N5

National Qualifications 2019

X857/75/02

Physics
Section 1 — Questions

WEDNESDAY, 15 MAY
1:00 PM – 3:30 PM

Instructions for the completion of Section 1 are given on *page 02* of your question and answer booklet X857/75/01.

Record your answers on the answer grid on *page 03* of your question and answer booklet.

Reference may be made to the Data sheet on *page 02* of this booklet and to the Relationships sheet X857/75/11.

Before leaving the examination room you must give your question and answer booklet to the Invigilator; if you do not, you may lose all the marks for this paper.

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A/SA

DATA SHEET

Speed of light in materials

Material	Speed in m s^{-1}
Air	3.0×10^8
Carbon dioxide	3.0×10^8
Diamond	1.2×10^8
Glass	2.0×10^8
Glycerol	2.1×10^8
Water	2.3×10^8

Gravitational field strengths

	Gravitational field strength on the surface in N kg^{-1}
Earth	9.8
Jupiter	23
Mars	3.7
Mercury	3.7
Moon	1.6
Neptune	11
Saturn	9.0
Sun	270
Uranus	8.7
Venus	8.9

Specific latent heat of fusion of materials

Material	Specific latent heat of fusion in J kg^{-1}
Alcohol	0.99×10^5
Aluminium	3.95×10^5
Carbon Dioxide	1.80×10^5
Copper	2.05×10^5
Iron	2.67×10^5
Lead	0.25×10^5
Water	3.34×10^5

Specific latent heat of vaporisation of materials

Material	Specific latent heat of vaporisation in J kg^{-1}
Alcohol	11.2×10^5
Carbon Dioxide	3.77×10^5
Glycerol	8.30×10^5
Turpentine	2.90×10^5
Water	22.6×10^5

Speed of sound in materials

Material	Speed in m s^{-1}
Aluminium	5200
Air	340
Bone	4100
Carbon dioxide	270
Glycerol	1900
Muscle	1600
Steel	5200
Tissue	1500
Water	1500

Specific heat capacity of materials

Material	Specific heat capacity in J kg^{-1} °C^{-1}
Alcohol	2350
Aluminium	902
Copper	386
Glass	500
Ice	2100
Iron	480
Lead	128
Oil	2130
Water	4180

Melting and boiling points of materials

Material	Melting point in °C	Boiling point in °C
Alcohol	−98	65
Aluminium	660	2470
Copper	1077	2567
Lead	328	1737
Iron	1537	2737
Water	–	100

Radiation weighting factors

Type of radiation	Radiation weighting factor
alpha	20
beta	1
fast neutrons	10
gamma	1
slow neutrons	3
X-rays	1

SECTION 1

Attempt ALL questions

1. Which of the following are **both** vectors?

   A   weight and acceleration

   B   kinetic energy and acceleration

   C   mass and acceleration

   D   force and speed

   E   speed and acceleration

2. A car is travelling at $6 \cdot 0\,\mathrm{m\,s^{-1}}$ along a straight level road.

   The car then accelerates uniformly at $2 \cdot 0\,\mathrm{m\,s^{-2}}$ for $4 \cdot 0\,\mathrm{s}$.

   The final speed of the car is

   A $8 \cdot 0\,\mathrm{m\,s^{-1}}$

   B $14\,\mathrm{m\,s^{-1}}$

   C $22\,\mathrm{m\,s^{-1}}$

   D $26\,\mathrm{m\,s^{-1}}$

   E $48\,\mathrm{m\,s^{-1}}$.

3. The graph shows how the speed v of a car varies with time t.
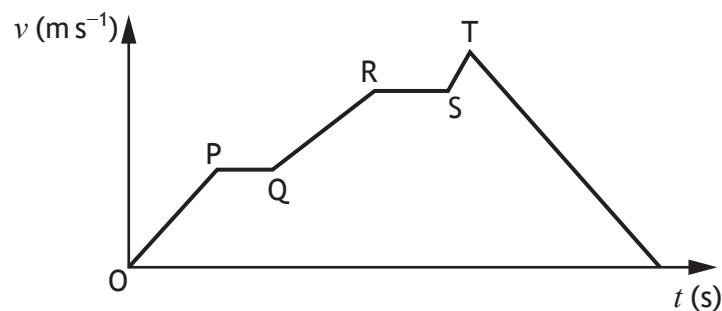
   During which part of the journey does the car have the greatest acceleration?

   A   OP

   B   PQ

   C   QR

   D   RS

   E   ST

4. A ball is kicked horizontally off a high river bank as shown.
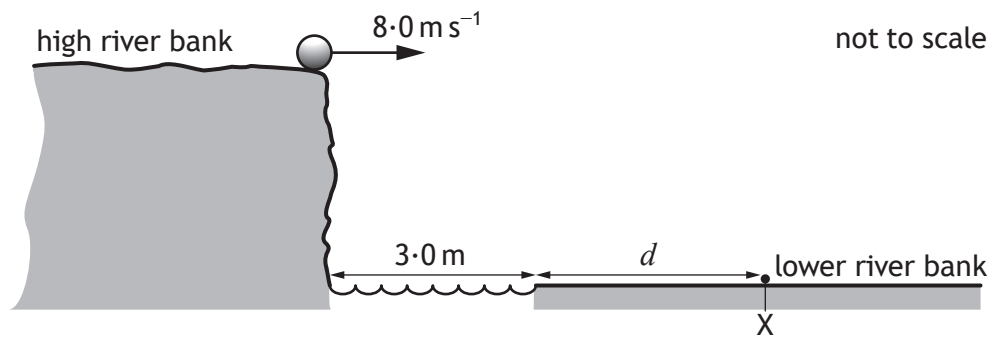
The ball lands on the lower river bank at X, 2·0 s after the ball is kicked.

The river is 3·0 m wide.

The effect of air resistance on the ball is negligible.

The distance d between the edge of the lower river bank and X is

A   1·0 m

B   4·0 m

C   13 m

D   16 m

E   19 m.

5. The table gives the distance from Earth, the approximate surface temperature and the age of five stars.

Star	Distance from Earth (light-years)	Approximate surface temperature (K)	Age (years)
Sirius A	8·6	9900	$2·4 \times 10^8$
Polaris	430	6000	$7·0 \times 10^7$
Betelgeuse	640	3600	$7·9 \times 10^6$
Rigel	860	11 000	$8·0 \times 10^6$
VY Canis Majoris	3900	3500	$1·0 \times 10^7$

A student makes the following statements based on this information.

I   As the distance from Earth increases, the age of a star decreases.

II   As the age of a star increases, the approximate surface temperature of the star increases.

III There is no apparent relationship between the distance from Earth and the approximate surface temperature of a star.

Which of these statements is/are correct?

A   I only

B   II only

C   III only

D   I and III only

E   I, II and III

6. A geostationary satellite orbits the Earth.

Which row in the table shows the altitude above the surface of the Earth and orbital period of the geostationary satellite?

	Altitude above the surface of the Earth (km)	Orbital period (hours)
A	36 000	12
B	36 000	24
C	36 000	48
D	18 000	12
E	18 000	24

7. The weight of a robot on Earth is 240 N.

The weight of the robot on Mars is

A   3·7 N

B   65 N

C   91 N

D   240 N

E   890 N.

8. A hairdryer is connected to a 230 V supply.

The current in the hairdryer is 2·0 A.

The electrical charge that passes through the hairdryer in 5 minutes is

A   10 C

B   460 C

C   600 C

D   1150 C

E   69 000 C.

9. The graph shows how the resistance R of a thermistor varies with temperature T.
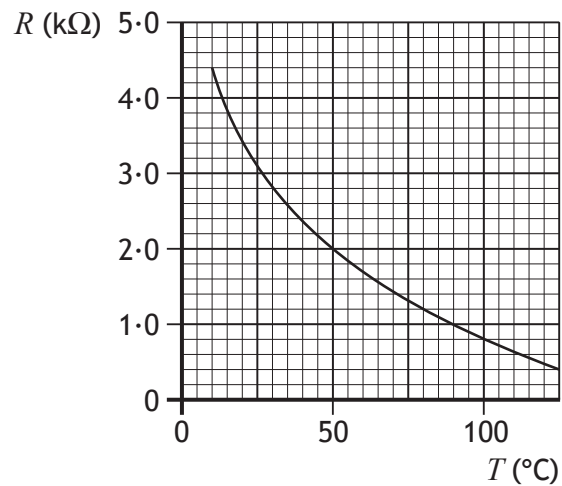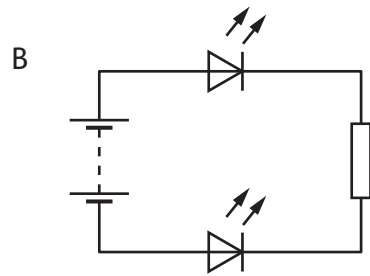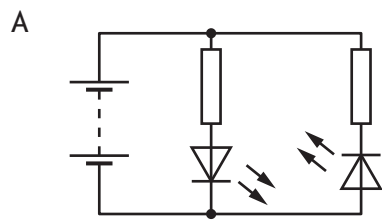

The thermistor is connected in a circuit.

At a temperature of 50 °C the current in the thermistor is 0·004 A.
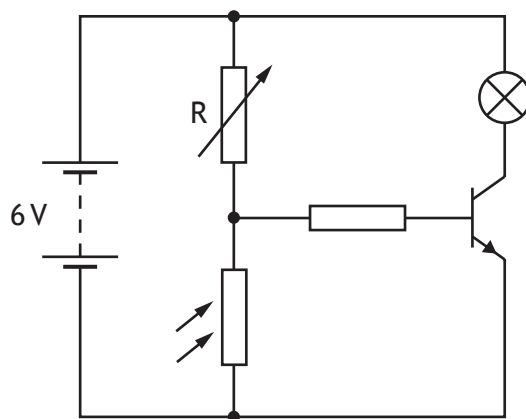
At this temperature the voltage across the thermistor is

A   0·000 02 V

B   0·002 V

C   0·008 V

D   8 V

E   500 V.

10. A student sets up the circuits shown.

In which circuit will both LEDs be lit?

A

B

C

D

E
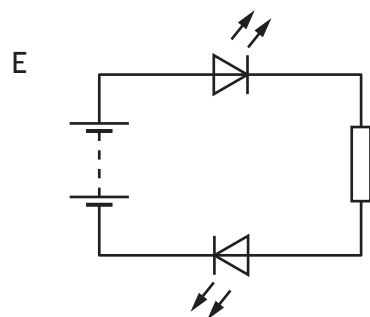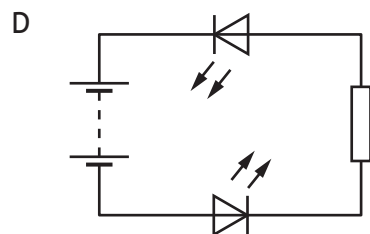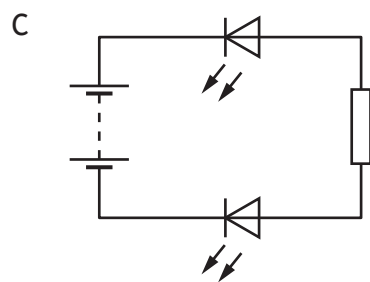
11. A circuit is set up as shown.

The room temperature is 20 °C.
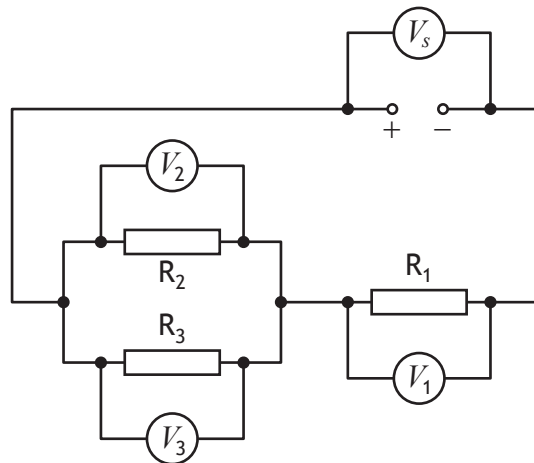
The lamp is off.

The lamp will light when

A   the light level is decreased below a certain value

B   the light level is increased above a certain value

C   the resistance of R is increased above a certain value

D   the battery voltage is reduced to 5 V

E   the temperature is increased above a certain value.

12. A circuit is set up as shown.

A student makes the following statements about the readings on the voltmeters.

I $\quad V_1 = V_2$

II $\quad V_2 = V_3$

III $\quad V_S = V_1 + V_2$

Which of these statements must **always** be true?

A II only

B I and II only

C I and III only

D II and III only

E I, II and III

13. A solid substance is placed in an insulated container and heated.

The graph shows how the temperature T of the substance varies with time t.
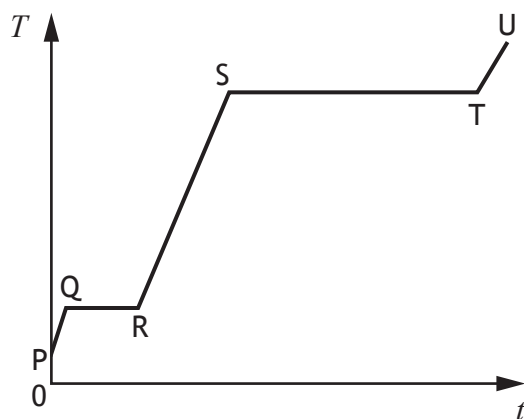
To calculate the specific latent heat of fusion of the substance a student would use the time from section

A   PQ

B   QR

C   RS

D   ST

E   TU.

14. The pressure p due to a liquid at a depth h is given by the relationship

$$p = \rho g h$$

where ρ is the density of the liquid and g is the gravitational field strength.

A liquid has a density of $990 \, \text{kg m}^{-3}$.

When the pressure due to the liquid is $1470 \, \text{Pa}$, the depth in the liquid is

A $0 \cdot 069 \, \text{m}$

B $0 \cdot 15 \, \text{m}$

C $0 \cdot 67 \, \text{m}$

D $1 \cdot 5 \, \text{m}$

E $6 \cdot 6 \, \text{m}$.

[Turn over

15. A car is parked in the sun for some time. During this time the air pressure inside the tyres increases.

The reason for this increase in pressure is

    A   the volume occupied by the air particles in the tyres has increased

    B   the force produced by the air particles in the tyres acts over a smaller area

    C   the average spacing between the air particles in the tyres has increased

    D   the increased temperature has made the air particles in the tyres expand

    E   the air particles in the tyres are moving with greater kinetic energy.

16. The temperature of a sample of gas in a container is 20 °C.

The volume of the gas is $0\cdot30\,m^3$.

The container is free to expand in order to maintain a constant pressure.

The temperature of the gas is increased to 50 °C.

The volume now occupied by the gas is

    A $0\cdot12\,m^3$

    B $0\cdot27\,m^3$

    C $0\cdot30\,m^3$

    D $0\cdot33\,m^3$

    E $0\cdot75\,m^3$.

17. The following diagram gives information about a wave.
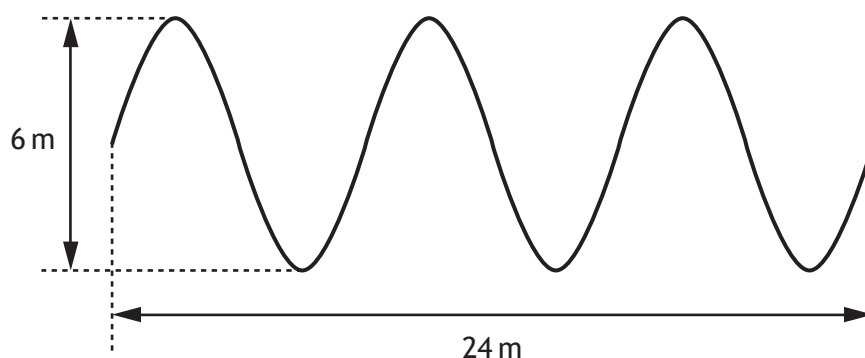
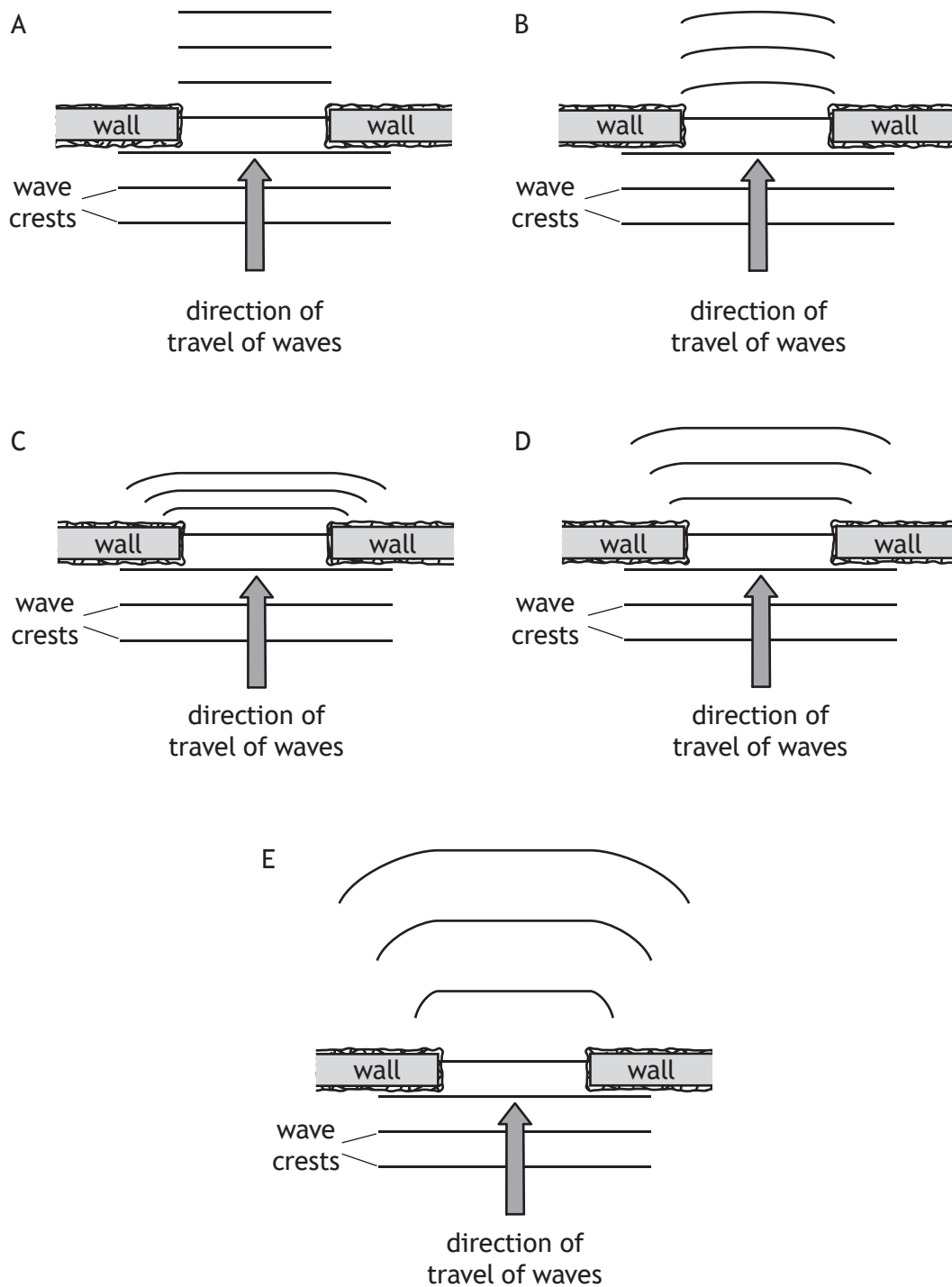Which row in the table shows the amplitude and wavelength of the wave?

	Amplitude (m)	Wavelength (m)
A	3	4
B	3	8
C	6	4
D	6	8
E	8	3

18. A student is studying waves with a period of 80·0 ms and a wavelength of 4·00 m.
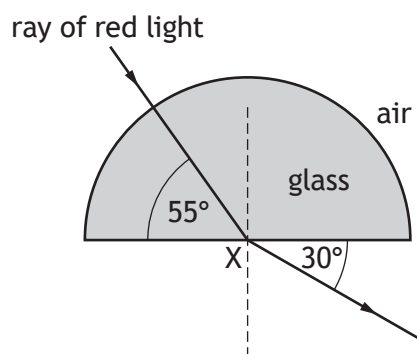
The frequency of these waves is

A   0·0125 Hz

B   0·320 Hz

C   12·5 Hz

D   80·0 Hz

E   320 Hz.

[Turn over

19. Which of the following diagrams shows the diffraction of water waves as they pass between two walls?

A

wall   wall

wave
crests

direction of
travel of waves

B

wall   wall

wave
crests

direction of
travel of waves

C

wall   wall

wave
crests

direction of
travel of waves

D

wall   wall

wave
crests

direction of
travel of waves

E

wall   wall

wave
crests

direction of
travel of waves

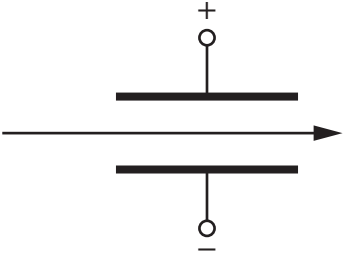**20.** A ray of red light passes through a glass block as shown.
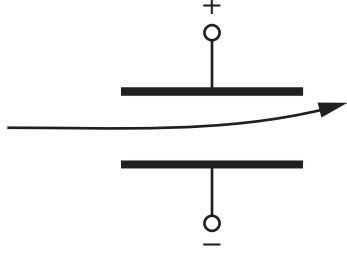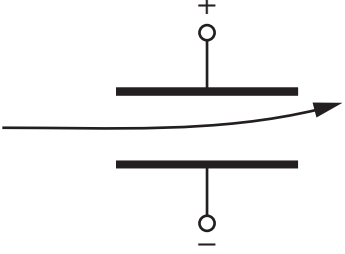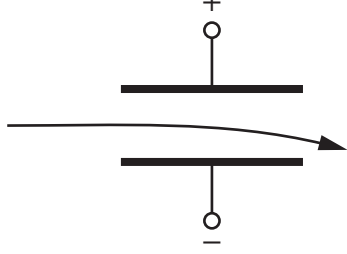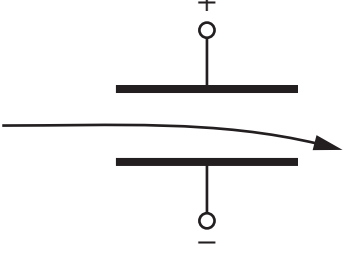

ray of red light
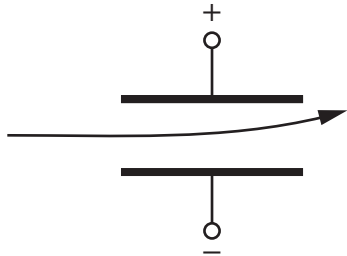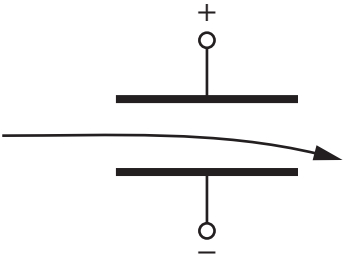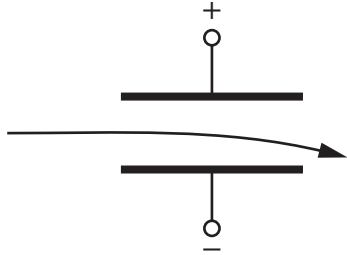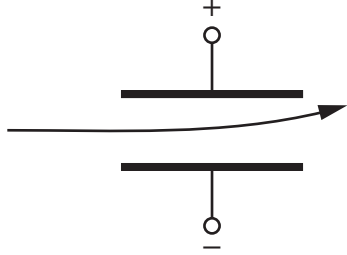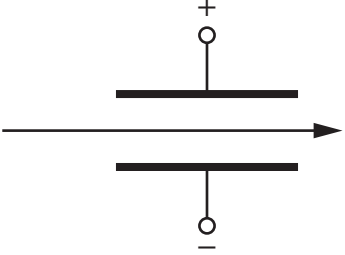
Which row in the table shows the angle of incidence and the corresponding angle of refraction at point X?

	Angle of incidence	Angle of refraction
A	35°	60°
B	30°	55°
C	35°	30°
D	55°	30°
E	60°	35°

21. Which row in the table shows the paths taken by alpha particles and gamma radiation as they pass through a uniform electric field between two metal plates?

	Path taken by alpha particles	Path taken by gamma radiation
A		
B		
C		
D		
E		

22. For a particular radioactive source, 1800 atoms decay in a time of 3 minutes.

   The activity of the source is

   A   10 Bq

   B   600 Bq

   C   1800 Bq

   D   5400 Bq

   E   324 000 Bq.

23. The crew on an aircraft during a transatlantic flight are exposed to cosmic radiation at an equivalent dose rate of $5 \cdot 0 \, \mu Sv \, h^{-1}$.

   The crew complete 6 transatlantic flights each month. The average duration of a flight is 8 hours.

   The equivalent dose received by the crew due to cosmic radiation during transatlantic flights in **one year** is

   A   30 μSv

   B   40 μSv

   C   60 μSv

   D   240 μSv

   E   2880 μSv.

24. A radioactive tracer is injected into a patient to enable doctors to check the function of a patient's kidneys.

   Radiation from the tracer is monitored outside the patient's body by a detector.

   Which row in the table shows the most suitable type of radiation emitted and the half-life for the tracer?

	Type of radiation emitted	Half-life of tracer
A	alpha	6 hours
B	beta	6 hours
C	beta	6 years
D	gamma	6 hours
E	gamma	6 years

[Turn over for next question

25. The activity of a radioactive source is 56 MBq.

   The activity of the source 40 hours later is 3·5 MBq.

   The half-life of this source is

   A   8 hours
   B   10 hours
   C   16 hours
   D   20 hours
   E   28 hours.

[END OF SECTION 1. NOW ATTEMPT THE QUESTIONS IN SECTION 2 OF YOUR QUESTION AND ANSWER BOOKLET]

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