1. Take the acceleration due to gravity, g_E, as 10 m s^{-2} on the surface of the Earth.

The acceleration due to gravity on the surface of the Moon is $\frac{g_E}{6}$. An object whose weight on Earth is 5.0 N is dropped from rest above the Moon's surface. What is its momentum after falling for 3.0s?

A 2.5 kg m s^{-1}

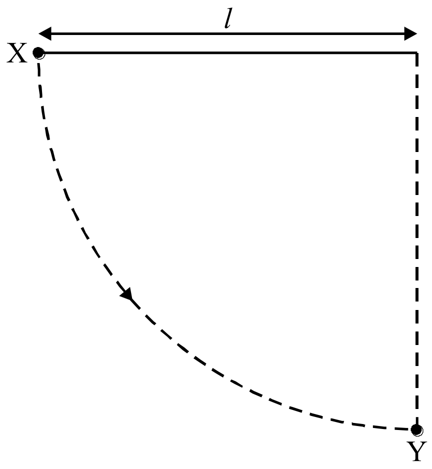
B 6.2 kg m s^{-1}

C 15 kg m s^{-1}

D 25 kg m s^{-1}

(Total 1 mark)

2.



A simple pendulum consists of a bob of mass m on the end of a light string of length l. The bob is released from rest at X when the string is horizontal. When the bob passes through Y its velocity is υ and the tension in the string is T. Which one of the following equations gives the correct value of T?

A $T = mg$

B $T = \frac{m\upsilon^2}{l}$

C $T + mg = \frac{m\upsilon^2}{l}$

D $T - mg = \frac{m\upsilon^2}{l}$

(Total 1 mark)

3. In experiments to pass a very high current through a gas, a bank of capacitors of total capacitance 50 μF is charged to 30 kV. If the bank of capacitors could be discharged completely in 5.0 ms what would be the mean power delivered?

A 9.0 MW

B 4.5 MW

C 110 kW

D 22 kW

(Total 1 mark)

4. The following data refer to two planets.

	radius/km	density/kg m^{-3}
planet P	8000	6000
planet Q	16000	3000

The gravitational field strength at the surface of P is 13.4 N kg^{-1}. What is the gravitational field strength at the surface of Q?

A 3.4 N kg^{-1}

B 13.4 N kg^{-1}

C 53.6 N kg^{-1}

D 80.4 N kg^{-1}

(Total 1 mark)

5. A body is in simple harmonic motion of amplitude 0.50 m and period 4π seconds. What is the speed of the body when the displacement of the body is 0.30 m?

A 0.10 m s^{-1}

B 0.15 m s^{-1}

C 0.20 m s^{-1}

D 0.40 m s^{-1}

(Total 1 mark)

6. Which one of the following statements always applies to a damping force acting on a vibrating system?

A It is in the same direction as the acceleration.

B It is in the same direction as the displacement.

C It is in the opposite direction to the velocity.

D It is proportional to the displacement.

(Total 1 mark)

7. A simple pendulum and a mass-spring system are taken to the Moon, where the gravitational field strength is less than on Earth. Which line, **A** to **D**, correctly describes the change, if any, in the period when compared with its value on Earth?

	period of pendulum	period of mass-spring system
A	decrease	decrease
B	increase	increase
C	no change	decrease
D	increase	no change

(Total 2 marks)

8. A body moves with simple harmonic motion of amplitude A and frequency $\dfrac{b}{2\pi}$.

What is the magnitude of the acceleration when the body is at maximum displacement?

A zero

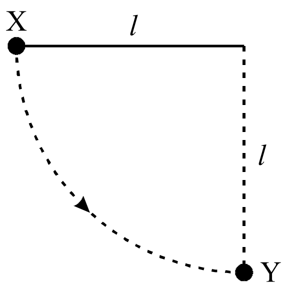
B $4\pi^2Ab^2$

C Ab^2

D $\dfrac{4\pi^2 A}{b^2}$

(Total 2 marks)

9.



A ball of mass m, which is fixed to the end of a light string of length l, is released from rest at X. It swings in a circular path, passing through the lowest point Y at speed υ. If the tension in the string at Y is T, which one of the following equations represents a correct application of Newton's laws of motion to the ball at Y?

A $T = \dfrac{m\upsilon^2}{l} - mg$

B $T - mg = \dfrac{m\upsilon^2}{l}$

C $mg - T = \dfrac{m\upsilon^2}{l}$

D $T + \dfrac{m\upsilon^2}{l} = mg$

(Total 2 marks)

10. The gravitational potential difference between the surface of a planet and a point P, 10 m above the surface, is 8.0 J kg^{-1}. Assuming a uniform field, what is the value of the gravitational field strength in the region between the planet's surface and P?

A 0.80 N kg^{-1}

B 1.25 N kg^{-1}

C 8.0 N kg^{-1}

D 80 N kg^{-1}

(Total 2 marks)

11. If the potential difference between a pair of identical, parallel, conducting plates is known, what is the only additional knowledge required to determine the electric field strength between the plates?

A the permittivity of the medium between the plates

B the separation and area of the plates

C the separation and area of the plates and the permittivity of the medium between the plates

D the separation of the plates

(Total 2 marks)

12. Which one of the following statements about *electric field strength* and *electric potential* is **incorrect**?

A Electric potential is a scalar quantity.

B Electric field strength is a vector quantity.

C Electric potential is zero whenever the electric field strength is zero.

D The potential gradient is proportional to the electric field strength.

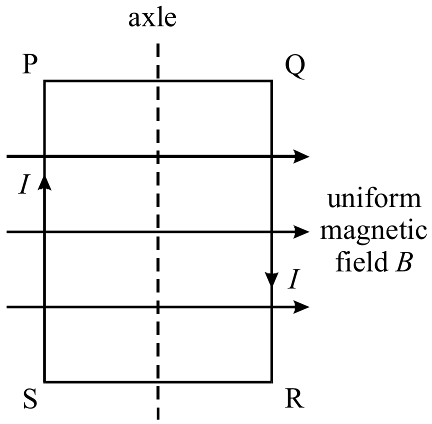
(Total 2 marks)

13. Which line, **A** to **D**, gives correct units for both magnetic flux and magnetic flux density?

	magnetic flux	magnetic flux destiny
A	Wb m^{-2}	Wb
B	Wb	T
C	Wb m^{-2}	T m^{-2}
D	T m^{-2}	Wb m^{-2}

(Total 2 marks)

14.



A coil, mounted on an axle, has its plane parallel to the flux lines of a uniform magnetic field B, as shown. When a current I is switched on, and before the coil is allowed to move,

A there are no forces due to B on the sides SP and QR.

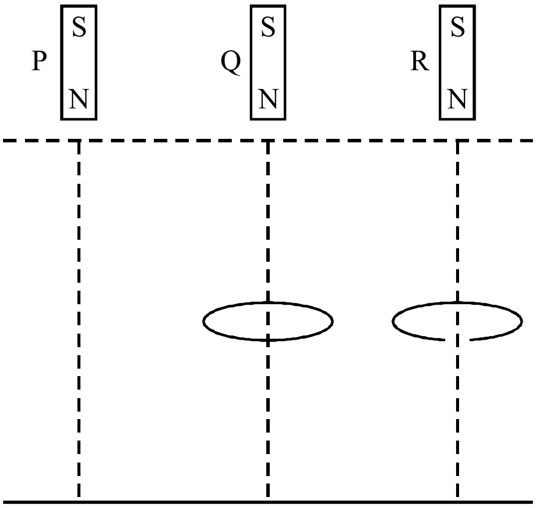
B there are no forces due to B on the sides PQ and RS.

C sides SP and QR tend to attract each other.

D sides PQ and RS tend to attract each other.

(Total 2 marks)

15.



Three identical magnets P, Q and R are released simultaneously from rest and fall to the ground from the same height. P falls directly to the ground, Q falls through the centre of a thick conducting ring and R falls through a ring which is identical except for a gap cut into it. Which one of the statements below correctly describes the sequence in which the magnets reach the ground?

A P and R arrive together followed by Q.

B P and Q arrive together followed by R.

C P arrives first, followed by Q which is followed by R.

D All three magnets arrive simultaneously.

(Total 2 marks)

16. A mass M hangs in equilibrium on a spring. M is made to oscillate about the equilibrium position by pulling it down 10 cm and releasing it. The time for M to travel back to the equilibrium position for the first time is 0.50 s. Which line, **A** to **D**, is correct for these oscillations?

	amplitude/cm	period/s
A	10	1.0
B	10	2.0
C	20	2.0
D	20	1.0

(Total 2 marks)

17. A wave motion has period T, frequency f, wavelength λ and speed υ. Which one of the following equations is **incorrect**?

A $1 = Tf$

B $T = \dfrac{\upsilon}{\lambda}$

C $\lambda = \dfrac{\upsilon}{f}$

D $T\upsilon = \lambda$

(Total 2 marks)

18. Which one of the following statements is true when an object performs simple harmonic motion about a central point O?

A The acceleration is always away from O.

B The acceleration and velocity are always in opposite directions.

C The acceleration and the displacement from O are always in the same direction.

D The graph of acceleration against displacement is a straight line.

(Total 2 marks)

19. A girl of mass 40 kg stands on a roundabout 2.0 m from the vertical axis as the roundabout rotates uniformly with a period of 3.0 s. The horizontal force acting on the girl is approximately

A zero.

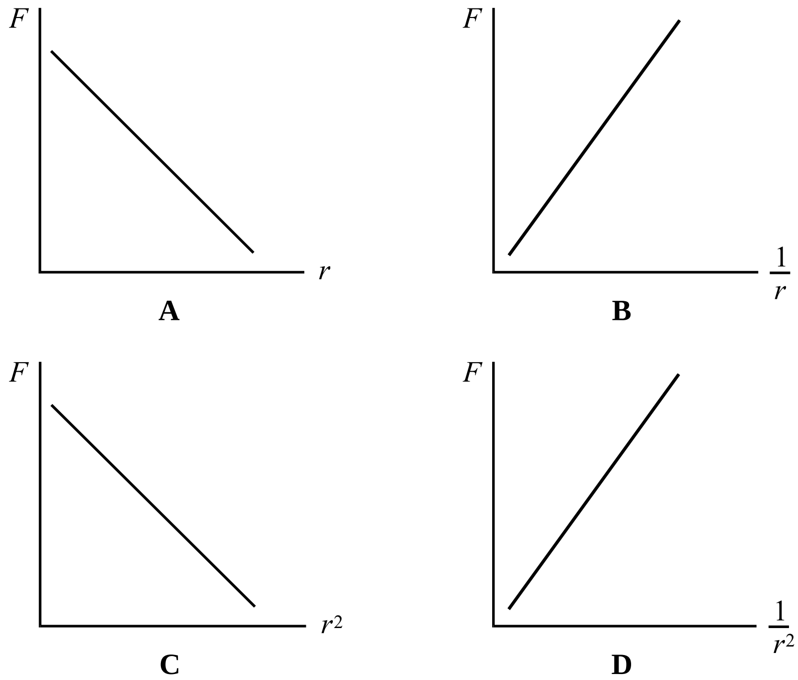
B 3.5×10^2 N.

C 7.2×10^2 N.

D 2.8×10^4 N.

(Total 2 marks)

20. Which one of the following graphs correctly shows the relationship between the gravitational force, *F*, between two masses and the distance, *r*, between them?



(Total 2 marks)

21. For a particle moving in a circle with uniform speed, which one of the following statements is **incorrect**?

A The velocity of the particle is constant.

B The force on the particle is always perpendicular to the velocity of the particle.

C There is no displacement of the particle in the direction of the force.

D The kinetic energy of the particle is constant.

(Total 2 marks)

22. A satellite is in orbit at a height h above the surface of a planet of mass M and radius R. What is the velocity of the satellite?

A $\sqrt{\dfrac{GM(R+h)}{R}}$

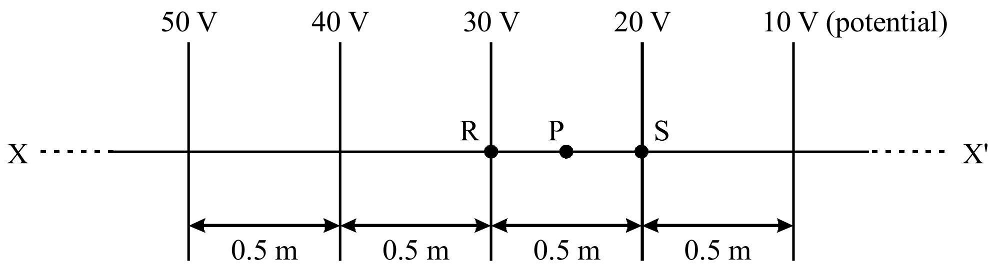
B $\dfrac{\sqrt{GM(R+h)}}{R}$

C $\sqrt{\dfrac{GM}{(R+h)}}$

D $\dfrac{\sqrt{GM}}{(R+h)}$

(Total 2 marks)

23.



The diagram shows how the electric potential varies along a line XX' in an electric field. What will be the electric field strength at a point P on XX' which is mid-way between R and S?

A 5.0 V m^{-1}

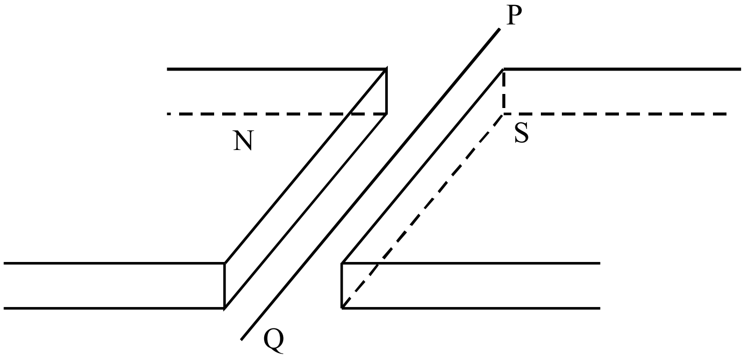
B 10 V m^{-1}

C 20 V m^{-1}

D 30 V m^{-1}

(Total 2 marks)

24.



A wire lies perpendicularly across a horizontal uniform magnetic field of flux density 20×10^{-3} T so that 0.30 m of the wire is effectively subjected to the field. If the force exerted on this length of wire due to a current in it is 30×10^{-3} N downward, what is the current in the wire?

A 0.45 A from P to Q

B 0.45 A from Q to P

C 5.0 A from P to Q

D 5.0 A from Q to P

(Total 2 marks)

25. An electron moves due North in a horizontal plane with uniform speed. It enters a uniform magnetic field directed due South in the same plane. Which one of the following statements concerning the motion of the electron in the magnetic field is correct?

A It continues to move North with its original speed.

B It slows down to zero speed and then accelerates due South.

C It is accelerated due West.

D It is accelerated due North.

(Total 2 marks)

26. Which one of the following gives the phase difference between the particle velocity and the particle displacement in simple harmonic motion?

A $\frac{\pi}{4}$ rad

B $\frac{\pi}{2}$ rad

C $\frac{3\pi}{4}$ rad

D 2π rad

(Total 2 marks)

27. A particle oscillates with undamped simple harmonic motion. Which one of the following statements about the acceleration of the oscillating particle is true?

A It is least when the speed is greatest.

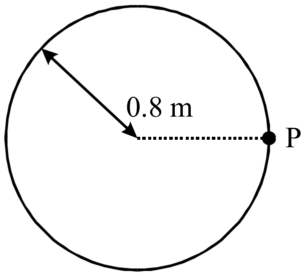
B It is always in the opposite direction to its velocity.

C It is proportional to the frequency.

D It decreases as the potential energy increases.

(Total 2 marks)

28.



A model car moves in a circular path of radius 0.8 m at an angular speed of $\frac{\pi}{2}$ rad s^{-1}.

What is its displacement from point P, 6 s after passing P?

A zero

B 1.6 m

C 0.47π m

D 1.6π m

(Total 2 marks)

29. A small mass is situated at a point on a line joining two large masses m_1 and m_2 such that it experiences no resultant gravitational force. If its distance from the mass m_1 is r_1 and its distance from the mass m_2 is r_2, what is the value of the ratio $\frac{r_1}{r_2}$?

A $\frac{m_1^{\,2}}{m_2^{\,2}}$

B $\frac{m_2^{\,2}}{m_1^{\,2}}$

C $\sqrt{\frac{m_1}{m_2}}$

D $\sqrt{\frac{m_2}{m_1}}$

(Total 2 marks)

30. Which one of the following has different units to the other three?

A gravitational potential

B gravitational field strength

C force per unit mass

D gravitational potential gradient

(Total 2 marks)

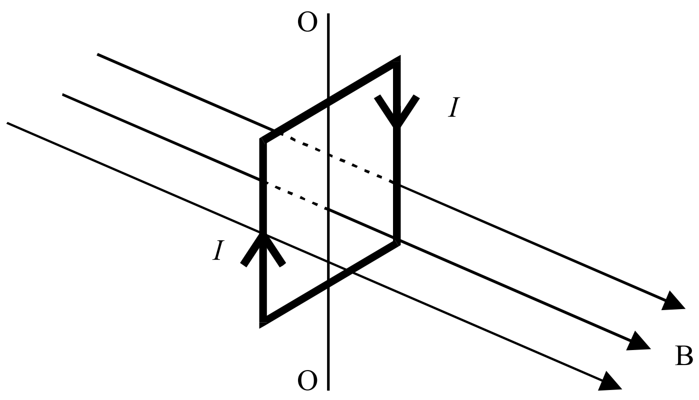
31. Two horizontal parallel plate conductors are separated by a distance of 5.0 mm in air. The lower plate is earthed and the potential of the upper plate is + 50 V.

Which line, **A** to **D**, gives correctly the electric field strength, *E*, and the potential, *V*, at a point midway between the plates?

	electric field strength E/V m^{-1}	*potential V*/V
A	1×10^4 upwards	25
B	1×10^4 downwards	25
C	1×10^4 upwards	50
D	1×10^4 downwards	50

(Total 2 marks)

32. The diagram shows a vertical square coil whose plane is at right angles to a horizontal uniform magnetic field B. A current, *I*, flows in the coil, which can rotate about a vertical axis OO'.



Which one of the following statements is correct?

A The forces on the two vertical sides of the coil are equal and opposite.

B A couple acts on the coil.

C No forces act on the horizontal sides of the coil.

D If the coil is turned through a small angle about OO', it will remain in position.

(Total 2 marks)

33. An α particle and a β^- particle both enter the same uniform magnetic field, which is perpendicular to their direction of motion. If the β^- particle has a speed 15 times that of the α particle, what is the value of the ratio

$$\frac{\text{magnitude of force on } \beta^- \text{ particle}}{\text{magnitude of force on } \alpha \text{ particle}}?$$

A 3.7

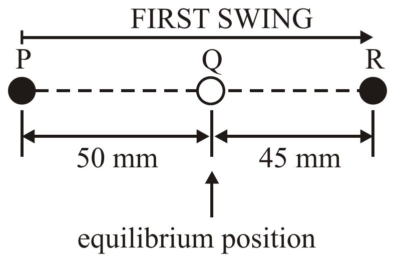
B 7.5

C 60

D 112.5

(Total 2 marks)

34. A particle, whose equilibrium position is at Q, is set into oscillation by being displaced to P, 50 mm from Q, and then released from rest. Its subsequent motion is simple harmonic, but subject to damping. On the first swing, the particle comes to rest momentarily at R, 45 mm from Q.



During this first swing, the greatest value of the acceleration of the particle is when it is at

A P.

B Q.

C R.

D P and R.

(Total 2 marks)

35. A particle of mass 5.0×10^{-3} kg performing simple harmonic motion of amplitude 150 mm takes 47 s to make 50 oscillations. What is the maximum kinetic energy of the particle?

A 2.0×10^{-3} J

B 2.5×10^{-3} J

C 3.9×10^{-3} J

D 5.0×10^{-3} J

(Total 2 marks)

36. When the length of a simple pendulum is decreased by 600 mm, the period of oscillation is halved. What is the original length of the pendulum?

A 800mm

B 1000mm

C 1200mm

D 1400mm

(Total 2 marks)

37. A wave of frequency 5 Hz travels at 8 km s^{-1} through a medium. What is the phase difference, in radians, between two points 2 km apart?

A 0

B $\frac{\pi}{2}$

C π

D $\frac{3\pi}{2}$

(Total 2 marks)

38. A 10 mF capacitor is charged to 10 V and then discharged completely through a small motor. During this process, the motor lifts a weight of mass 0.10 kg. If 10% of the energy stored in the capacitor is used to lift the weight, through what approximate height will the weight be lifted?

A 0.05 m

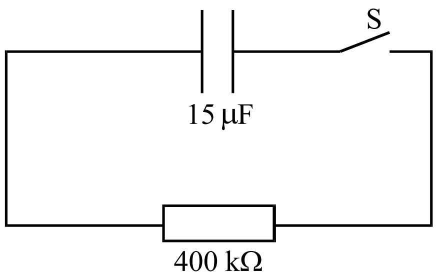
B 0.10 m

C 0.50 m

D 1.00 m

(Total 2 marks)

39. A capacitor of capacitance 15 μF is fully charged and the potential difference across its plates is 8.0V. It is then connected into the circuit as shown.



The switch S is closed at time $t = 0$. Which one of the following statements is correct?

A The time constant of the circuit is 6.0 ms.

B The initial charge on the capacitor is 12 μC.

C After a time equal to twice the time constant, the charge remaining on the capacitor is Q_0e^2, where Q_0 is the charge at time $t = 0$.

D After a time equal to the time constant, the potential difference across the capacitor is 2.9 V.

(Total 2 marks)

40. A fairground roundabout makes nine revolutions in one minute. What is the angular speed of the roundabout?

A 0.15 rad s^{-1}

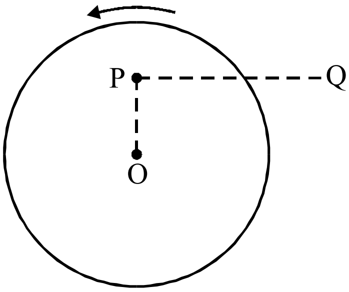
B 0.34 rad s^{-1}

C 0.94 rad s^{-1}

D 2.1 rad s^{-1}

(Total 2 marks)

41.



A small mass is placed at P on a horizontal disc which has centre O. The disc rotates anti-clockwise about a vertical axis through O with constant angular speed. Which one of the following describes the force which keeps the mass at rest relative to the disc?

A the weight of the mass

B a frictional force directed away from O

C a frictional force directed towards O

D a frictional force directed from P to Q

(Total 2 marks)

42. The force between two point charges is F when they are separated by a distance r. If the separation is increased to $3r$ what is the force between the charges?

A $\frac{F}{3r}$

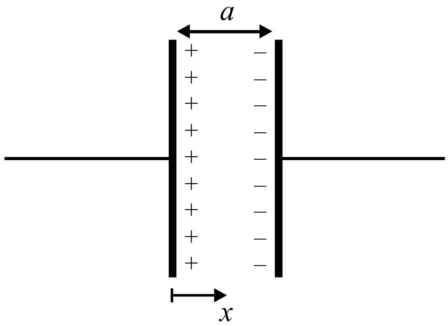
B $\frac{F}{9r}$

C $\frac{F}{3}$

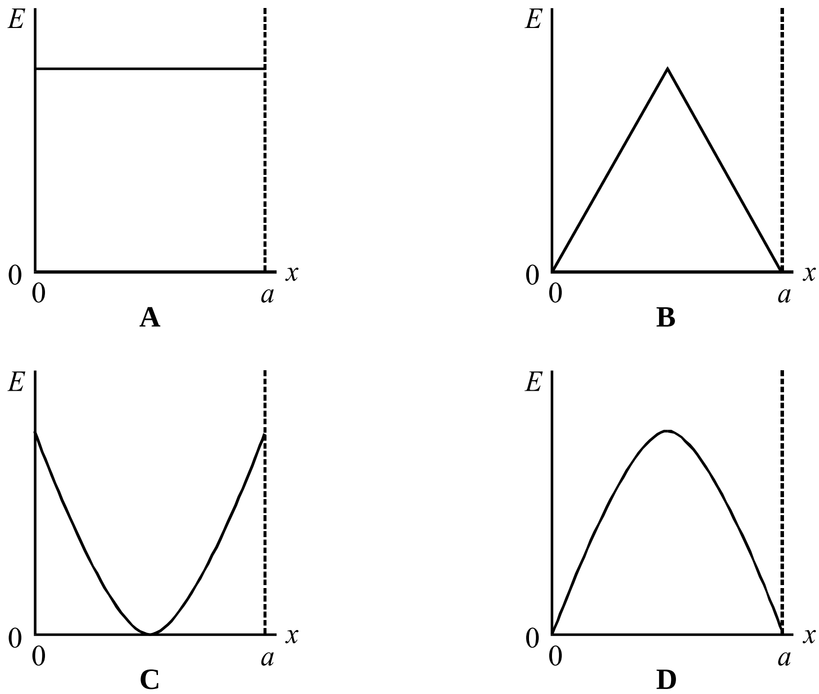
D $\frac{F}{9}$

(Total 2 marks)

43.



Two parallel metal plates of separation a carry equal and opposite charges. Which one of the following graphs, **A** to **D**, best represents how the electric field strength E varies with the distance x in the space between the plates?



(Total 2 marks)

44. A body moves in simple harmonic motion of amplitude 0.90 m and period 8.9 s. What is the speed of the body when its displacement is 0.70 m?

A 0.11 m s^{-1}

B 0.22 m s^{-1}

C 0.40 m s^{-1}

D 0.80 m s^{-1}

(Total 2 marks)

45. To find a value for the acceleration of free fall, g, a student measured the time of oscillation, T, of a simple pendulum whose length, l, is changed. The student used the results to plot a graph of T^2 (y axis) against l (x axis) and found the slope of the line to be S. It follows that g is

A $\frac{4\pi^2}{S}$.

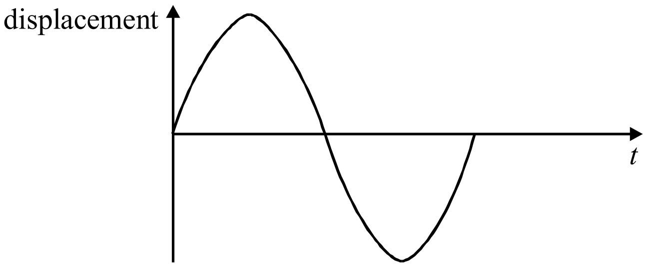
B $4\pi^2 S$.

C $\frac{2\pi}{S}$.

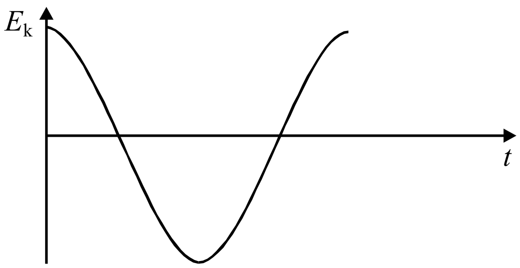
D $2\pi S$.

(Total 2 marks)

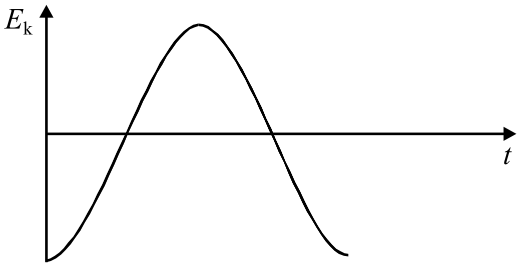
46. The top graph is a displacement/time graph for a particle executing simple harmonic motion. Which one of the other graphs shows correctly how the kinetic energy, E_k, of the particle varies with time?



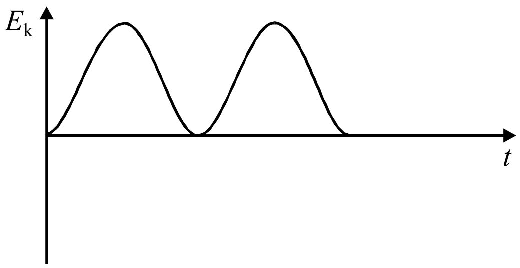
A



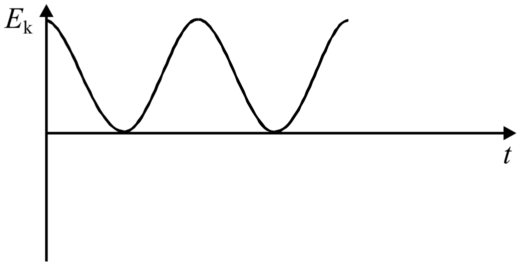
B



C



D



(Total 2 marks)

47. What is the angular speed of a satellite in a geo-synchronous orbit around the Earth?

A 7.3×10^{-5} rad s^{-1}

B 2.6×10^{-1} rad s^{-1}

C 24 rad s^{-1}

D 5.0×10^{6} rad s^{-1}

(Total 2 marks)

48. An object moving at constant speed in a circle experiences a force that is

A in the direction of motion.

B outwards and at right angles to the direction of motion.

C inwards and at right angles to the direction of motion.

D opposite to the direction of motion.

(Total 2 marks)

49. A planet has a radius half of the Earth's radius and a mass a quarter of the Earth's mass. What is the approximate gravitational field strength on the surface of the planet?

A 1.6 N kg^{-1}

B 5.0 N kg^{-1}

C 10 N kg^{-1}

D 20 N kg^{-1}

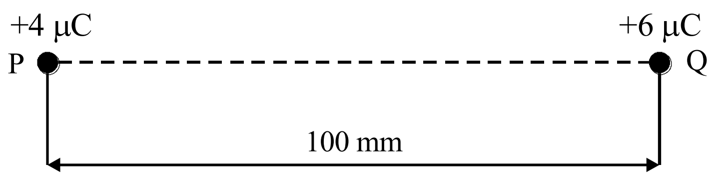
(Total 2 marks)

50. At a distance R from a fixed charge, the electric field strength is E and the electric potential is V. Which line, **A** to **D**, gives the electric field strength and electric potential at a distance $2R$ from the charge?

	electric field strength	electric potential
A	$\frac{E}{2}$	$\frac{V}{4}$
B	$\frac{E}{2}$	$\frac{V}{2}$
C	$\frac{E}{4}$	$\frac{V}{2}$
D	$\frac{E}{4}$	$\frac{V}{4}$

(Total 2 marks)

51. Two charges, P and Q, are 100 mm apart.



X is a point on the line between P and Q. If the potential at X is 0 V, what is the distance from P to X?

A 40 mm

B 45 mm

C 50 mm

D 60 mm

(Total 2 marks)

52. Which line, **A** to **D**, correctly describes the trajectory of charged particles which enter, at right angles, (a) a uniform electric field, and (b) a uniform magnetic field?

	(a) uniform electric field	(b) uniform magnetic field
A	circular	circular
B	circular	parabolic
C	parabolic	circular
D	parabolic	parabolic

(Total 2 marks)

53. A body is in simple harmonic motion of amplitude 0.50 m and period 4π seconds. What is the speed of the body when the displacement of the body is 0.30 m?

A 0.10 m s^{-1}

B 0.15 m s^{-1}

C 0.20 m s^{-1}

D 0.40 m s^{-1}

(Total 2 marks)

54. Which one of the following statements about an oscillating mechanical system at resonance, when it oscillates with a constant amplitude, is **not** correct?

A The amplitude of oscillations depends on the amount of damping.

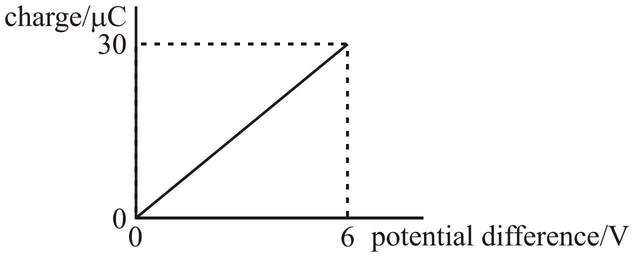
B The frequency of the applied force is the same as the natural frequency of oscillation of the system.

C The total energy of the system is constant.

D The applied force prevents the amplitude from becoming too large.

(Total 2 marks)

55. The graph shows how the charge stored by a capacitor varies with the potential difference across it as it is charged from a 6 V battery.



Which one of the following statements is **not** correct?

A The capacitance of the capacitor is 5.0 μF.

B When the potential difference is 2 V the charge stored is 10 μC.

C When the potential difference is 2 V the energy stored is 10 μJ.

D When the potential difference is 6 V the energy stored is 180 μJ.

(Total 2 marks)

56. A capacitor of capacitance C discharges through a resistor of resistance R.
Which one of the following statements is **not** true?

A The time constant will increase if R is increased.

B The time constant will decrease if C increased.

C After charging to the same voltage, the initial discharge current will increase if R is decreased.

D After charging to the same voltage, the initial discharge current will be unaffected if C is increased.

(Total 2 marks)

57. What is the angular speed of a point on the Earth's equator?

A 7.3×10^{-5} rad s^{-1}

B 4.2×10^{-3} rad s^{-1}

C 2.6×10^{-1} rad s^{-1}

D 15 rad s^{-1}

(Total 2 marks)

58. The following data refer to two planets.

	radius/km	density/kg m^{-3}
planet P	8 000	6 000
planet Q	16 000	3 000

The gravitational field strength at the surface of P is 13.4 N kg^{-1}. What is the gravitational field strength at the surface of Q?

A 3.4 N kg^{-1}

B 13.4 N kg^{-1}

C 53.6 N kg^{-1}

D 80.4 N kg^{-1}

(Total 2 marks)

59. Near the surface of a planet the gravitational field is uniform and for two points, 10 m apart vertically, the gravitational potential difference is 3 J kg^{-1}. How much work must be done in raising a mass of 4 kg vertically through 5 m?

A 3 J

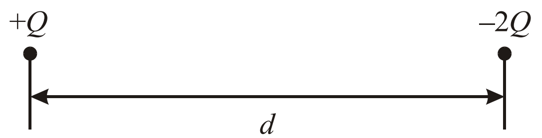
B 6 J

C 12 J

D 15 J

(Total 2 marks)

60.



The diagram shows two particles at a distance d apart. One particle has charge $+Q$ and the other $-2Q$. The two particles exert an electrostatic force of attraction, F, on each other. Each particle is then given an additional charge $+Q$ and their separation is increased to a distance of $2d$. Which one of the following gives the force that now acts between the two particles?

A an attractive force of $\frac{F}{4}$

B a repulsive force of $\frac{F}{4}$

C an attractive force of $\frac{F}{2}$

D a repulsive force of $\frac{F}{2}$

(Total 2 marks)

61. The electrical field strength, E, and the electrical potential, V, at the surface of a sphere of radius r carrying a charge Q are given by the equations

$$E = \frac{Q}{4\pi\varepsilon_0 r^2} \text{ and } V = \frac{Q}{4\pi\varepsilon_0 r}$$

A school van de Graaff generator has a dome of radius 100 mm. Charge begins to leak into the air from the dome when the electric field strength at its surface is approximately 3×10^6 V m^{-1}. What, approximately, is the maximum potential to which the dome can be raised without leakage?

A 3×10^4 V

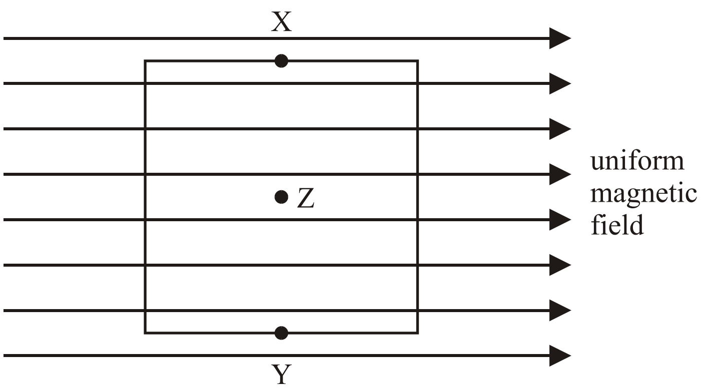
B 3×10^5 V

C 3×10^6 V

D 3×10^7 V

(Total 2 marks)

62.



The diagram shows a square coil with its plane parallel to a uniform magnetic field. Which one of the following would induce an emf in the coil?

A movement of the coil slightly to the left

B movement of the coil slightly downwards

C rotation of the coil about an axis through XY

D rotation of the coil about an axis perpendicular to the plane of the coil through Z

(Total 2 marks)

63. Which one of the following statements always applies to a damping force acting on a vibrating system?

A It is in the same direction as the acceleration.

B It is in the opposite direction to the velocity.

C It is in the same direction as the displacement.

D It is proportional to the displacement.

(Total 2 marks)

64. A 1.0 μF capacitor is charged by means of a **constant** current of 10 μA for 20s. What is the energy finally stored in the capacitor?

A 4.0×10^{-4} J

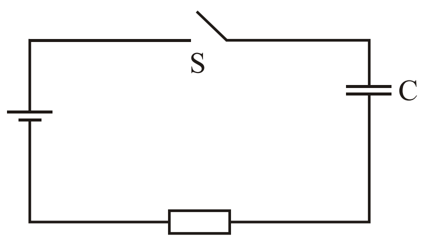
B 2.0×10^{-3} J

C 2.0×10^{-2} J

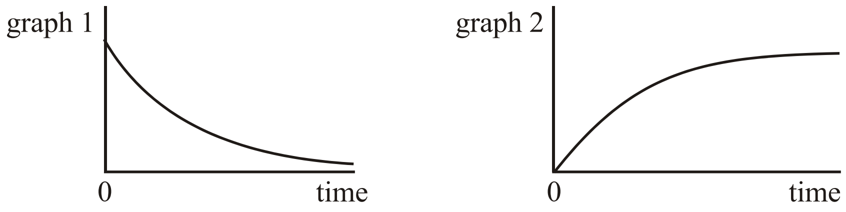
D 4.0×10^{-2} J

(Total 2 marks)

65. In the circuit shown, the capacitor C is charged to a potential difference V when the switch S is closed.



Which line, **A** to **D**, in the table gives a correct pair of graphs showing how the charge and current change with time after S is closed?



	charge	current
A	graph 1	graph 1
B	graph 1	graph 2
C	graph 2	graph 2
D	graph 2	graph 1

(Total 2 marks)

66. A mass on the end of a string is whirled round in a horizontal circle at increasing speed until the string breaks. The subsequent path taken by the mass is

A a straight line along a radius of the circle.

B a horizontal circle.

C a parabola in a horizontal plane.

D a parabola in a vertical plane.

(Total 2 marks)

67. Two isolated point charges are separated by 0.04 m and attract each other with a force of 20 μN. If the distance between them is increased by 0.04 m, what is the new force of attraction?

A 40 μN

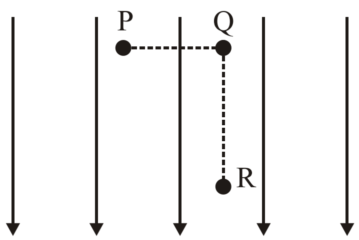
B 20 μN

C 10 μN

D 5 μN

(Total 2 marks)

68.



The diagram shows a uniform electric field of strength 10 V m^{-1}

A charge of 4 μC is moved from P to Q and then from Q to R. If the distance PQ is 2 m and QR is 3 m, what is the change in potential energy of the charge when it is moved from P to R?

A 40 μJ

B 50 μJ

C 120 μJ

D 200 μJ

(Total 2 marks)

69. A spring is suspended from a fixed point. A mass attached to the spring is set into vertical undamped simple harmonic motion. When the mass is at its lowest position, which one of the following has its minimum value?

A the potential energy of the system

B the kinetic energy of the mass

C the acceleration of the mass

D the tension in the spring

(Total 2 marks)

70. The time period of a simple pendulum is doubled when the length of the pendulum is increased by 3.0 m. What is the original length of the pendulum?

A 1.0 m

B 1.5 m

C 3.0 m

D 6.0 m

(Total 2 marks)

71. The Earth has density ρ and radius R. The gravitational field strength at the surface is g. What is the gravitational field strength at the surface of a planet of density 2ρ and radius $2R$?

A g

B $2g$

C $4g$

D $16g$

(Total 2 marks)

72. A particle of mass m moves in a circle of radius r at uniform speed, taking time T for each revolution. What is the kinetic energy of the particle?

A $\dfrac{\pi^2 m r}{T^2}$

B $\dfrac{\pi^2 m r^2}{T^2}$

C $\dfrac{2\pi^2 m r^2}{T}$

D $\dfrac{2\pi^2 m r^2}{T^2}$

(Total 2 marks)

73. Two protons, each of mass *m* and charge *e*, are a distance *d* apart. Which one of the following expressions correctly gives the ratio $\left(\dfrac{\text{electrostatic force}}{\text{gravitational force}}\right)$ for the forces acting between them?

A $\dfrac{4\pi\varepsilon_0 e^2}{Gm^2}$

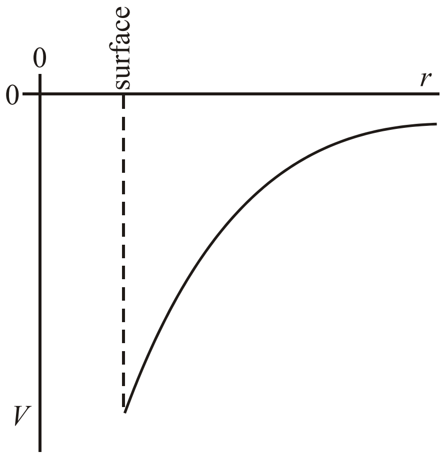
B $\dfrac{Ge^2}{4\pi\varepsilon_0 m^2}$

C $\dfrac{e^2 m^2}{4\pi\varepsilon_0 G}$

D $\dfrac{e^2}{4\pi\varepsilon_0 Gm^2}$

(Total 2 marks)

74. The graph shows how the gravitational potential, V, varies with the distance, r, from the centre of the Earth.



What does the gradient of the graph at any point represent?

A the magnitude of the gravitational field strength at that point

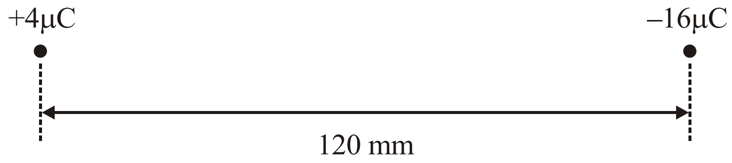
B the magnitude of the gravitational constant

C the mass of the Earth

D the potential energy at the point where the gradient is measured

(Total 2 marks)

75.



The diagram shows two charges, +4 μC and –16 μC, 120 mm apart. What is the distance from the +4 μC charge to the point between the two charges, where the resultant electric potential is zero?

A 24 mm

B 40 mm

C 80 mm

D 96 mm

(Total 2 marks)

76. An electron travelling at constant speed enters a uniform electric field at right angles to the field. While the electron is in the field it accelerates in a direction which is

A in the same direction as the electric field.

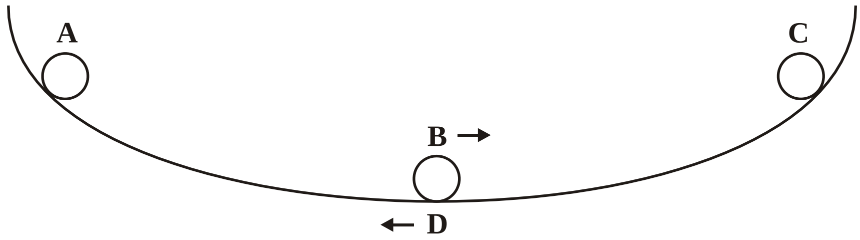
B in the opposite direction to the electric field.

C in the same direction as the motion of the electron.

D in the opposite direction to the motion of the electron.

(Total 2 marks)

77. A ball bearing rolls on a concave surface, as shown in the diagram, in approximate simple harmonic motion. It is released from **A** and passes through the lowest point **B** before reaching **C**. It then returns through the lowest point **D**. At which stage, **A**, **B**, **C** or **D**, does the ball bearing experience maximum acceleration to the left?



(Total 2 marks)

78. A body moves with simple harmonic motion of amplitude A and frequency $\frac{b}{2\pi}$.

What is the magnitude of the acceleration when the body is at maximum displacement?

A zero

B $4\pi^2 A b^2$

C $A b^2$

D $\frac{4\pi^2 A}{b^2}$

(Total 2 marks)

79. A 400 μF capacitor is charged so that the voltage across its plates rises at a constant rate from 0 V to 4.0 V in 20 s. What current is being used to charge the capacitor?

A 5 μA

B 20 μA

C 40 μA

D 80 μA

(Total 2 marks)

80. What is the value of the angular velocity of a point on the surface of the Earth?

A 1.2×10^{-5} rad s^{-1}

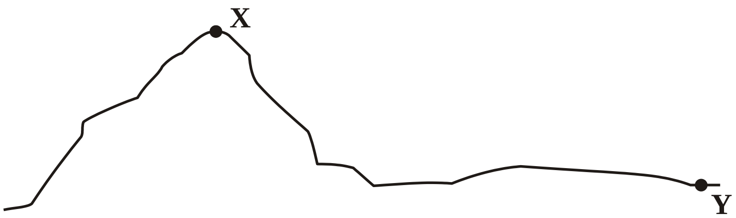
B 7.3×10^{-5} rad s^{-1}

C 2.6×10^{-1} rad s^{-1}

D 4.6×10^{2} rad s^{-1}

(Total 2 marks)

81. The diagram shows two positions, **X** and **Y**, at different heights on the surface of the Earth.



Which line, **A** to **D**, in the table gives correct comparisons at **X** and **Y** for gravitational potential and angular velocity?

	gravitational potential at X compared with Y	**angular velocity at X compared with Y**
A	greater	greater
B	greater	same
C	greater	smaller
D	same	same

(Total 2 marks)

82. A projectile moves in a gravitational field. Which one of the following is a correct statement for the gravitational force acting on the projectile?

A The force is in the direction of the field.

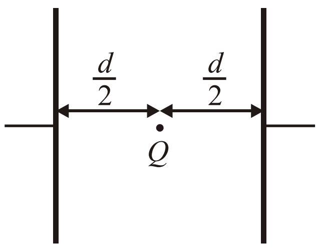
B The force is in the opposite direction to that of the field.

C The force is at right angles to the field.

D The force is at an angle between 0° and 90° to the field.

(Total 2 marks)

83. Two parallel metal plates separated by a distance *d* have a potential difference V across them. What is the magnitude of the electrostatic force acting on a charge Q placed midway between the plates?



A $\frac{2VQ}{d}$

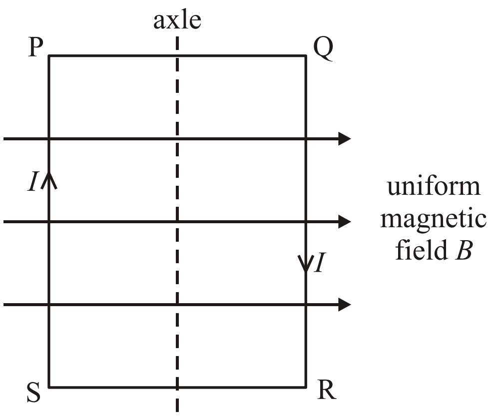
B $\frac{VQ}{2d}$

C $\frac{VQ}{d}$

D $\frac{Qd}{V}$

(Total 2 marks)

84.



A coil, mounted on an axle, has its plane parallel to the flux lines of a uniform magnetic field B, as shown. When a current I is switched on, and before the coil is allowed to move,

A there are no forces due to B on the sides PQ and RS.

B there are no forces due to B on the sides SP and QR.

C sides SP and QR attract each other.

D sides PQ and RS attract each other.

(Total 2 marks)

85. Protons, each of mass m and charge e, follow a circular path when travelling perpendicular to a magnetic field of uniform flux density B. What is the time taken for one complete orbit?

A $\dfrac{2\pi eB}{m}$

B $\dfrac{m}{2\pi eB}$

C $\dfrac{eB}{2\pi m}$

D $\dfrac{2\pi m}{eB}$

(Total 2 marks)

86. A mass M on a spring oscillates along a vertical line with the same period T as an object O in uniform circular motion in a vertical plane. When M is at its highest point, O is at its lowest point.

What is the least time interval between successive instants when the acceleration of M is exactly in the opposite direction to the acceleration of O?

A $\frac{T}{4}$

B $\frac{T}{2}$

C $\frac{3T}{4}$

D T

(Total 2 marks)

87. A particle of mass m oscillates with amplitude A at frequency f. What is the maximum kinetic energy of the particle?

A $\frac{1}{2}\pi^2 mf^2A^2$

B $\pi^2 mf^2A^2$

C $2\pi^2 mf^2A^2$

D $4\pi^2 mf^2A^2$

(Total 2 marks)

88. A 1000 μF capacitor, initially uncharged, is charged by a steady current of 50 μA. How long will it take for the potential difference across the capacitor to reach 2.5 V?

A 20 s

B 50 s

C 100 s

D 400 s

(Total 2 marks)

89. In experiments to pass a very high current through a gas, a bank of capacitors of total capacitance 50 μF is charged to 30 kV. If the bank of capacitors could be discharged completely in 5.0 m s what would be the mean power delivered?

A 22 kW

B 110 kW

C 4.5 MW

D 9.0 MW

(Total 2 marks)

90. For a particle moving in a circle with uniform speed, which **one** of the following statements is correct?

A The displacement of the particle is in the direction of the force.

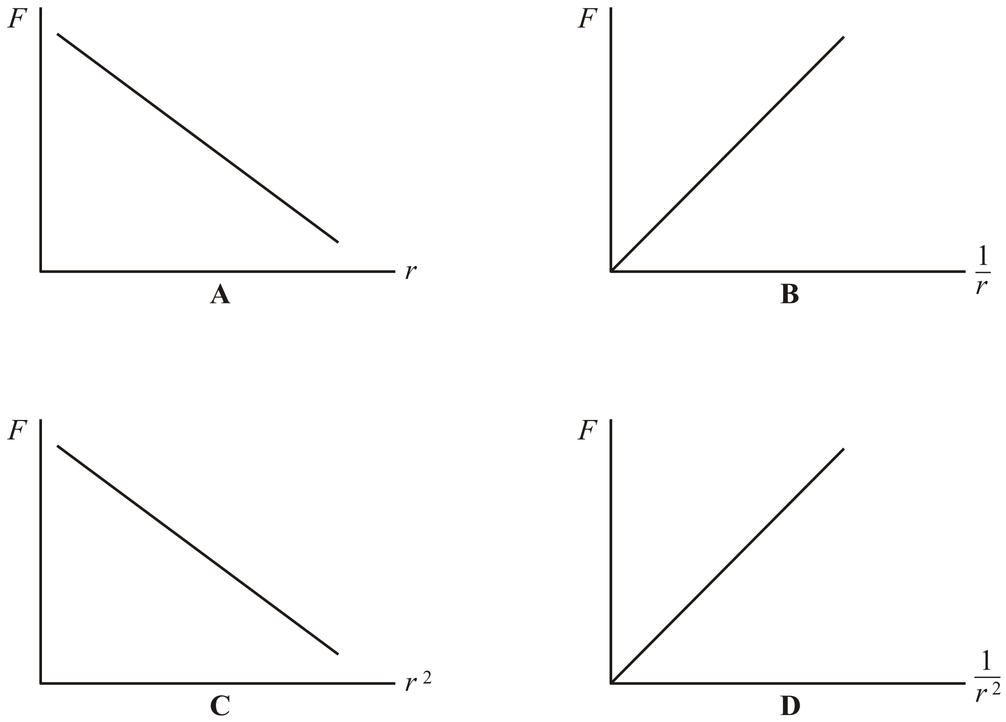
B The force on the particle is in the same direction as the direction of motion of the particle.

C The momentum of the particle is constant.

D The kinetic energy of the particle is constant.

(Total 2 marks)

91. Which one of the following graphs correctly shows the relationship between the gravitational force, F, between two masses and their separation r.



(Total 2 marks)

92. When at the surface of the Earth, a satellite has weight W and gravitational potential energy $-U$. It is projected into a circular orbit whose radius is equal to twice the radius of the Earth. Which line, **A** to **D**, in the table shows correctly what happens to the weight of the satellite and to its gravitational potential energy?

	weight	**gravitational potential energy**
A	becomes $\frac{W}{2}$	increases by $\frac{U}{2}$
B	becomes $\frac{W}{4}$	increases by $\frac{U}{2}$
C	remains W	increases by U
D	becomes $\frac{W}{4}$	increases by U

(Total 2 marks)

93. Two protons are 1.0×10^{-14} m apart. Approximately how many times is the electrostatic force between them greater than the gravitational force between them?

A 10^{23}

B 10^{30}

C 10^{36}

D 10^{42}

(Total 2 marks)

94. Particles of mass m carrying a charge Q travel in a circular path of radius r in a magnetic field of flux density B with a speed v. How many of the following quantities, if changed one at a time, would change the radius of the path?

- m
- Q
- B
- v

A one

B two

C three

D four

(Total 2 marks)

95. For the two physical quantities, impulse and force, which one of the following is correct?

A Impulse is a scalar and force is a scalar.

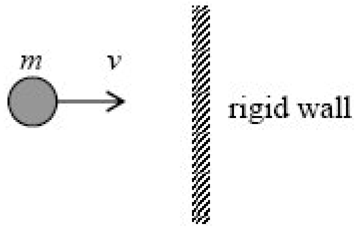
B Impulse is a scalar and force is a vector.

C Impulse is a vector and force is a scalar.

D impulse is a vector and force is a vector.

(Total 1 mark)

96. A particle of mass m strikes a rigid wall perpendicularly from the left with velocity v.



If the collision is perfectly elastic, the change in momentum of the particle which occurs as a result of the collision is

A $2mv$ to the right.

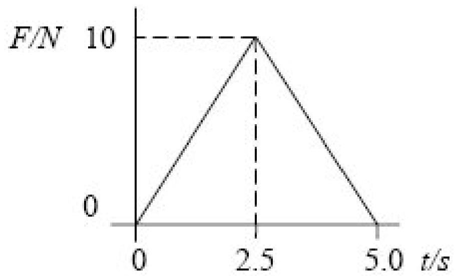
B $2mv$ to the left.

C mv to the left.

D zero.

(Total 1 mark)

97.



A force, F, varies with time, t, as shown by the graph and is applied to a body initially at rest on a smooth surface. What is the momentum of the body after 5.0 s?

A zero.

B 12.5 N s.

C 25 N s.

D 50 N s.

(Total 1 mark)

98. The rate of change of momentum of a body falling freely under gravity is equal to its

A weight.

B power.

C kinetic energy.

D potential energy.

(Total 1 mark)

99. What is the value of the angular velocity of a point on the surface of the Earth?

A 1.2×10^{-5} rad s^{-1}

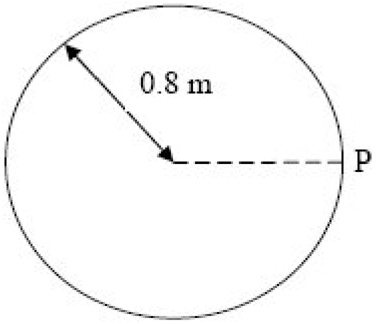
B 7.3×10^{-5} rad s^{-1}

C 2.6×10^{-1} rad s^{-1}

D 4.6×10^{2} rad s^{-1}

(Total 1 mark)

100.



A model car moves in a circular path of radius 0.8 m at an angular speed of $\frac{\pi}{2}$ rad s^{-1}. What is its displacement from point P, 6 s after passing P?

A zero

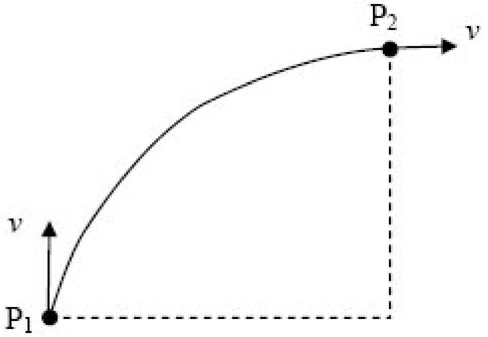
B 1.6 m

C 0.4 πm

D 1.6 πm

(Total 1 mark)

101. A particle of mass m moves horizontally at constant speed v along the arc of a circle from P_1 to P_2 under the action of a force. What is the work done on the particle by the force during this displacement?



A zero

B $\dfrac{\pi m v^2}{2}$

C $mv^2\sqrt{2}$

D $2\,mv^2$

(Total 1 mark)

102. A body moves with simple harmonic motion of amplitude 0.50 m and period 4π seconds. What is the speed of the body when the displacement of the body from the equilibrium position is 0.30 m?

A $0.10\ \text{m s}^{-1}$

B $0.15\ \text{m s}^{-1}$

C $0.20\ \text{m s}^{-1}$

D $0.40\ \text{m s}^{-1}$

(Total 1 mark)

103. The time period of a simple pendulum is doubled when the length of the pendulum is increased by 3.0 m. What is the original length of the pendulum?

A 1.0 m

B 1.5 m

C 3.0 m

D 6.0 m

(Total 1 mark)

104. Which one of the following statements is not true for a body vibrating in simple harmonic motion when damping is present?

A The damping force is always in the opposite direction to the velocity.

B The damping force is always in the opposite direction to the displacement.

C The presence of damping gradually reduces the maximum potential energy of the system.

D The presence of damping gradually reduces the maximum kinetic energy of the system.

(Total 1 mark)

105. The Earth has density ρ and radius R. The gravitational field strength at the surface is g. What is the gravitational field strength at the surface of a planet of density 2ρ and radius $2R$?

A g

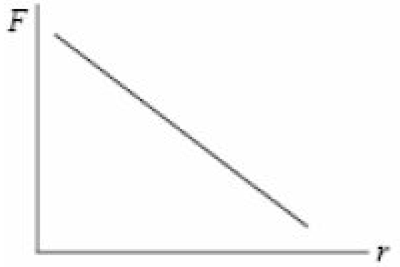
B $2g$

C $4g$

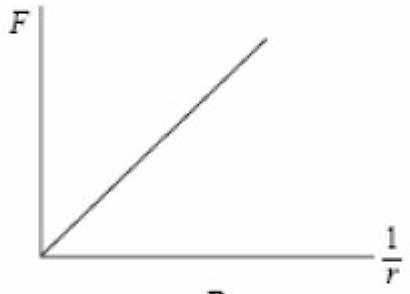
D $16g$

(Total 1 mark)

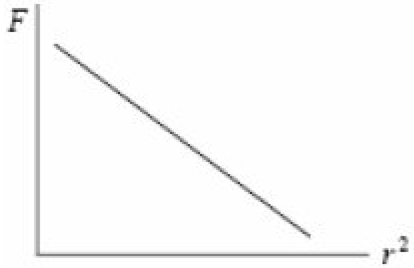
106. Which one of the following graphs correctly shows the relationship between the gravitational force, F, between two masses and their separation, r?



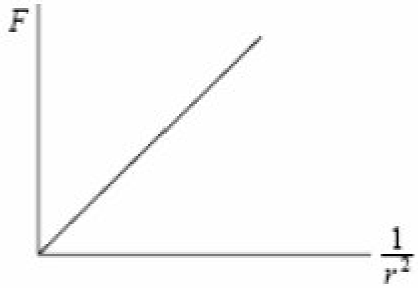
A



B



C



D

(Total 1 mark)

107. Near the surface of a planet the gravitational field strength is uniform and for two points, 10 m apart vertically, the gravitational potential difference is 3 J kg^{-1}. How much work must be done in raising a mass of 4 kg vertically through 5 m?

A 3 J

B 6 J

C 12 J

D 15 J

(Total 1 mark)

108. Two isolated point charges are separated by 0.04 m and attract each other with a force of 20 µN. If the distance between them is increased by 0.04 m, what is the new force of attraction?

A 5 µN

B 10 µN

C 20 µN

D 40 µN

(Total 1 mark)

109. Two protons, each of mass m and charge e, are a distance d apart. Which one of the following expressions correctly gives the ratio $\left(\frac{\text{electrostatic force}}{\text{gravitational force}}\right)$ for the forces acting between them?

A $\dfrac{4\pi\varepsilon_0 e^2}{Gm^2}$

B $\dfrac{Ge^2}{4\pi\varepsilon_0 m^2}$

C $\dfrac{e^2 m^2}{4\pi\varepsilon_0 G}$

D $\dfrac{e^2}{4\pi\varepsilon_0 Gm^2}$

(Total 1 mark)

110. An electron travelling at constant speed enters a uniform electric field at right angles to the field. While the electron is in the filed it accelerates in a direction which is

A in the same direction as the electric field

B in the opposite direction to the electric field

C in the same direction as the motion of the electron

D in the opposite direction to the motion of the electron 7

(Total 1 mark)

111. Which one of the following statements about electric potential and electric field strength is correct?

A electric potential is zero whenever the electric field strength is zero

B electric field strength is a scalar quantity

C electric potential is a vector quantity

D electric potential due to a point charge varies as (l/*r*) where *r* is the distance from the point charge

(Total 1 mark)

112. A 1000 μF capacitor and a 10 μF capacitor are charged so that the potential difference across each of them is the same. The charge stored in the 100 μF capacitor is Q_1 and the charge stored in the 10 μF capacitor is Q_2. What is the ratio $\frac{Q_1}{Q_2}$?

A 100

B 10

C 1

D $\frac{1}{100}$

(Total 1 mark)

113. In experiments to pass a very high current through a gas, a bank of capacitors of total capacitance 50 μF is charged to 30kV. If the bank of capacitors could be discharged completely in 5.0 ms, what would be the mean power delivered?

A 22 kW

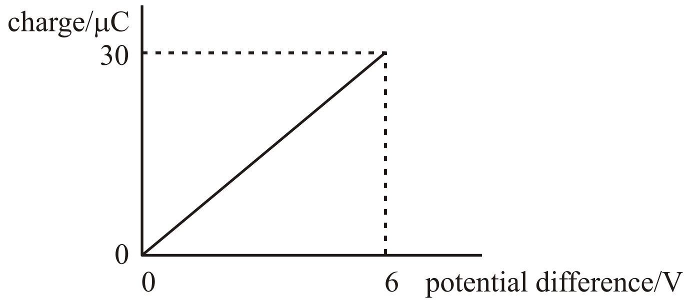
B 110 kW

C 4.5 MW

D 9.0 MW

(Total 1 mark)

114. The graph shows how the charge stored by a capacitor varies with the potential difference across it as it is charged from a 6 V battery.



Which one of the following statements is **not** correct?

A The capacitance of the capacitor is 5.0 μF.

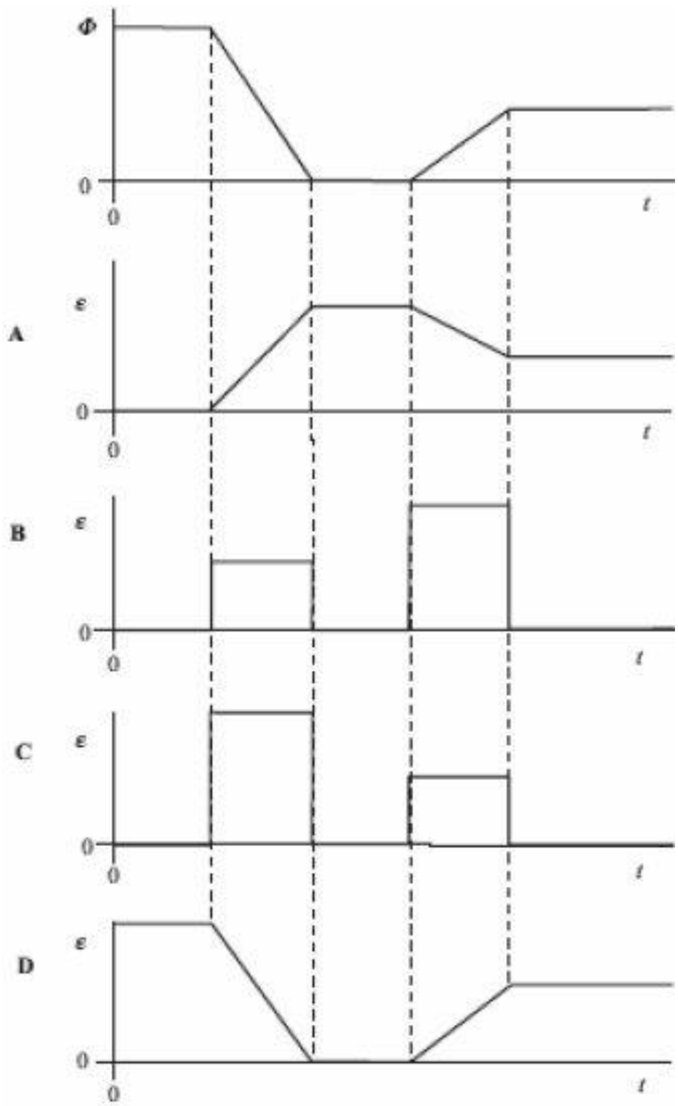
B When the potential difference is 2 V the charge stored is 10 μC.

C When the potential difference is 2 V the energy stored is 10 μJ.

D When the potential difference is 6 V the energy stored is 180 μJ.

(Total 1 mark)

115. The magnetic flux, Φ, through a coil varies with time, t, as shown by the first graph. Which one of the following graphs, A to D, best represents how the magnitude, $\in$, of the induced emf varies in this same period of time?



(Total 1 mark)

116. Protons, each of mass m and charge e, follow a circular path when travelling perpendicular to a magnetic field of uniform flux density B. What is the time taken for one complete orbit?

A $\frac{2\pi eB}{m}$

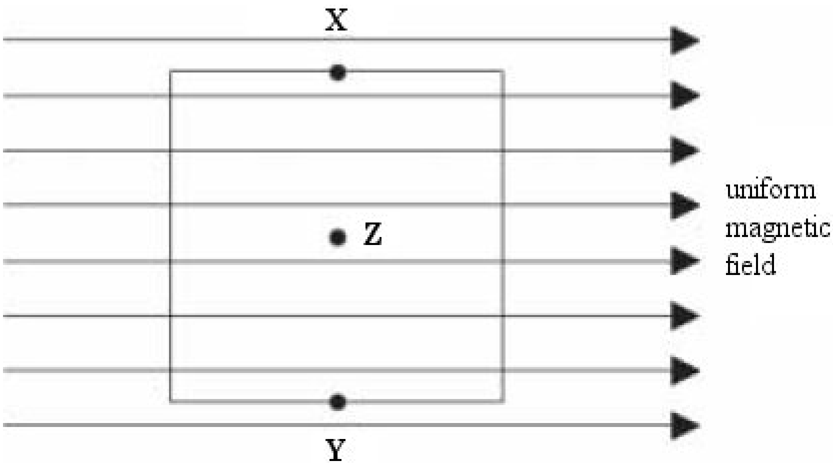
B $\frac{m}{2\pi eB}$

C $\frac{eB}{2\pi m}$

D $\frac{2\pi m}{eB}$

(Total 1 mark)

117.



The diagram shows a square coil with its plane parallel to a uniform magnetic field. Which one of the following would induce an emf in the coil?

A movement of the coil slightly to the left

B movement of the coil slightly downwards

C rotation of the coil about an axis through XY

D rotation of the coil about an axis perpendicular to the plane of the coil through Z

(Total 1 mark)

118. The primary winding of a perfectly efficient transformer has 200 turns and the secondary has

1000 turns. When a sinusoidal pd of rms value 10 V is applied to the input, there is a primary current of rms value 0.10 A rms. Which line in the following table, **A** to **D**, gives correct rms output values obtainable from the secondary when the primary is supplied in this way?

	rms output emf/V	**rms output current/A**
A	50	0.10
B	50	0.02
C	10	0.10
D	10	0.02

(Total 1 mark)

119. Why, when transporting electricity on the National Grid, are high voltages and low currents used?

A The energy lost by radiation from electromagnetic waves is reduced.

B The electrons move more rapidly.

C The heat losses are reduced.

D The resistance of the power lines is reduced.

(Total 1 mark)