⬭

(Total 1 mark)

4 A pure sample of nuclide **X** containing N nuclei has an activity A.
The half-life of **X** is 6000 years.

A pure sample of nuclide **Y** containing $3N$ nuclei has an activity $6A$.

What is the half-life of nuclide **Y**?

A 1000 years ⬭

B 3000 years ⬭

C 12 000 years ⬭

D 18 000 years ⬭

(Total 1 mark)

5 Nobelium-259 has a half-life of 3500 s.

What is the decay constant of nobelium-259?

A $8.7 \times 10^{-5}\ s^{-1}$ ⬭

B $2.0 \times 10^{-4}\ s^{-1}$ ⬭

C $1.7 \times 10^{-2}\ s^{-1}$ ⬭

D $1.2 \times 10^{-2}\ s^{-1}$ ⬭

(Total 1 mark)

6 A Geiger counter is placed near a radioactive source and different materials are placed between the source and the Geiger counter.

The results of the tests are shown in the table.

Material	Count rate of Geiger counter / s^{-1}
None	1000
Paper	1000
Aluminium foil	250
Thick steel	50

What is the radiation emitted by the source?

A α only ⬭

B α and γ ⬭

C α and β ⬭

D β and γ ⬭

(Total 1 mark)

7 The Rutherford scattering experiment led to

A the discovery of the electron. ⬭

B the quark model of hadrons. ⬭

C the discovery of the nucleus. ⬭

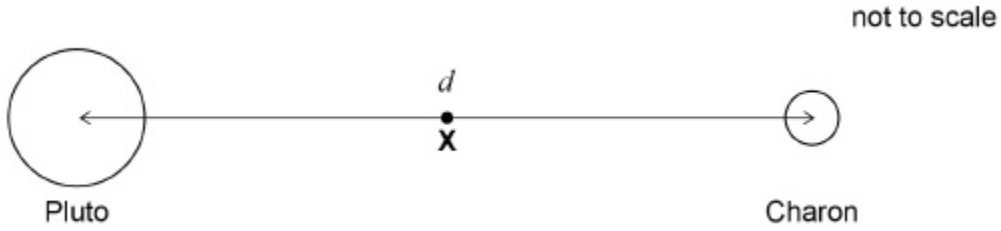
D evidence for wave-particle duality. ⬭

(Total 1 mark)

8 Charon is a moon of Pluto that has a mass equal to $\frac{1}{9}$ that of Pluto.

The distance between the centre of Pluto and the centre of Charon is *d*.

X is the point at which the resultant gravitational field due to Pluto and Charon is zero.



What is the distance of **X** from the centre of Pluto?

A $\frac{2}{9}d$ ⬭

B $\frac{2}{3}d$ ⬭

C $\frac{3}{4}d$ ⬭

D $\frac{8}{9}d$ ⬭

(Total 1 mark)

9 The distance between the Sun and Mars varies from 2.1×10^{11} m to 2.5×10^{11} m.
When Mars is closest to the Sun, the force of gravitational attraction between them is F.

What is the force of gravitational attraction between them when they are furthest apart?

A $0.71F$ ⬭

B $0.84F$ ⬭

C $1.2F$ ⬭

D $1.4F$ ⬭

(Total 1 mark)

10 What is the total internal energy of 2.4 mol of an ideal gas which has a temperature of 15 °C?

A 6.0×10^{-21} J ⬭

B 1.4×10^{-20} J ⬭

C 4.5×10^{2} J ⬭

D 8.6×10^{3} J ⬭

(Total 1 mark)

11 The composition of a carbon dioxide (CO_2) molecule is one atom of $^{12}_{6}C$ and two atoms of $^{16}_{8}O$.

What is the number of molecules of CO_2 in 2.2 kg of the gas?

A 1.0×10^{22} ⬭

B 3.0×10^{22} ⬭

C 3.0×10^{25} ⬭

D 4.7×10^{25} ⬭

(Total 1 mark)

12 A student measures the power of a microwave oven. He places 200 g of water at 23 °C into the microwave and heats it on full power for 1 minute. When he removes it, the temperature of the water is 79 °C.

The specific heat capacity of water is 4200 J kg^{-1} K^{-1}.

What is the average rate at which thermal energy is gained by the water?

A 780 W ⬭

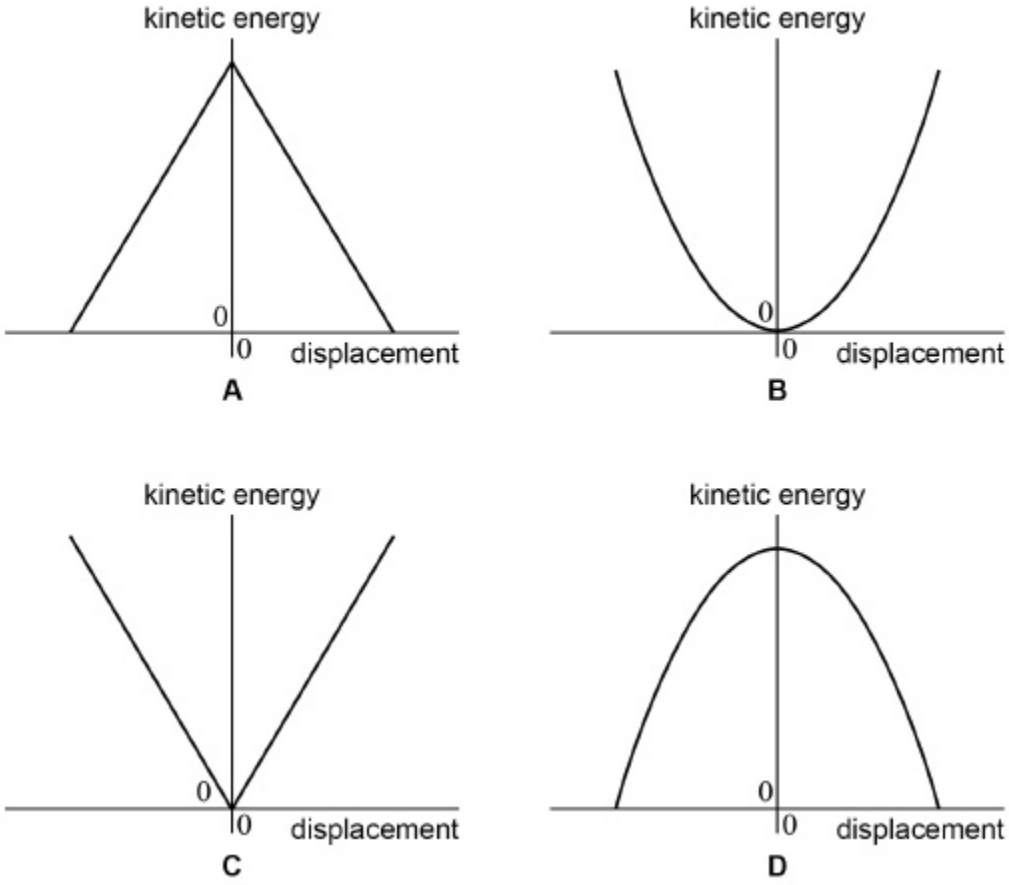
B 840 W ⬭

C 1.1 kW ⬭

D 4.6 kW ⬭

(Total 1 mark)

13 Which graph best shows how the kinetic energy of a simple pendulum varies with displacement from the equilibrium position?



A ⬭

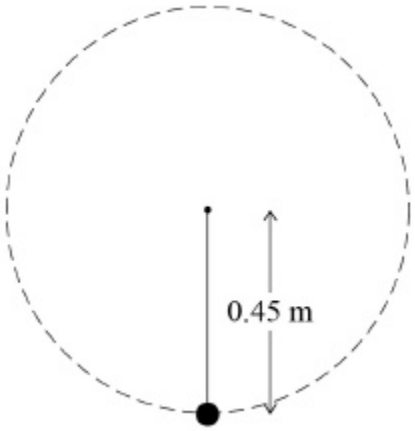
B ⬭

C ⬭

D ⬭

(Total 1 mark)

14 A bob of mass 0.50 kg is suspended from the end of a piece of string 0.45 m long.
The bob is rotated in a vertical circle at a constant rate of 120 revolutions per minute.



What is the tension in the string when the bob is at the bottom of the circle?

A 5.8 N ⬭

B 31 N ⬭

C 36 N ⬭

D 40 N ⬭

(Total 1 mark)

15 A continuous stream of water falls through a vertical distance of 100 m.
Assume no thermal energy is transferred to the surroundings.
The specific heat capacity of water is 4200 J kg^{-1} K^{-1}.

What is the temperature difference of the water between the top and bottom of the waterfall?

A 0.023 K ⬭

B 0.23 K ⬭

C 2.3 K ⬭

D 4.3 K ⬭

(Total 1 mark)