IB DIPLOMA PROGRAMME
PROGRAMME DU DIPLÔME DU BI
PROGRAMA DEL DIPLOMA DEL BI

PHYSICS
STANDARD LEVEL
PAPER 1

Thursday 17 November 2005 (afternoon)

45 minutes

INSTRUCTIONS TO CANDIDATES

- Do not open this examination paper until instructed to do so.
- Answer all the questions.
- For each question, choose the answer you consider to be the best and indicate your choice on the answer sheet provided.

1.   The mass of an atom of the isotope strontium-92 (^{92}Sr) is of the order of

   A. 10^{-23} kg.

   B. 10^{-25} kg.

   C. 10^{-27} kg.

   D. 10^{-29} kg.

2.   Which **one** of the following is a fundamental unit in the SI system?

   A.   Ampere

   B.   Volt

   C.   Ohm

   D.   Tesla

3.   Which **one** of the following measurements is stated correctly to two significant digits?

   A.   0.006 m

   B.   0.06 m

   C.   600 m

   D.   620 m

4.   The frequency f of an oscillating system is given by

$$f = \frac{1}{2\pi}\sqrt{\frac{g}{l}}$$

where g and π are constants.

The frequency f is measured for different values of l and a graph is plotted.

Which **one** of the following will produce a straight-line graph?

	y-axis	*x*-axis
A.	$\sqrt{f}$	$\sqrt{l}$
B.	$\sqrt{f}$	l
C.	f^2	$\dfrac{1}{l}$
D.	f^2	$\sqrt{l}$

Turn over

5.   The graph below shows the variation with time t of the acceleration a of a spaceship.
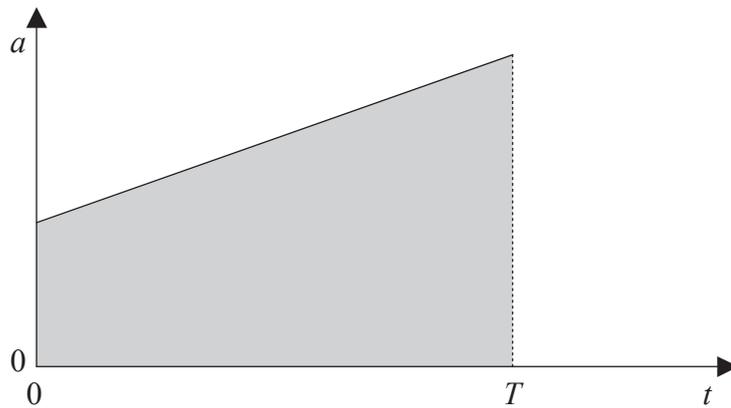
The spaceship is at rest at $t=0$.

The shaded area represents

A.   the distance travelled by the spaceship between $t=0$ and $t=T$.

B.   the speed of the spaceship at $t=T$.

C.   the rate at which the speed of the spaceship changes between $t=0$ and $t=T$.

D.   the rate at which the acceleration changes between $t=0$ and $t=T$.

6.   A particle moves from a point P to a point Q in a time T. Which **one** of the following correctly defines both the average velocity and average acceleration of the particle?

	Average velocity	**Average acceleration**
A.	$\dfrac{\text{displacement of Q from P}}{T}$	$\dfrac{\text{change in speed from P to Q}}{T}$
B.	$\dfrac{\text{displacement of Q from P}}{T}$	$\dfrac{\text{change in velocity from P to Q}}{T}$
C.	$\dfrac{\text{distance between Q and P}}{T}$	$\dfrac{\text{change in speed from P to Q}}{T}$
D.	$\dfrac{\text{distance between Q and P}}{T}$	$\dfrac{\text{change in velocity from P to Q}}{T}$

7. Two stones, X and Y, of different mass are dropped from the top of a cliff. Stone Y is dropped a short time after stone X. Air resistance is negligible.

Whilst the stones are falling, the distance between them will

    A.   decrease if the mass of Y is greater than the mass of X.

    B.   increase if the mass of X is greater than the mass of Y.

    C.   decrease whether the mass of X is greater or less than the mass of Y.

    D.   increase whether the mass of X is greater or less than the mass of Y.

8.   A horse pulls a boat along a canal at constant speed in a straight-line as shown below.

horse

P F

L boat   direction of travel
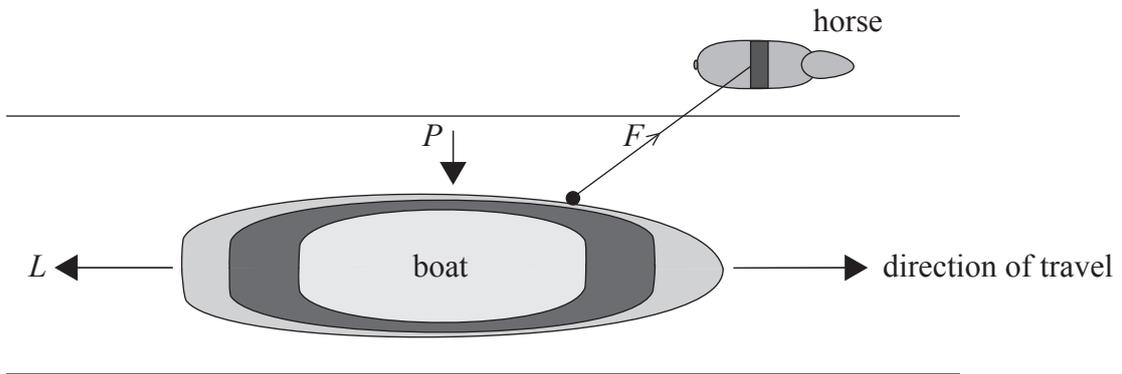
The horse exerts a constant force F on the boat. The water exerts a constant drag force L and a constant force P on the boat. The directions of F, L and P are as shown. Which **one** of the following best represents a free-body diagram for the boat?

A.

F

L

P

B.

F

L

P

C.

F

L

P

D.

F

L

P
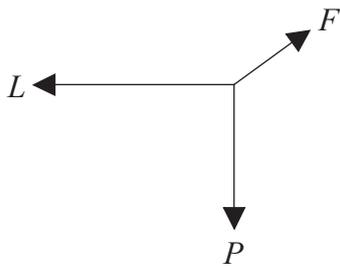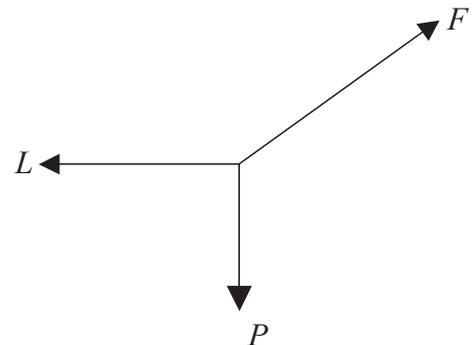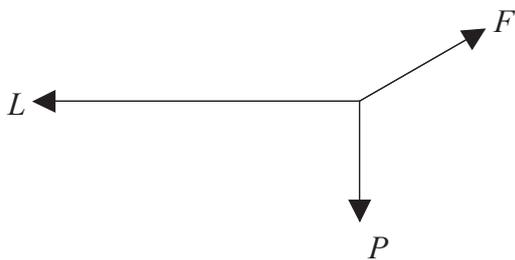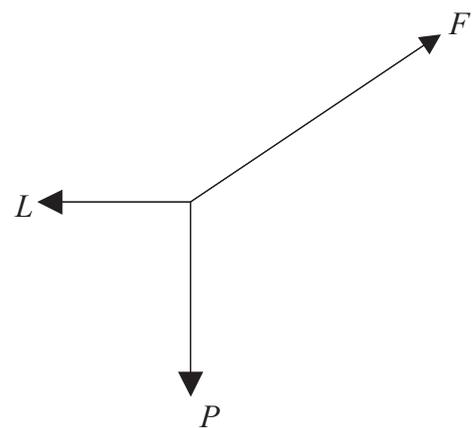
9. If the resultant external force acting on a particle is zero, the particle

    A.   must have constant speed.

    B.   must be at rest.

    C.   must have constant velocity.

    D.   must have zero momentum.

10. The inertial mass of a body may be defined as

    A.   the ratio of the resultant force acting on the body to its acceleration.

    B.   the ratio of the weight of the body to its acceleration.

    C.   the amount of matter in the body.

    D.   the ratio of the gravitational mass of the body to its weight.

11. The velocity of a body of mass m changes by an amount Δv in a time Δt. The impulse given to the body is equal to

    A. $m\Delta t$.

    B. $\dfrac{\Delta v}{\Delta t}$.

    C. $m\dfrac{\Delta v}{\Delta t}$.

    D. $m\Delta v$.

12. A ball is held at rest at point X and is then released. It drops on to a flat horizontal surface and rebounds to a maximum height at point Y.

point X

point Y

before

after
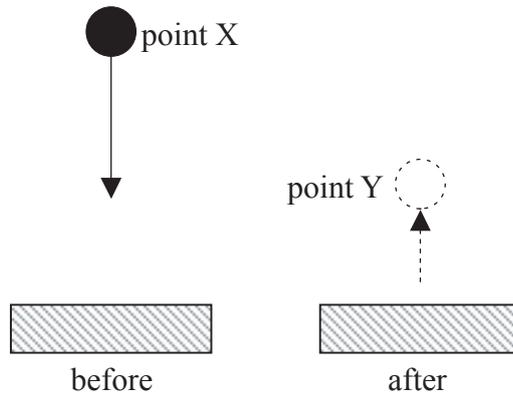
Which **one** of the following graphs best shows the variation with time t of the momentum p of the ball as it moves between point X and point Y?

A.

p

B.

p

C.

p

D.

p
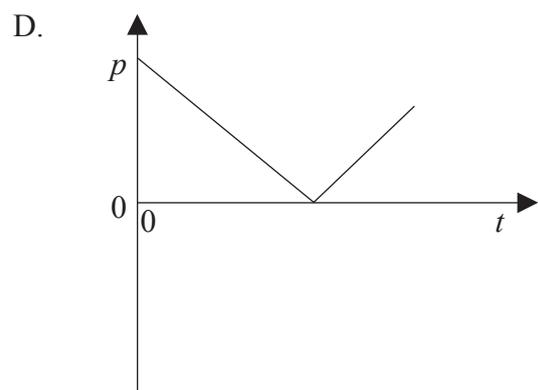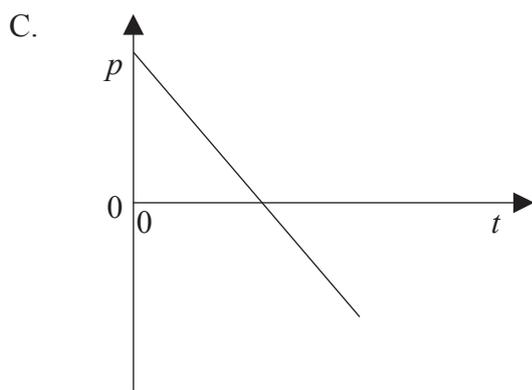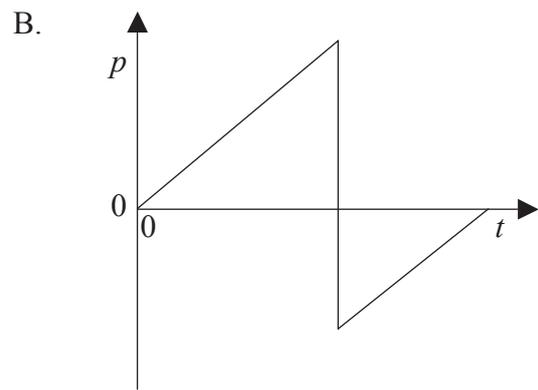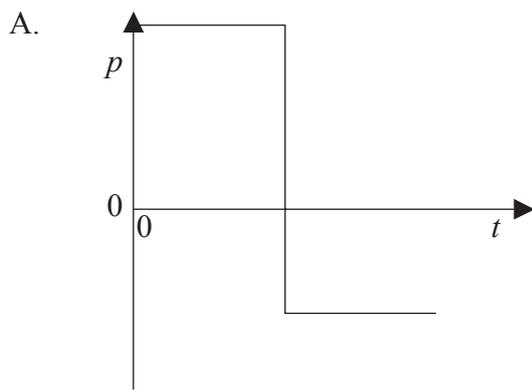
13. A ball of weight W is dropped on to the pan of a top pan weighing balance and rebounds off the pan.

pan

00.00
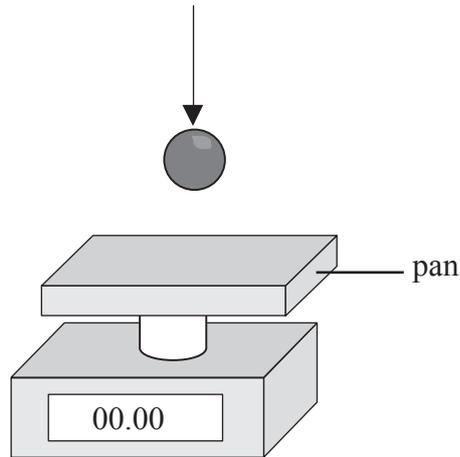
At the instant that the ball has zero velocity when in contact with the pan, the scale will read

A.   zero.

B.   a value less than W but greater than zero.

C. W.

D.   a value greater than W.

14. A small ball P moves with speed v towards another identical ball Q along a line joining the centres of the two balls. Ball Q is at rest. Kinetic energy is conserved in the collision.

v

P   Q at rest

Which **one** of the following situations is a possible outcome of the collision between the balls?

A. v ←   → v

P   Q

B. $v=0$ → v

P   Q

C. $\frac{v}{4}$ ←   → $\frac{3v}{4}$

P   Q

D. → $\frac{v}{2}$ → $\frac{v}{2}$

P   Q

15. Temperature is the **only** property that determines

    A.   the total internal energy of a substance.

    B.   the phase (state) of a substance.

    C.   the direction of thermal energy transfer between two bodies in thermal contact.

    D.   the process by which a body loses thermal energy to the surroundings.

16. A substance is heated at a constant rate. The sketch graph shows the variation with time t of the temperature θ of the substance.
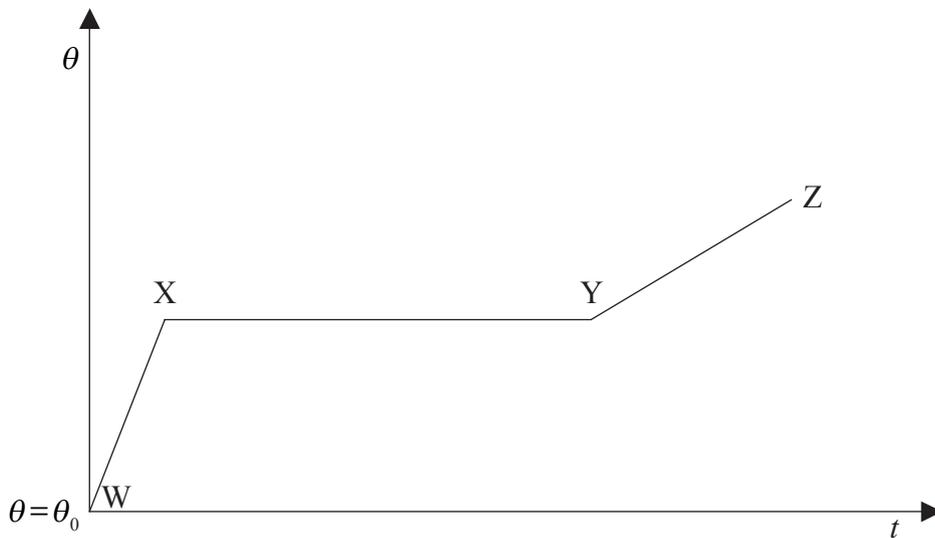
In which region **or** regions of the graph must there be more than one phase of the substance present?

    A.   WX and YZ

    B.   WX only

    C.   WX, XY and YZ

    D.   XY only

17. Two ideal gases X and Y, are contained in a cylinder at constant temperature. The mass of the atoms of X is m and of Y is $4m$.

Which **one** of the following is the correct value of the ratio

$$\frac{\text{average kinetic energy of the atoms of Y}}{\text{average kinetic energy of the atoms of X}}?$$

A.   1

B.   2

C   4

D.   16

18. Container X below has volume V and holds n moles of an ideal gas at kelvin temperature T. Container Y has volume $2V$ and holds $3n$ moles of an ideal gas also at kelvin temperature T.

volume V
temperature T
n moles
pressure P_X

container X

volume $2V$
temperature T
$3n$ moles
pressure P_Y
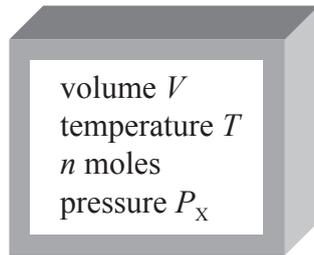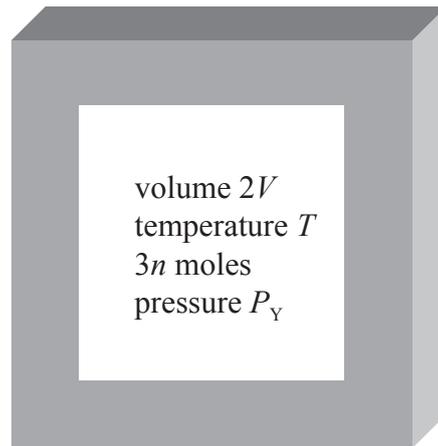
container Y

The pressure of the gas in X is P_X and in Y is P_Y.

The ratio $\dfrac{P_X}{P_Y}$ is

A. $\dfrac{2}{3}$.

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

C.   5.

D.   6.

19. Diagram 1 below shows the displacement of part of a medium through which a wave is travelling at time $t=0$. Diagram 2 shows the displacement at a later time $t=4.0$ s in which the wave has moved forward 10 cm. In this time, the point P on the wave has moved from a crest through zero displacement to a trough.
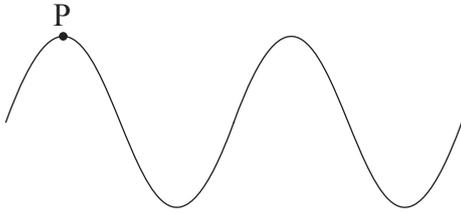
Diagram 1   Diagram 2
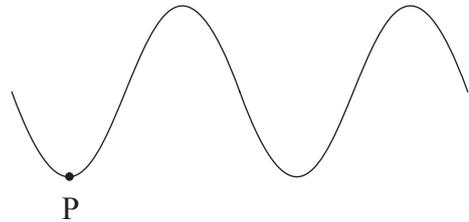
The wavelength of the wave is

A.   5.0 cm.

B.   10 cm.

C.   20 cm.

D.   40 cm.

20. The diagram below shows a pulse travelling along a rope from X to Y. The end Y of the rope is tied to a fixed support.
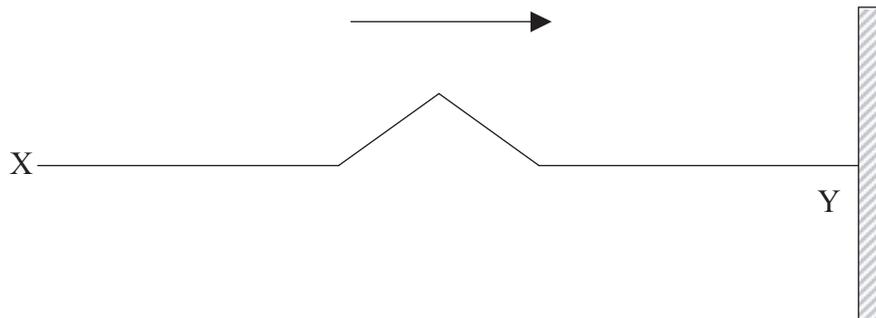
When the pulse reaches end Y it will

A.   disappear.

B.   cause the end of the rope at Y to oscillate up and down.

C.   be reflected and be inverted.

D.   be reflected and not be inverted.

21. Which **one** of the following is correct for transfer of energy along a standing wave and for amplitude of vibration of the standing wave?

	Transfer of energy along a standing wave	Amplitude of vibration of the standing wave
A.	None	Constant amplitude
B.	None	Variable amplitude
C.	Energy is transferred	Constant amplitude
D.	Energy is transferred	Variable amplitude

22. Two pipes P and Q are of the same length. Pipe P is closed at one end and pipe Q is open at both ends. The fundamental frequency (first harmonic) of the closed pipe P is 220 Hz.

The best estimate for the fundamental frequency of the open pipe Q is

A. 880 Hz.

B. 440 Hz.

C. 110 Hz.

D. 55 Hz.

Turn over

23. A positively charged rod is brought close to the top of an uncharged gold leaf electroscope.
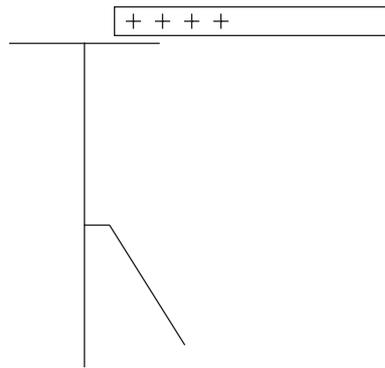
The top of the gold leaf electroscope is now earthed with the rod still in position.
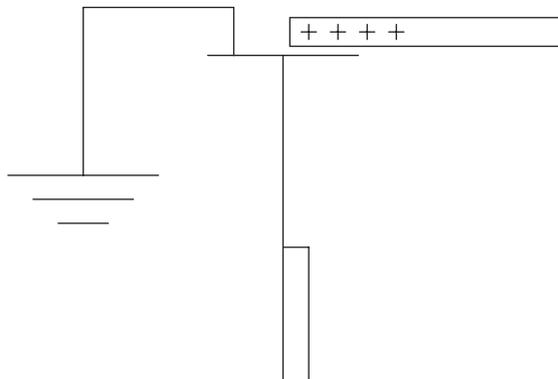
The earth connection is removed and then the charged rod is removed.

Which **one** of the following best shows the correct charge distribution on the gold leaf electroscope as a result of these actions?
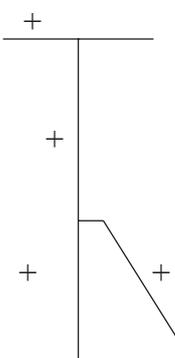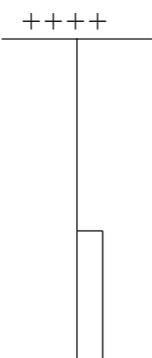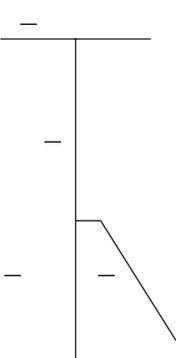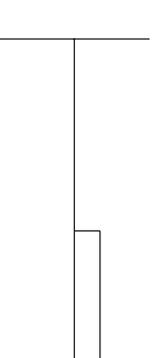
24. The diagram below represents a solenoid in which there is no electric current.

00000000000000000000000000

00000000000000000000000000

Which **one** of the following best represents the magnetic field pattern due to an electric current in the solenoid?

A.

00000000000000000000000000

00000000000000000000000000

B.

00000000000000000000000000

00000000000000000000000000

C.

00000000000000000000000000

00000000000000000000000000

D.

00000000000000000000000000

00000000000000000000000000
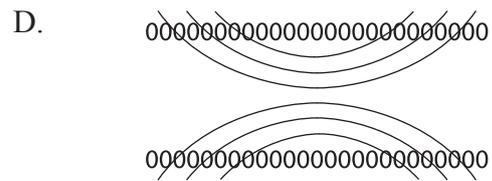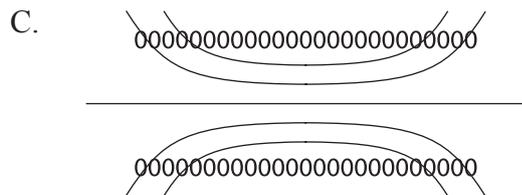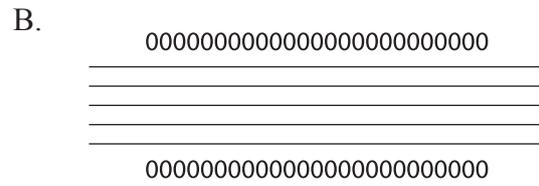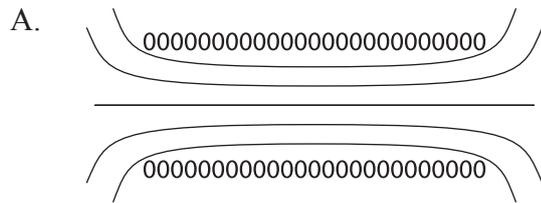
25. In the two circuits X and Y below, each cell has an e.m.f. E and negligible internal resistance. Each resistor has a resistance R.
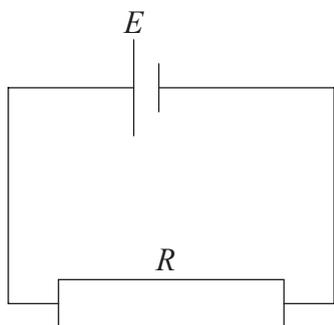
circuit X   circuit Y
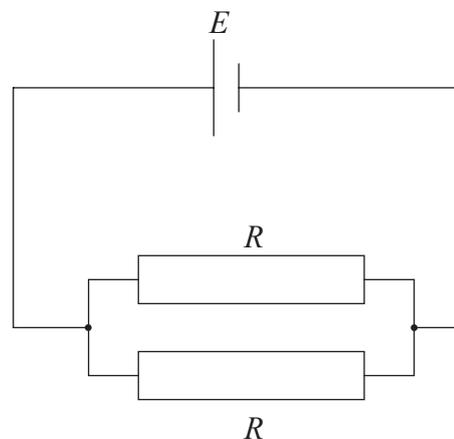
The power dissipated in circuit X is P.

The best estimate for the power dissipated in circuit Y is

A. $\dfrac{P}{4}$.

B. $\dfrac{P}{2}$.

C. $2P$.

D. $4P$.

26. The drift velocity of the electrons in a copper wire in which there is an electric current is

A.   equal to the speed of light.

B.   close to that of the speed of light.

C.   of the order of a few kilometres per second.

D.   of the order of a few millimetres per second.

27. An electron is travelling in the direction shown and enters a region of uniform magnetic field.

direction of travel of
the electron $\longrightarrow$
e^-

direction of
magnetic field

region of uniform
magnetic field
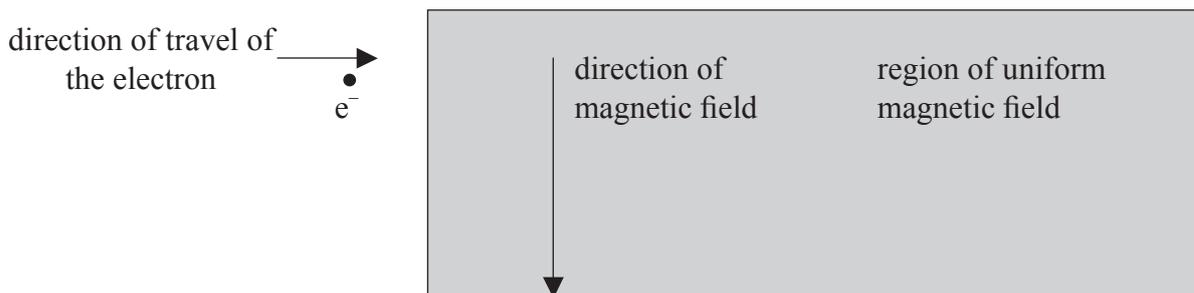
On entering the field the direction of the force acting on the electron is

A. into the plane of the paper.

B. out of the plane of the paper.

C. towards the top of the page.

D. towards the bottom of the page.

28. Which **one** of the following provides evidence for a nuclear model of the atom?

A. Natural radioactive decay

B. The ionizing properties of radiation

C. The stability of certain elements

D. The scattering of alpha particles by gold foil

29. When the isotope aluminium-27 is bombarded with alpha particles, the following nuclear reaction can take place.

$$_2^4\text{He} + _{13}^{27}\text{Al} \rightarrow \text{X} + \text{neutron}$$
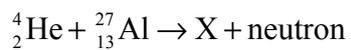
Which **one** of the following correctly gives the atomic (proton) number and mass (nucleon) number of the nucleus X?

	Proton number	Nucleon number
A.	15	30
B.	16	31
C.	30	15
D.	31	16

30. The main source of the Sun's energy is

A. chemical reaction.

B. natural radioactivity.

C. nuclear fusion.

D. nuclear fission.