IB · DP · Physics

30 mins 30 questions

Practice Paper 1

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Total Marks /30

1 When a constant braking force is applied to a vehicle moving at speed v, the distance d moved by the vehicle as it comes to rest is given by the expression:

$$d = kv^2$$

In this equation, k is a constant.

When d is measured in metres and v is measured in metres per second, the constant has a value of k_1.

What is the value of the constant when the distance is measured in metres, and the speed is measured in kilometres per hour?

A. $\frac{k_1}{12.96}$

B. $\frac{k_1}{3.6}$

C. $3.6k_1$

D. $12.96k_1$

(1 mark)

2 A micrometer is used to measure the diameters of two spheres.

Diameter of first sphere	15.01 ± 0.01 mm
Diameter of second sphere	17.38 ± 0.02 mm

The difference in the diameters is calculated.

What is the uncertainty in this difference?

A. ± 0.01 mm

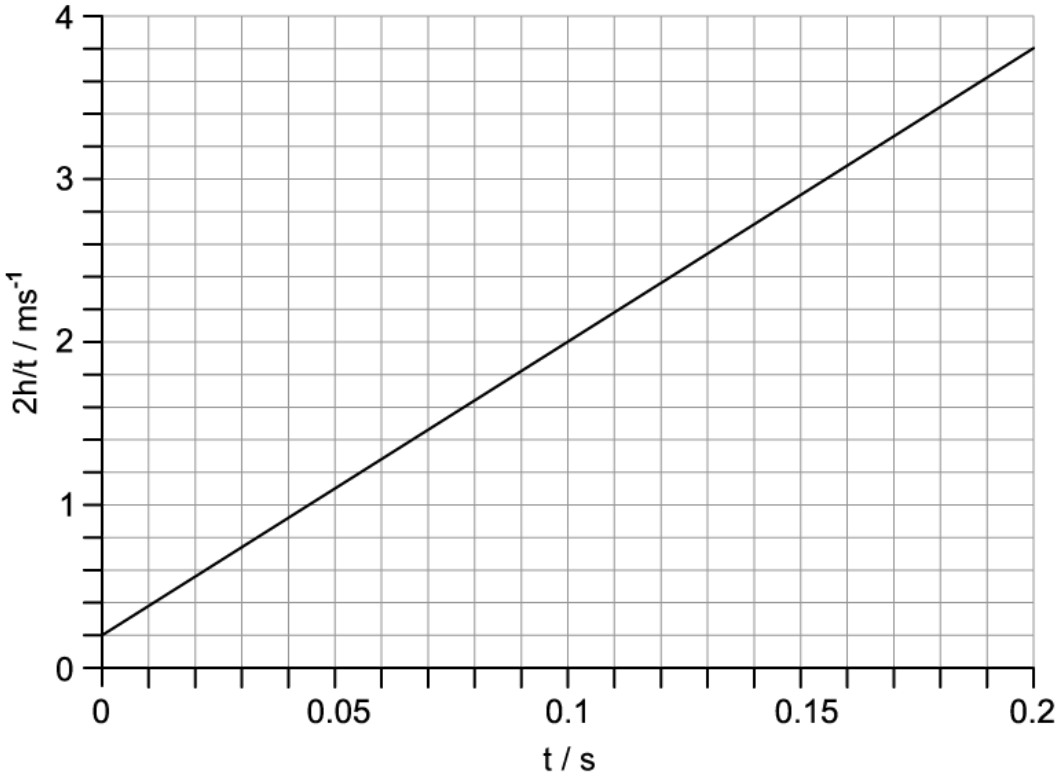
B. ± 0.02 mm

C. 0.03 mm

D. ± 0.06 mm

(1 mark)

3 The graph shows the results obtained by a student who designed an experiment to determine the value of the acceleration due to free fall, *g*, using a falling ball bearing and a pair of light gates. The value obtained is inaccurate.



Which of the following could have contributed to the inaccurate value of *g* obtained by the student?

A. Measured values of *h* are too large due to parallax error

B. Plotting $\frac{2h}{t}$ against *t*

C. The ball bearing colliding with the light gate when travelling through

D. An increase in measured values of *t* due to residual magnetism in the release mechanism

(1 mark)

4 A student throws a stone with velocity 3 m s^{-1} at an angle θ to the vertical from the surface of a lake. Air resistance can be ignored. The acceleration due to gravity is g.

What is the angle θ if the stone hits the surface of the lake 15 m from the student after 10 s?

You may use the fact that sin 30 = 0.5.

A. 90°

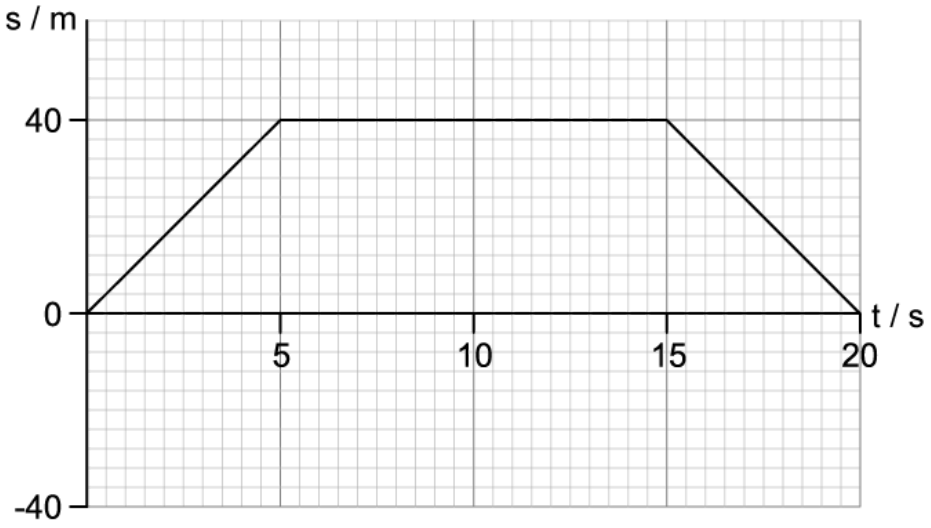
B. 45°

C. 60°

D. 30°

(1 mark)

5 A particle moving in a straight line has the displacement–time graph shown.



Which row is correct about the average speed and average velocity of the particle?

	Average speed / m s^{-1}	Average velocity / m s^{-1}
A.	0	4
B.	0	2
C.	4	0
D.	2	16

(1 mark)

6 A child of mass *m* sits in a car seat which is accelerating horizontally at 0.2*g*, where *g* is the acceleration due to gravity.

What is the magnitude of the total force exerted by the car seat on the child?

A. mg

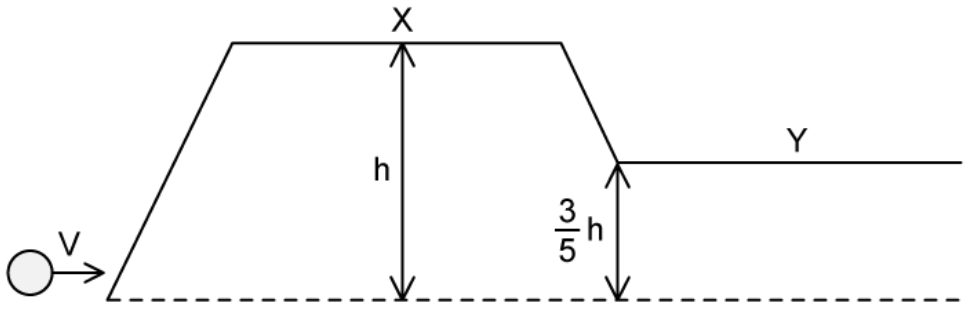
B. $\sqrt{mg}$

C. $\sqrt{0.2}\,mg$

D. $\sqrt{1.04}\,mg$

(1 mark)

7 A mass with speed *v* travels up to point X then down to Y.



Assuming air resistance is negligible, what is *v* of the mass at point Y?

A. $\sqrt{\frac{2gh}{5}}$

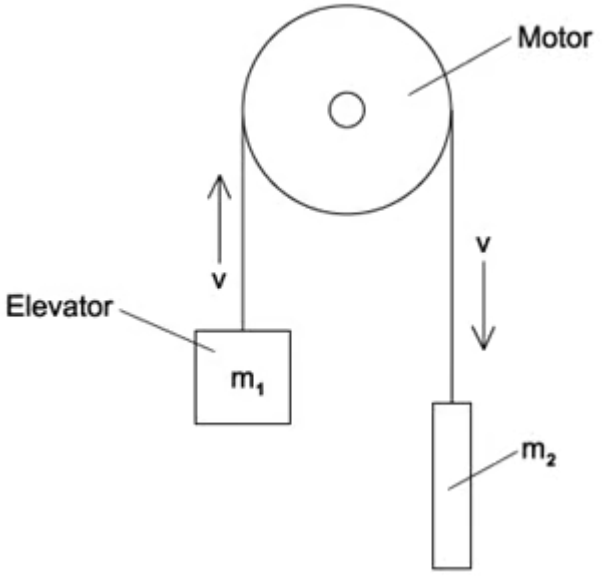
B. $2\sqrt{\frac{gh}{5}}$

C. $4\sqrt{\frac{gh}{5}}$

D. $\sqrt{\frac{3gh}{5}}$

(1 mark)

8 The diagram shows a pulley in a crane system. An elevator m_1 is used to lift building materials. A counterbalance m_2 is used in the system. g is the acceleration due to free fall.



What rate does the motor provide energy to the system when the elevator is rising at a steady speed v m s^{-1}?

A. m_1gv

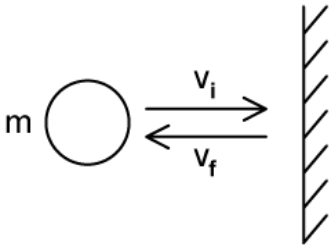
B. $\frac{1}{2}m_1v^2$

C. $gv(m_1 - m_2)$

D. $gv(m_1 + m_2)$

(1 mark)

9 A ball of mass m travels horizontally and strikes a vertical wall with a speed of v_i ms^{-1}. It then rebounds horizontally at speed v_f ms^{-1}. The ball is in contact with the wall for time Δt.



What is if the ball rebounds after an impulse of magnitude I?

A. $v_{final} = \frac{I + v_{initial}}{m}$

B. $v_{final} = \frac{I + mv_{initial}}{m}$

C. $v_{final} = \frac{I - mv_{initial}}{m}$

D. $v_{final} = \frac{I - v_{initial}}{m}$

(1 mark)

10 A flask contains a mass *m* of a fluid. When 2000 J of heat is provided the temperature of the water and the flask increases by 10 K.

The mass of the fluid is doubled, and the experiment is repeated. This time 4500 J is required to increase the temperature by 10 K.

The specific heat capacity of the fluid is 5000 J kg^{-1} K^{-1}.

What is the value of *m*?

A. 5 g

B. 25 g

C. 40 g

D. 50 g

(1 mark)

11 1 kg of water at 20 °C cools to 0 °C and then freezes to form ice, also at 0 °C.

What is the energy released during this process?

You may use the following values:

- Specific heat capacity of water = 4000 J kg^{-1} K^{-1}
- Specific latent heat of fusion of ice = 3.4×10^5 J kg^{-1}

A. 1.1×10^5 J

B. 3.0×10^5 J

C. 4.2×10^5 J

D. 5.0×10^5 J

(1 mark)

12 A materials scientist carries out an experiment to investigate the relationship between the volume and temperature of an ideal gas. The pressure of the gas is kept constant throughout the experiment. Two of their readings are shown below.

Temperature / °C	Volume of gas / cm^3
0	55
100	76

What is the value for absolute zero that can be calculated from these results?

A. −273.15 °C

B. −261.9 °C

C. 0 °C

D. 100 °C

(1 mark)

13 Identify the statement that is not a condition of simple harmonic motion.

A. The restoring force is directed toward the amplitude x_0

B. Acceleration is directed toward the equilibrium position

C. The oscillations are isochronous

D. The magnitude of the restoring force is proportional to the displacement

(1 mark)

14 The intensity, I, of a sound wave is inversely proportional to the square of the distance, d, from the source and directly proportional to the square of the amplitude, A.

At distance d from the point source of a sound wave, the amplitude of the wave is 6 A.

What is the amplitude at a distance of 3 *d*?

A. $\frac{1}{3}A$

B. 2 *A*

C. 3 *A*

D. 6 *A*

(1 mark)

15 A longitudinal travelling wave has speed *v* and wavelength *λ*. What is the least distance between a compression and a rarefaction measured against the direction of propagation?

A. v

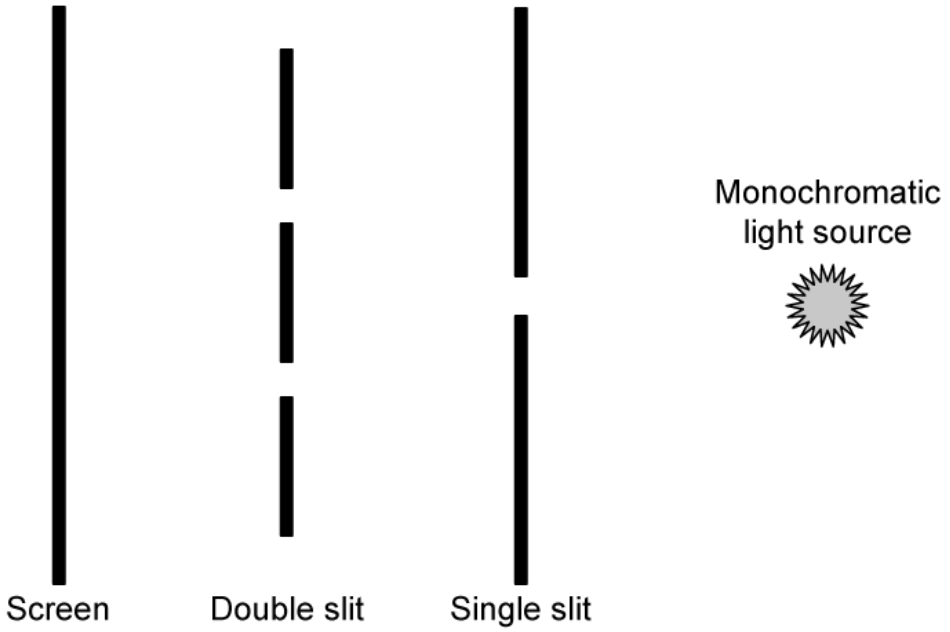
B. $\frac{v}{\lambda}$

C. λ

D. $\frac{\lambda}{2}$

(1 mark)

16 Young's double-slit experiment is setup as shown, including a monochromatic source, a single slit, a double slit and a screen. What is the purpose of the double slit in this experiment?



A. To make sure there is equal intensity in the double-slits

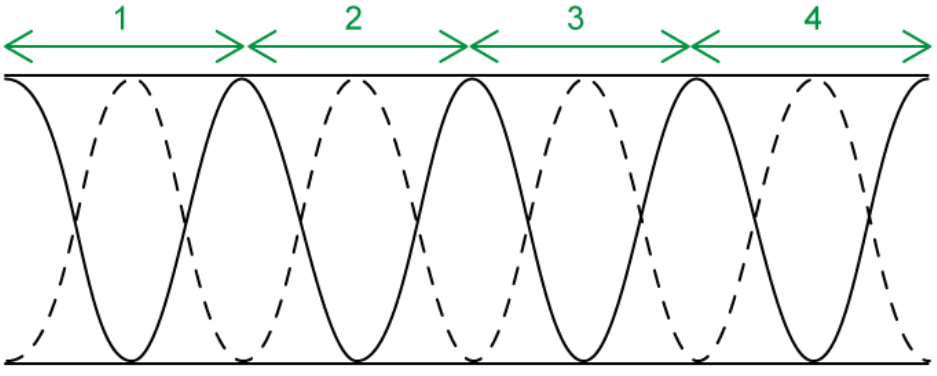
B. To make sure the light is coherent upon the double-slits

C. To decrease intensity for the double-slits

D. To reduce the wavelength of the light

(1 mark)

17 The diagram shows a standing wave in a column of air, where the pipe is open at both ends. How many wavelengths fit in the pipe?



A. 3

B. 4

C. 6

D. 8

(1 mark)

18 Two charges, $Q_1 = q$ and $Q_2 = 4q$ are separated by a distance r and exert a force of magnitude F on each other. By what factor does the magnitude of the force change if the charge on Q_1 doubles and the separation distance trebles?

A. $\frac{1}{9}$

B. $\frac{2}{3}$

C. $\frac{2}{9}$

D. 2

(1 mark)

19 A science student who lives in the UK, where the mains voltage is 240 V, buys a light bulb marked 60 W which she uses in her bedroom. The student takes the lightbulb with her on a trip to Canada where the mains voltage is 100 V and also uses it there.

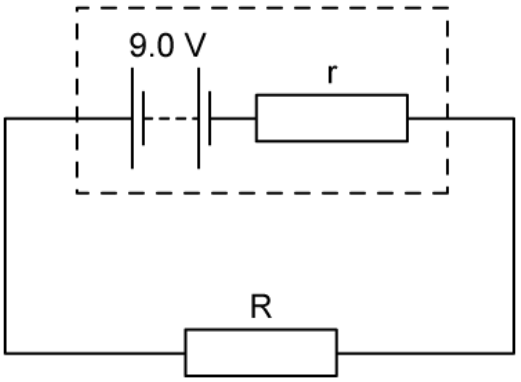
Which line correctly identifies the approximate power dissipated in the bulb in the UK and Canada?

	UK / W	Canada / W
A.	30	10
B.	60	30
C.	60	10
D.	120	60

A.

(1 mark)

20 A resistor *R* is connected to the terminals of a battery of emf 9.0 V and internal resistance *r*.



A charge of 240 C through the resistor in two minutes. The power dissipated in the resistor as a result is 1440 J. What is the internal resistance *r* of the battery?

A. 3.0 Ω

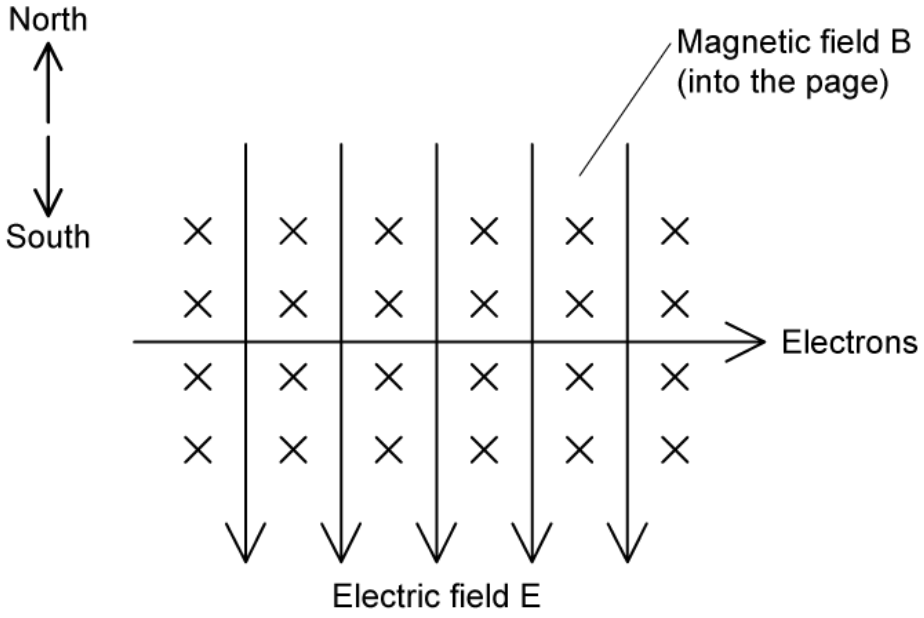
B. 2.0 Ω

C. 1.5 Ω

D. 4.5 Ω

(1 mark)

21 A beam of electrons enters a region in which there are uniform magnetic and electric fields directed at right angles to each other. The field strengths are adjusted such that the beam remains undeflected, as shown in the diagram below.



Which of the following statements is **incorrect**?

A. Conventional current flows from right to left in this diagram

B. The velocity of the electron beam *v* is equal to the ratio of the magnetic flux density *B* to the electric field strength *E*

C. The magnetic force on the electron beam is in the direction indicated 'south'

D. The electric force on the electron beam is in the direction indicated 'north'

(1 mark)

22 Which of the following statements about magnetic fields is **incorrect**?

A. The strength of a magnetic field is also known as the magnetic flux density

B. There is a force on a conductor carrying a current at 90° to magnetic field lines

C. The magnetic flux density is measured in units of Tesla, T

D. There is a force on a current carrying conductor parallel to magnetic field lines

(1 mark)

23 A planet has triple the mass of Earth and a third of its radius. What is the gravitational field strength on the surface of the planet?

A. 10 N kg^{-1}

B. 270 N kg^{-1}

C. 90 N kg^{-1}

D. 240 N kg^{-1}

(1 mark)

24 A source is known to be radioactive but the type of radiation being emitted is unknown.

A Geiger-Müller tube is placed close to the source and different materials are placed between the two. A table of the count rates recorded for each material is shown below. The background count rate is 15 counts per minute.

Material	Count rate recorded / counts per minute
Paper	528
Nothing	1064
Thick lead	17
Aluminium	524

What types of radiation are being emitted by the source?

A. α, β and γ

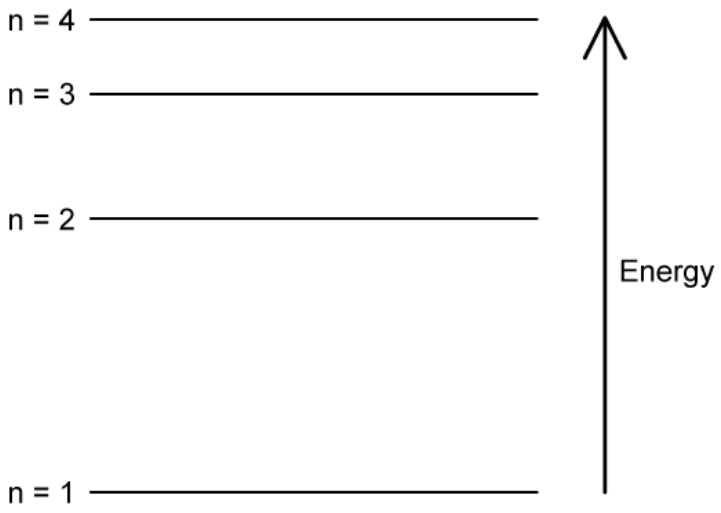
B. α only

C. β and γ

D. α and γ

(1 mark)

25 The energy levels of an atom are shown in the diagram below.



Which transition will emit the photon with the shortest wavelength?

A. n = 4 to n = 1

B. n = 2 to n = 1

C. n = 2 to n = 1

D. n = 4 to n = 3

(1 mark)

26 Protactinium-231 ($^{231}_{91}Pa$) is a radioactive element, it decays by alpha radiation and then beta-minus decay as shown below:

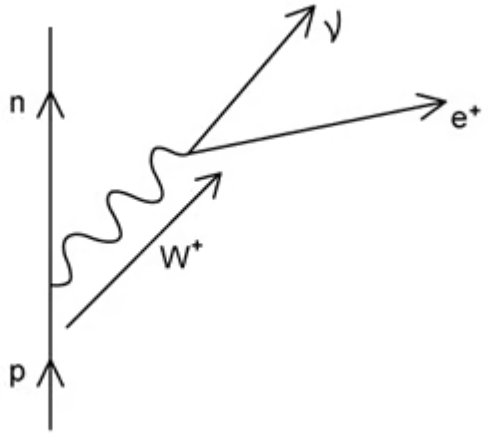
$$^{231}_{91}Pa \rightarrow A + \alpha \rightarrow B + \beta^{-} + \overline{\upsilon}_{e}$$

What proton number and mass number will element **B** have?

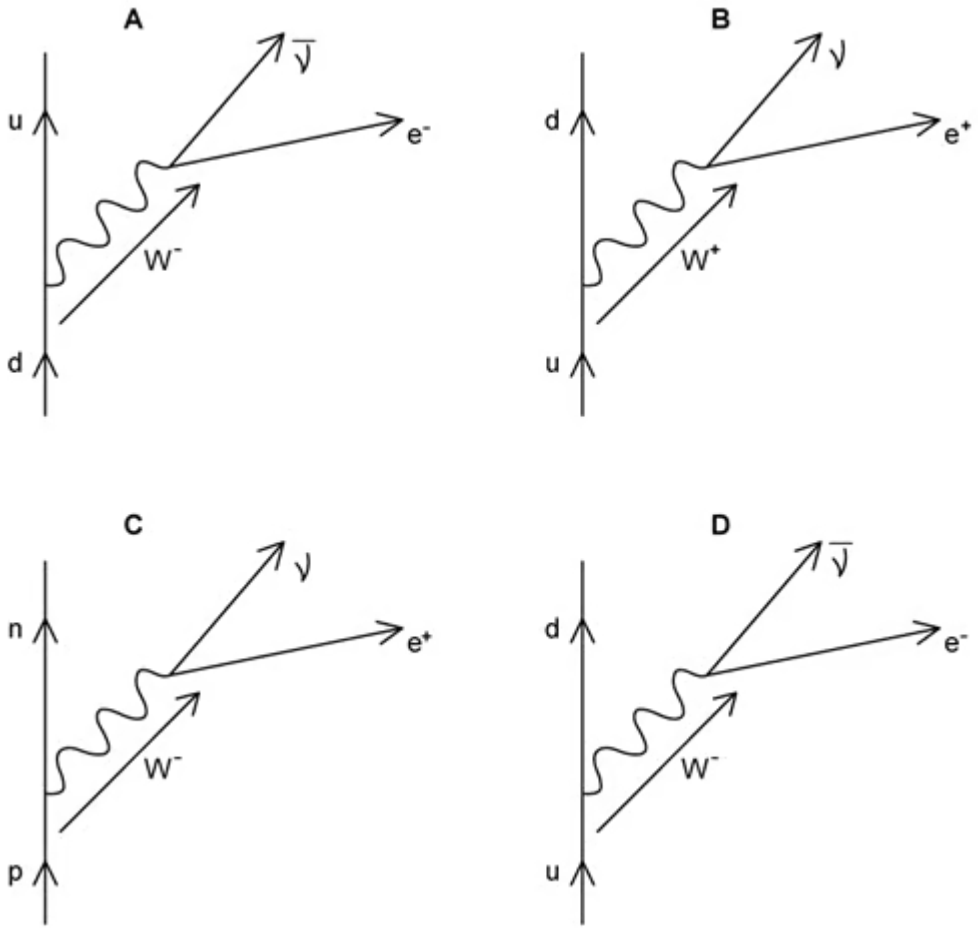
	Proton Number	Mass Number
A.	89	229
B.	90	229
C.	89	227
D.	90	227

(1 mark)

27 The following Feynman diagram shows the baryons and leptons in a nuclear decay.



Which of the four Feynman diagrams, **A** to **D**, is physically equivalent to the diagram given for this decay?



(1 mark)

28 What is the most common energy source used in central heating systems around the world?

A. Natural Gas

B. Electricity

C. Petrol

D. Solar

(1 mark)

29 Diesel fuel has a specific energy of about 4.5×10^7 J kg^{-1} and an energy density of close to 3.5×10^{10} J m^{-3}. Which value is closest to the density of diesel?

A. 1.2×10^{-3} kg m^{-3}

B. 800 kg m^{-3}

C. 3.7×10^{10} kg m^{-3}

D. 1.7×10^{18} kg m^{-3}

(1 mark)

30 Which factors affect the amount of solar power incident on a given point on the surface of the Earth?

I. Weather conditions
II. Latitude
III. Position of the Moon in its orbit of the Earth
IV. Position of the Earth in its orbit of the Sun

A. I and IV only

B. I and II only

C. I, II and III

D. I, II and IV

(1 mark)