Mock P1 [30 marks]

1. The sides of a square are measured to be $5.0 \pm 0.2\,\text{cm}$. Which of the following gives the area of the square and its uncertainty?

A. $25.0 \pm 0.2\,\text{cm}^2$

B. $25.0 \pm 0.4\,\text{cm}^2$

C. $25 \pm 2\,\text{cm}^2$

D. $25 \pm 4\,\text{cm}^2$

2. *[1 mark]*

What is the unit of power expressed in fundamental SI units?

A. kg m s^{-3}

B. kg m s^{-1}

C. $\text{kg m}^2\,\text{s}^{-1}$

D. $\text{kg m}^2\,\text{s}^{-3}$

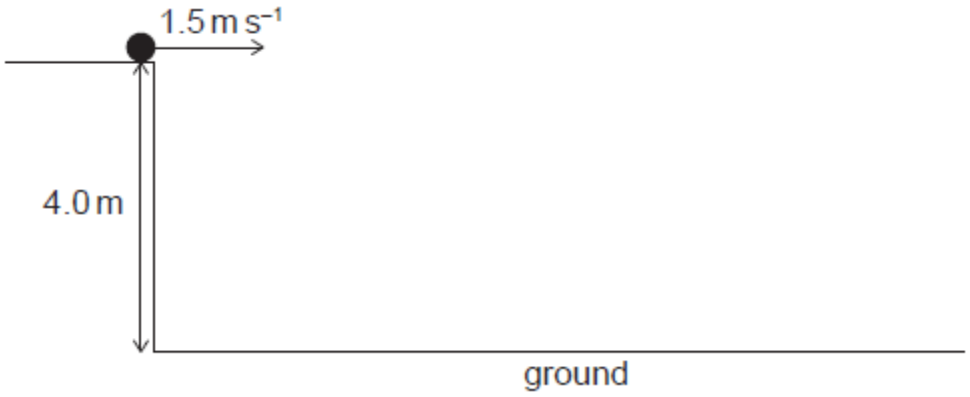
3. *[1 mark]*

A car moves north at a constant speed of 3m s^{-1} for 20s and then east at a constant speed of 4m s^{-1} for 20s. What is the average speed of the car during this motion?

A. 7.0m s^{-1}
B. 5.0m s^{-1}
C. 3.5m s^{-1}
D. 2.5m s^{-1}

4. A stone is kicked horizontally at a speed of 1.5 m s−1 from the edge of a cliff on one of Jupiter's moons. It hits the ground 2.0 s later. The height of the cliff is 4.0 m. Air resistance is negligible.

What is the magnitude of the displacement of the stone?



A. 7.0 m

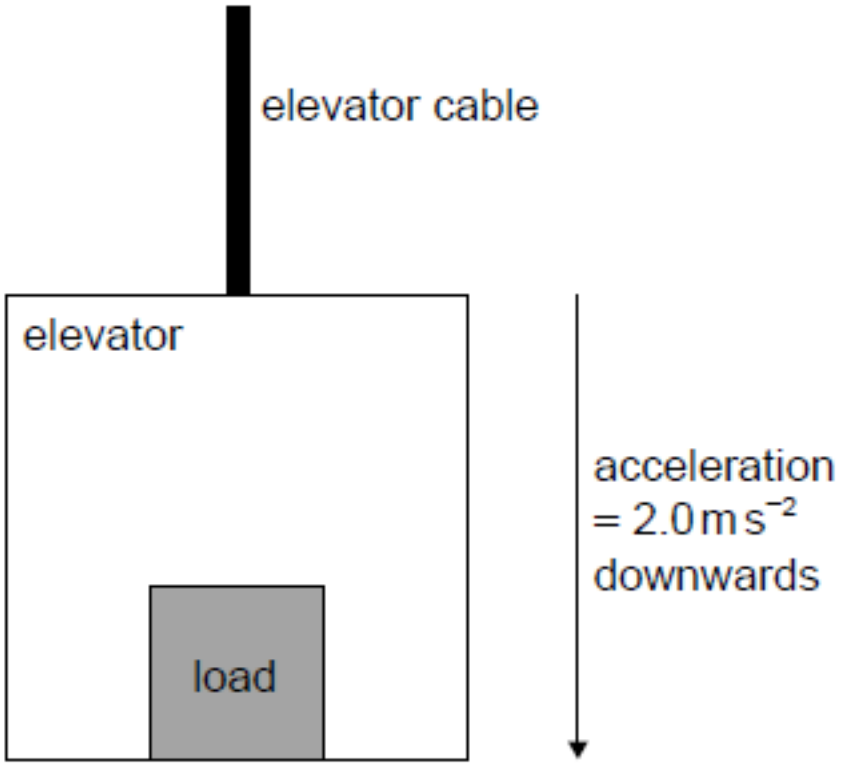
B. 5.0 m

C. 4.0 m

D. 3.0 m

5. *[1 mark]*

An elevator (lift) and its load have a total mass of 750 kg and accelerate vertically downwards at 2.0 m s^{-2}.

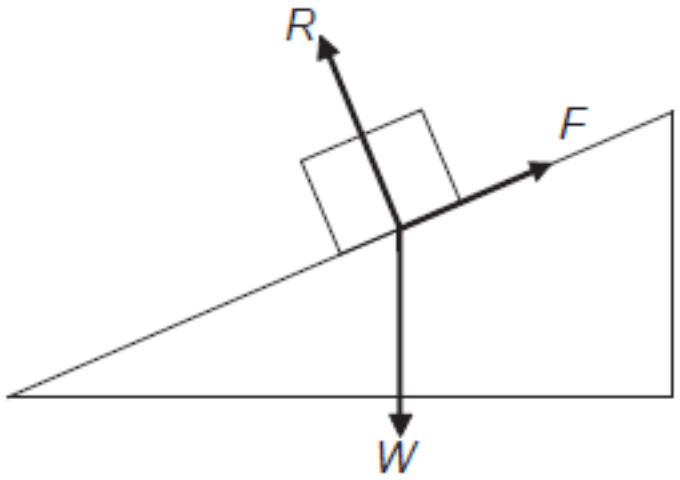


What is the tension in the elevator cable?

A. 1.5 kN
B. 6.0 kN
C. 7.5 kN
D. 9.0 kN

6. *[1 mark]*

Three forces act on a block which is sliding down a slope at constant speed. W is the weight, R is the reaction force at the surface of the block and F is the friction force acting on the block.



In this situation

A. there must be an unbalanced force down the plane.

B. $W = R$.

C. $F = W$.

D. the resultant force on the block is zero.

7. Two trolleys of equal mass travel in opposite directions as shown.

The trolleys collide head-on and stick together.

What is their velocity after the collision?

A. 1 m s−1

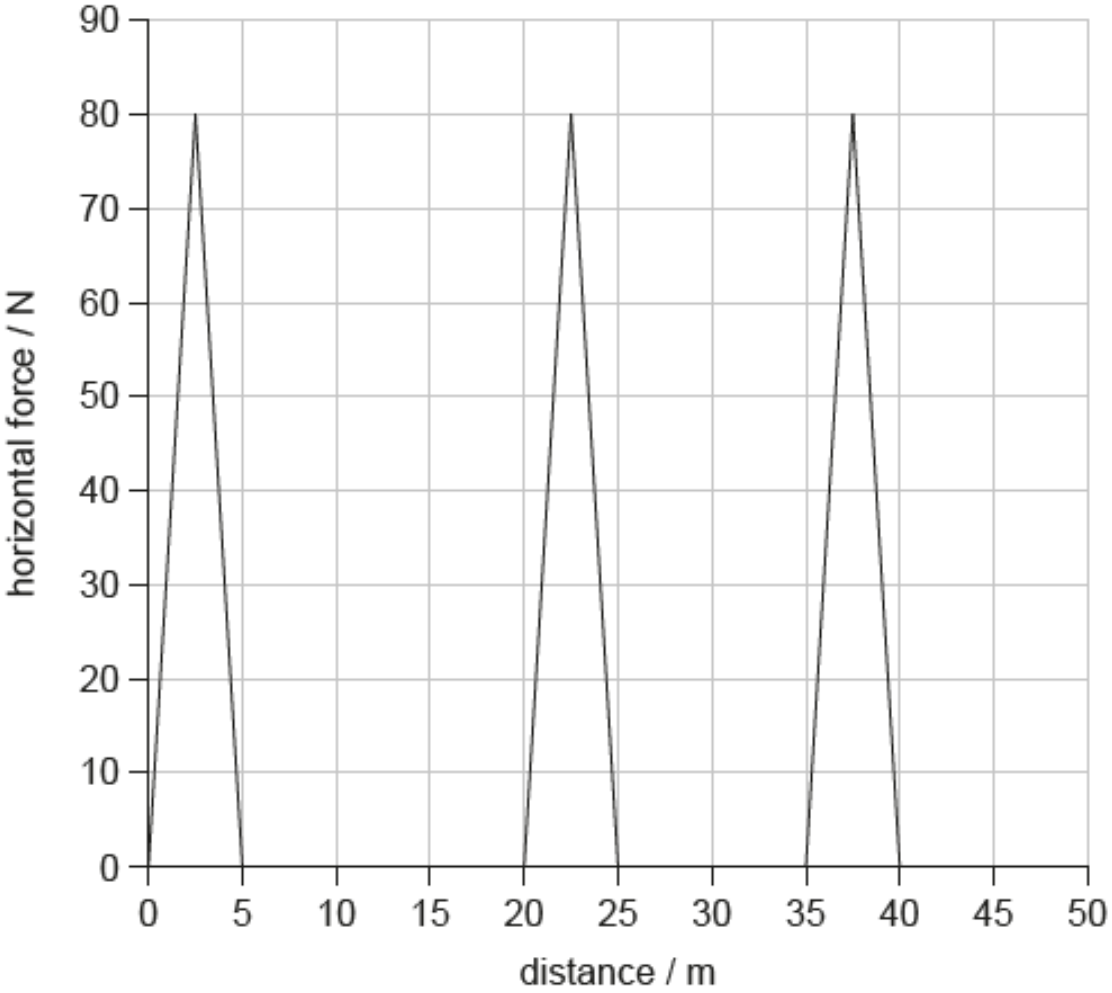
B. 2 m s−1

C. 5 m s−1

D. 10 m s−1

8. *[1 mark]*

The graph shows the variation with distance of a horizontal force acting on an object. The object, initially at rest, moves horizontally through a distance of 50 m.



A constant frictional force of 2.0 N opposes the motion. What is the final kinetic energy of the object after it has moved 50 m?

A. 100 J

B. 500 J

C. 600 J

D. 1100 J

9. A block of glass of mass 5 kg and temperature 30°C is brought into contact with a block of asphalt of mass 20 kg and temperature 75°C. The specific heat capacity of asphalt is twice that of glass. No energy is transferred to the surroundings. What is the final temperature of both blocks?

A. 35°C

B. 45°C

C. 60°C

D. 70°C

10. *[1 mark]*

Two containers X and Y are maintained at the same temperature. X has volume $4\,m^3$ and Y has volume $6\,m^3$. They both hold an ideal gas. The pressure in X is 100 Pa and the pressure in Y is 50 Pa. The containers are then joined by a tube of negligible volume. What is the final pressure in the containers?

A. 70 Pa

B. 75 Pa

C. 80 Pa

D. 150 Pa

11. *[1 mark]*

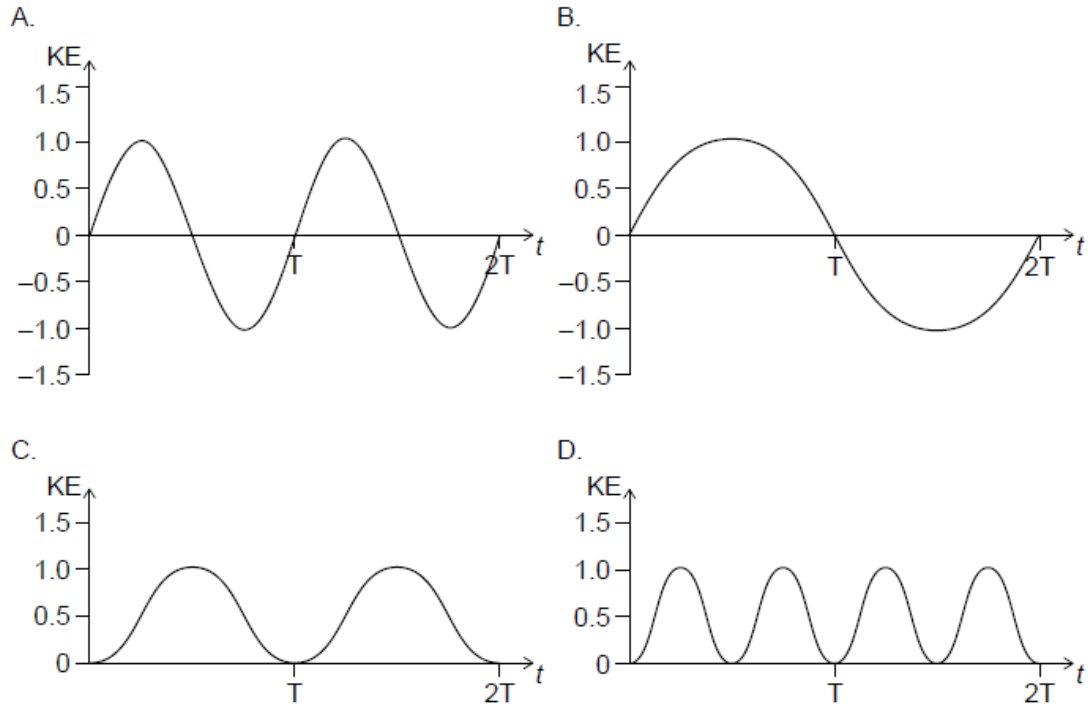
A substance changes from the solid phase to the gas phase without becoming a liquid and without a change in temperature.

What is true about the internal energy of the substance and the total intermolecular potential energy of the substance when this phase change occurs?

	Internal energy of the substance	Total intermolecular potential energy of the substance
A.	increases	no change
B.	no change	no change
C.	increases	increases
D.	no change	increases

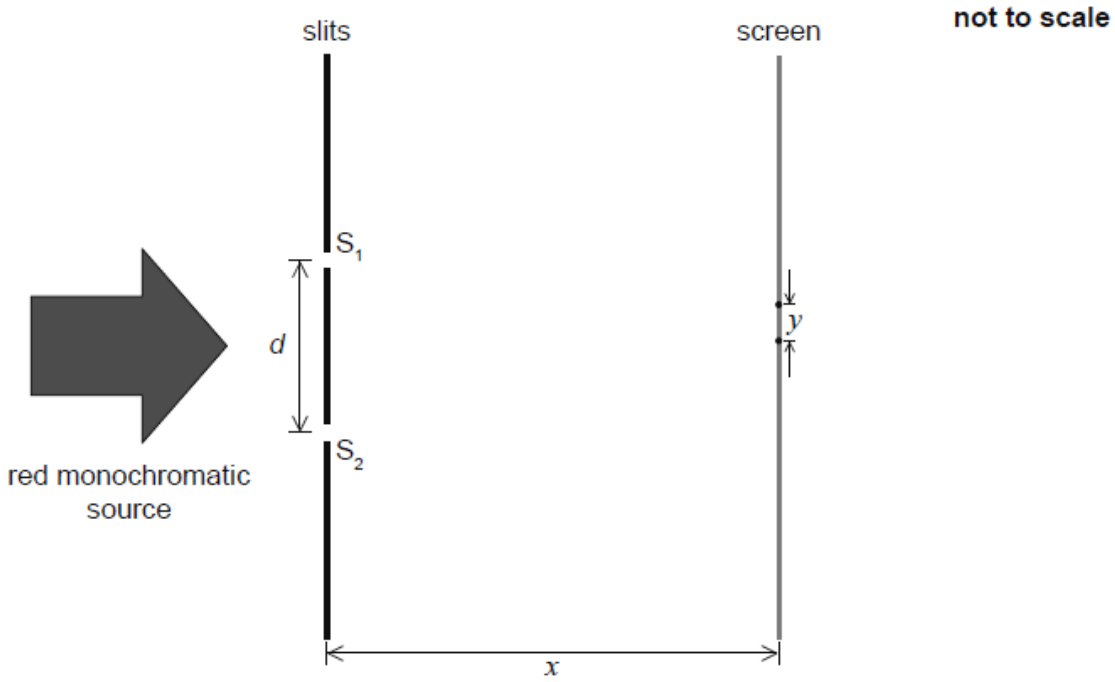
12. *[1 mark]*

Which graph shows the variation with time t of the kinetic energy (KE) of an object undergoing simple harmonic motion (shm) of period T?



13. *[1 mark]*

In a double-slit experiment, a source of monochromatic red light is incident on slits S_1 and S_2 separated by a distance d. A screen is located at distance x from the slits. A pattern with fringe spacing y is observed on the screen.



Three changes are possible for this arrangement

I. increasing x

II. increasing d

III. using green monochromatic light instead of red.

Which changes will cause a decrease in fringe spacing y?

A. I and II only

B. I and III only

C. II and III only

D. I, II, and III

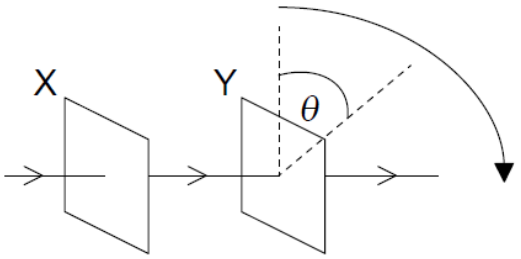
14. *[1 mark]*

An object undergoing simple harmonic motion (SHM) has a period T and total energy E. The amplitude of oscillations is halved. What are the new period and total energy of the system?

	Period	Total energy
A.	$\frac{T}{2}$	$\frac{E}{4}$
B.	$\frac{T}{2}$	$\frac{E}{2}$
C.	T	$\frac{E}{4}$
D.	T	$\frac{E}{2}$

15. *[1 mark]*

Unpolarized light is incident on two polarizing filters X and Y. They are arranged so that light emerging from Y has a maximum intensity. X is fixed and Y is rotated through θ about the direction of the incident beam in its own plane.



What are the first three successive values of θ for which the final transmitted intensity is a maximum?

A. 90°, 180°, 270°

B. 90°, 270°, 450°

C. 180°, 360°, 540°

D. 180°, 540°, 720°

16. *[1 mark]*

A pipe of length L is closed at one end. Another pipe is open at both ends and has length $2L$. What is the lowest common frequency for the standing waves in the pipes?

A. $\frac{\text{speed of sound in air}}{8\text{L}}$

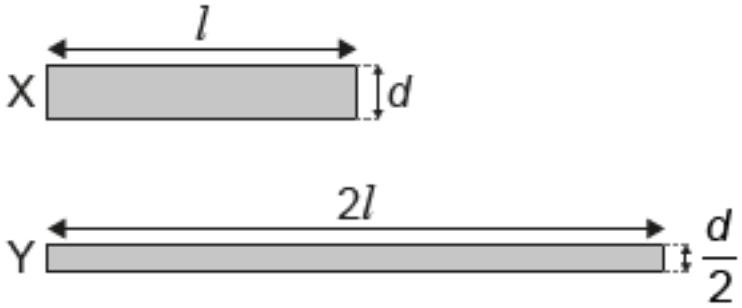
B. $\frac{\text{speed of sound in air}}{4\text{L}}$

C. $\frac{\text{speed of sound in air}}{2\text{L}}$

D. $\frac{\text{speed of sound in air}}{\text{L}}$

17. *[1 mark]*

The diagram shows two cylindrical wires, X and Y. Wire X has a length l, a diameter d, and a resistivity ρ. Wire Y has a length $2l$, a diameter of $\frac{d}{2}$ and a resistivity of $\frac{\rho}{2}$.



What is $\frac{\text{resistance of X}}{\text{resistance of Y}}$?

A. 4

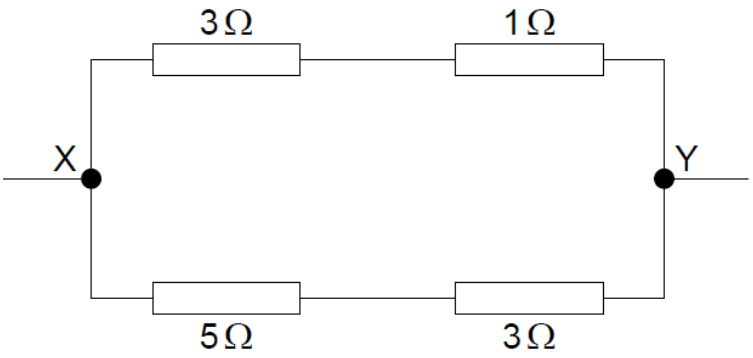
B. 2

C. 0.5

D. 0.25

18. *[1 mark]*

The diagram shows a resistor network. The potential difference between X and Y is 8.0 V.



What is the current in the 5Ω resistor?

A. 1.0A

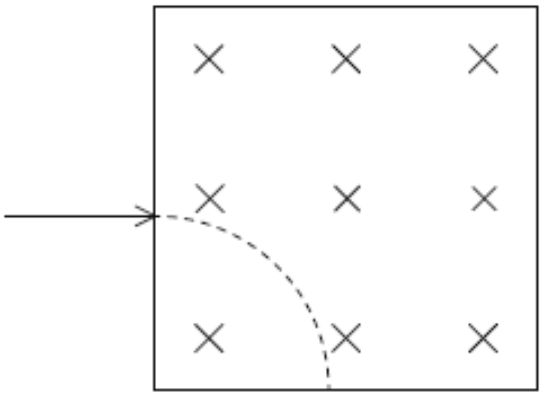
B. 1.6A

C. 2.0A

D. 3.0A

19. *[1 mark]*

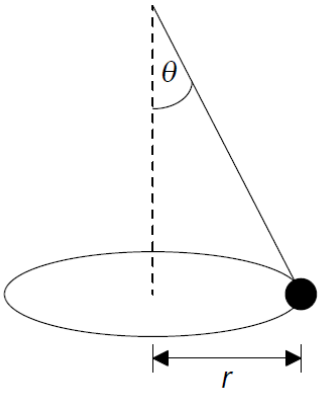
A particle of mass *m* and charge of magnitude *q* enters a region of uniform magnetic field *B* that is directed into the page. The particle follows a circular path of radius *R*. What are the sign of the charge of the particle and the speed of the particle?



	Charge of the particle	Speed of the particle
A.	positive	$\frac{qBR}{m}$
B.	negative	$\frac{qBR}{m}$
C.	negative	$\sqrt{\frac{qBR}{m}}$
D.	positive	$\sqrt{\frac{qBR}{m}}$

20. *[1 mark]*

An object hangs from a light string and moves in a horizontal circle of radius *r*.



The string makes an angle θ with the vertical. The angular speed of the object is ω. What is $\tan\theta$?

A. $\frac{\omega^2 r}{g}$

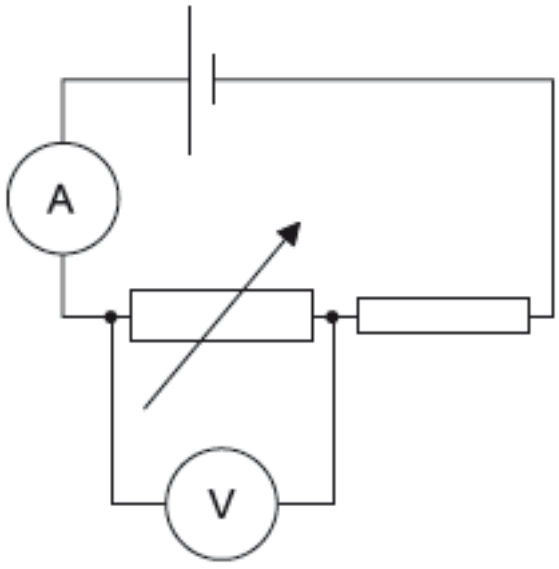
B. $\frac{g}{\omega^2 r}$

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

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

21. *[1 mark]*

A cell with negligible internal resistance is connected as shown. The ammeter and the voltmeter are both ideal.



What changes occur in the ammeter reading and in the voltmeter reading when the resistance of the variable resistor is increased?

	Change in ammeter reading	Change in voltmeter reading
A.	increases	increases
B.	increases	decreases
C.	decreases	increases
D.	decreases	decreases

22. *[1 mark]*

Magnetic field lines are an example of

A. a discovery that helps us understand magnetism.

B. a model to aid in visualization.

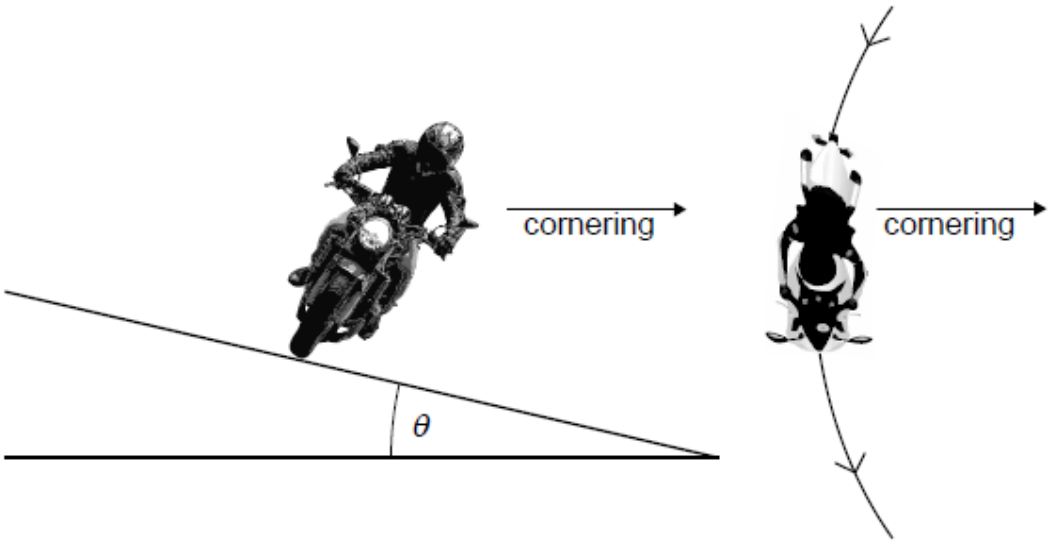
C. a pattern in data from experiments.

D. a theory to explain concepts in magnetism.

23. *[1 mark]*

A motorcyclist is cornering on a curved race track.

Which combination of changes of banking angle θ and coefficient of friction μ between the tyres and road allows the motorcyclist to travel around the corner at greater speed?



	Banking angle θ	Coefficient of friction μ
A.	increase	increase
B.	increase	decrease
C.	decrease	increase
D.	decrease	decrease

24. *[1 mark]*

What statement about alpha particles, beta particles and gamma radiation is true?

A. Gamma radiation always travels faster than beta particles in a vacuum.

B. In air, beta particles produce more ions per unit length travelled than alpha particles.

C. Alpha particles are always emitted when beta particles are emitted.

D. Alpha particles are deflected in the same direction as beta particles in a magnetic field.

25. *[1 mark]*

Two pure samples of radioactive nuclides X and Y have the same initial number of atoms. The half-life of X is $T_{\frac{1}{2}}$.

After a time equal to 4 half-lives of X the ratio $\frac{\text{number of atoms of X}}{\text{number of atoms of Y}}$ is $\frac{1}{8}$.

What is the half-life of Y?

A. $0.25T_{\frac{1}{2}}$

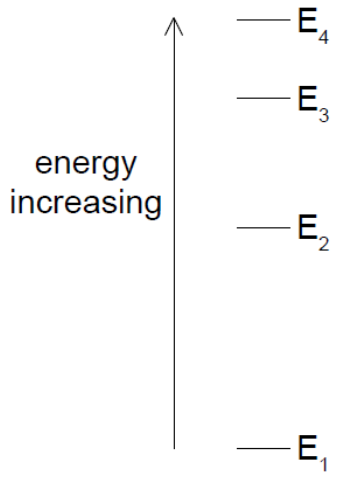
B. $0.5T_{\frac{1}{2}}$

C. $3T_{\frac{1}{2}}$

D. $4T_{\frac{1}{2}}$

26. *[1 mark]*

The energy levels for an atom are shown to scale.



A photon of wavelength λ is emitted because of a transition from E_3 to E_2. Which transition leads to the emission of a photon of longer wavelength?

A. E_4 to E_1

B. E_4 to E_3

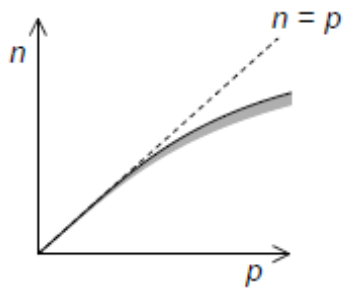
C. E_3 to E_1

D. E2 to E_1

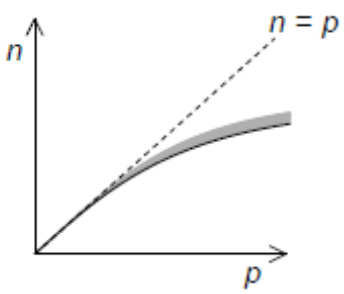
27. *[1 mark]*

The positions of stable nuclei are plotted by neutron number *n* and proton number *p*. The graph indicates a dotted line for which *n* = *p*. Which graph shows the line of stable nuclides and the shaded region where unstable nuclei emit beta minus (β^-) particles?

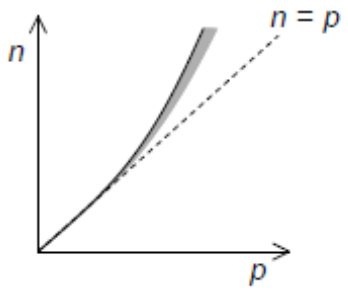
A.



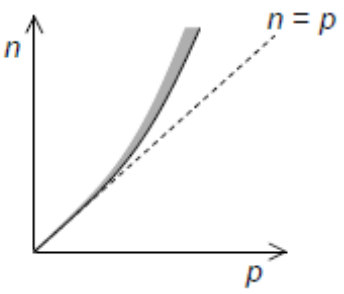
B.



C.



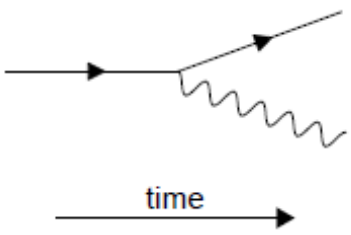
D.



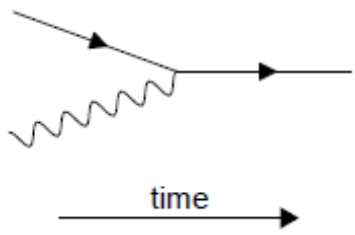
28. *[1 mark]*

Which Feynman diagram shows the emission of a photon by a charged antiparticle?

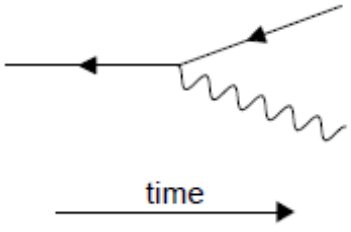
A.



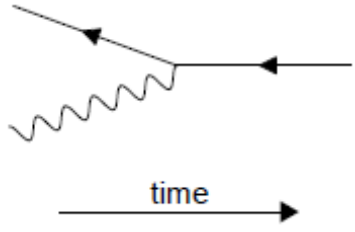
B.



C.



D.



29. *[1 mark]*

What is the main role of carbon dioxide in the greenhouse effect?

A. It absorbs incoming radiation from the Sun.

B. It absorbs outgoing radiation from the Earth.

C. It reflects incoming radiation from the Sun.

D. It reflects outgoing radiation from the Earth.

30. *[1 mark]*

What is the function of control rods in a nuclear power plant?

A. To slow neutrons down

B. To regulate fuel supply

C. To exchange thermal energy

D. To regulate the reaction rate