Orbits of Planets & Satellite
TOPIC QUESTIONS

| Level	A Level
Subject	Physics
Exam Board	AQA
Paper Type	Multiple Choice

Time Allowed : 30min

1. The gravitational field strengths at the surfaces of the Earth and the Moon are 9.8 N kg^{-1} and 1.7 N kg^{-1} respectively. If the mass of the Earth is 81 × the mass of the Moon, what is the ratio of the radius of the Earth to the radius of the Moon?

    A   3.7

    B   5.8

    C   14

    D   22

2. Two stars of mass M and $4M$ are at a distance d between their centres.
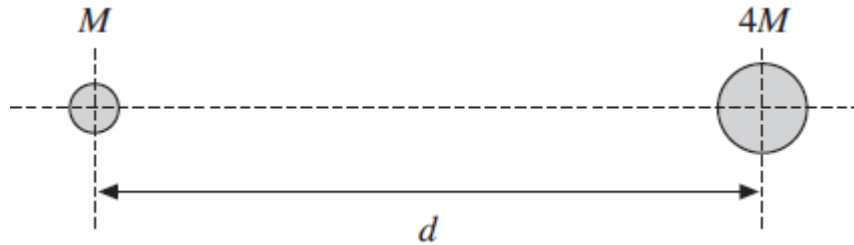
The resultant gravitational field strength is zero along the line between their centres at a distance y from the centre of the star of mass M.

What is the value of the ratio $\dfrac{y}{d}$?

A $\dfrac{1}{2}$

B $\dfrac{1}{3}$

C $\dfrac{2}{3}$

D $\dfrac{3}{4}$

3. Mars has a diameter approximately 0.5 that of the Earth, and a mass of 0.1 that of the Earth. The gravitational potential at the Earth's surface is −63 MJ kg^{-1}.
What is the approximate value of the gravitational potential at the surface of Mars?

A   −13 MJ kg^{-1}

B   −25 MJ kg^{-1}

C   −95 MJ kg^{-1}

D   −320 MJ kg^{-1}

4. Two satellites P and Q, of equal mass, orbit the Earth at radii R and $2R$ respectively. Which one of the following statements is correct?

A   P has less kinetic energy and more potential energy

than Q.

B   P has less kinetic energy and less potential energy

than Q.

 C   P has more kinetic energy and less potential energy

than Q.

D   P has more kinetic energy and more potential energy
than Q.

5. 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. Its distance from the centre of mass of m_1 is r_1 and its distance from the centre of mass of m_2 is r_2.

What is the value of the ratio $\dfrac{r_1}{r_2}$?

A $\dfrac{m_1^2}{m_2^2}$

B $\dfrac{m_2^2}{m_1^2}$

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

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

6. 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	$\dfrac{E}{2}$	$\dfrac{V}{4}$
B	$\dfrac{E}{2}$	$\dfrac{V}{2}$
C	$\dfrac{E}{4}$	$\dfrac{V}{2}$
D	$\dfrac{E}{4}$	$\dfrac{V}{4}$

7. 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 $\dfrac{r_1}{r_2}$?

A $\dfrac{m_1^2}{m_2^2}$

B $\dfrac{m_2^2}{m_1^2}$

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

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

8. A planet of mass M and radius R rotates so rapidly that loose material at the equator just remains on the surface. What is the period of rotation of the planet?

G is the universal gravitational constant.

A $2\pi\sqrt{\dfrac{R}{GM}}$

B $2\pi\sqrt{\dfrac{R^2}{GM}}$

C $2\pi\sqrt{\dfrac{GM}{R^3}}$

D $2\pi\sqrt{\dfrac{R^3}{GM}}$

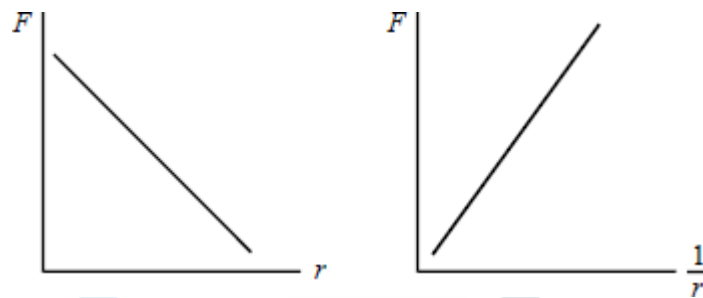9. Which one of the following has different units to the other three?

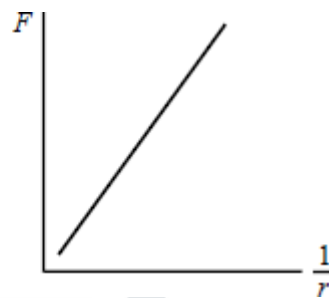A   gravitational potential

B   gravitational field strength

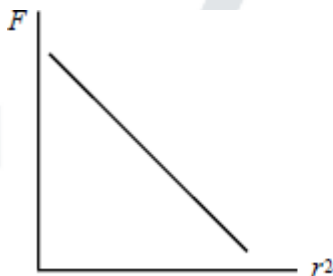C   force per unit mass

D   gravitational potential gradient

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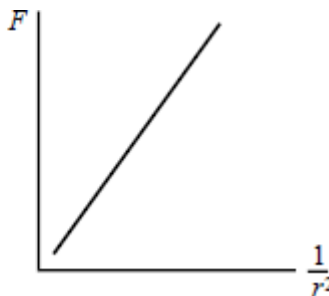

A

B

C

D

11. A satellite orbiting the Earth moves to an orbit which is closer to the Earth.

Which line, **A** to **D**, in the table shows correctly what happens to the speed of the satellite and to the time it takes for one orbit of the Earth?

	Speed of satellite	Time For One Orbit Of Earth
A	decreases	decreases
B	decreases	increases
C	increases	decreases

D	increases	increases

12. A positive ion has a charge−to−mass ratio of 2.40×10^7 C kg^{-1}. It is held stationary in a vertical electricfield.
Which line, **A** to **D**, in the table shows correctly both the strength and the direction of the electricfield?

	Electric field strength $/$V m^{-1}	Direction
A	4.09×10^{-7}	upwards
B	4.09×10^{-7}	downwards
C	2.45×10^{6}	upwards
D	2.45×10^{6}	downwards

13. In the equation $X = \dfrac{ab}{r^n}$, X represents a physical variable in an electric or a gravitational field, a is a constant, b is either mass or charge and n is a number.

Which line, A to D, in the table provides a consistent representation of X, a and b according to the value of n?

The symbols E, g, V and r have their usual meanings.

	n	X	a	b
A	1	E	$\dfrac{1}{4\pi\varepsilon_0}$	charge
B	1	V	$\dfrac{1}{4\pi\varepsilon_0}$	mass
C	2	g	G	mass
D	2	V	G	charge

14. Which one of the following statements is correct?

An electron follows a circular path when it is moving at right angles to

A   a uniform magnetic field.

B   a uniform electric field.

C   uniform electric and magnetic fields which are perpendicular.

D   uniform electric and magnetic fields which are in opposite directions.

15. The diagram shows a small negative charge at a point in an electric field, which is represented by the arrowed field lines.
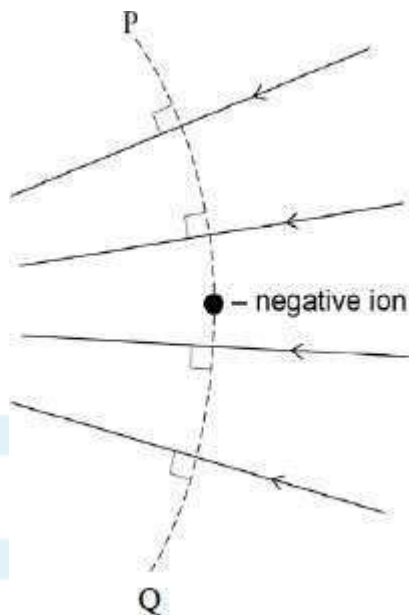
Which of the following statements, about what happens when the charge is displaced, is correct?

When the negative charge is displaced

|	
A	to the left the magnitude of the electric force on it decreases.
B	to the right its potential energy increases.
C	along the line PQ towards Q its potential energy decreases.
D	along the line PQ towards P the magnitude of the electric force on it is unchanged.

16. The distance between the Sun and the Earth is 1.5×10^{11} m

What is the gravitational force exerted on the Sun by the Earth?

A 3.5×10^{22} N

B 1.7×10^{26} N

C 5.3×10^{33} N

D 8.9×10^{50} N

17. The diagram shows gravitational equipotentials. Adjacent equipotentials are separated by an equal gravitational potential difference V.
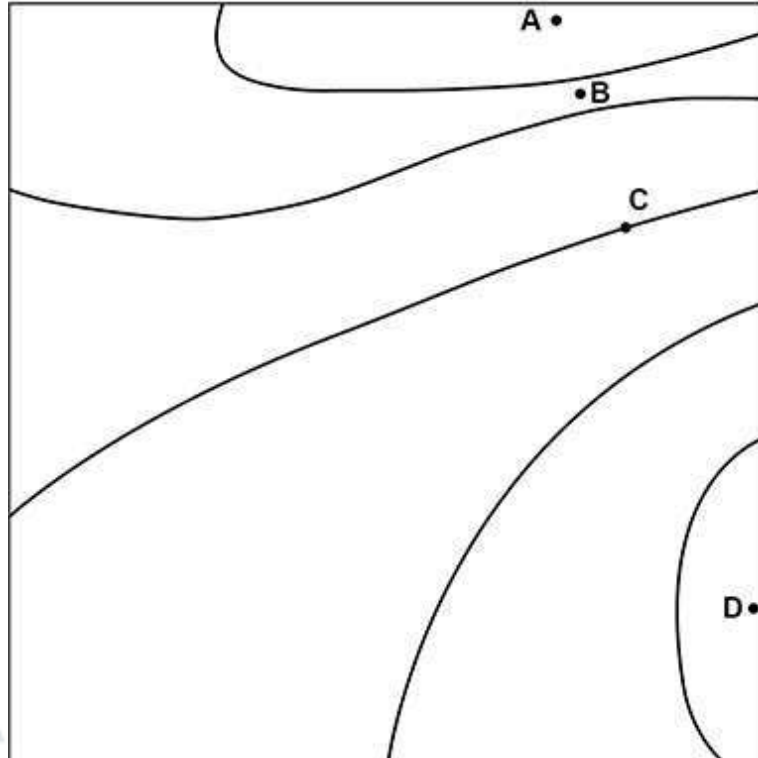
Which point has the greatest gravitational field strength?

A

B

C

D

18. A planet has radius R and density ρ. The gravitational field strength at the surface is g.

What is the gravitational field strength at the surface of a planet of radius $2R$ and density 2ρ?

   A $2g$

   B $4g$

   C $8g$

   D $16g$

19. The diagram shows equipotential lines for a uniform gravitational field. The lines are separated by 20 m.
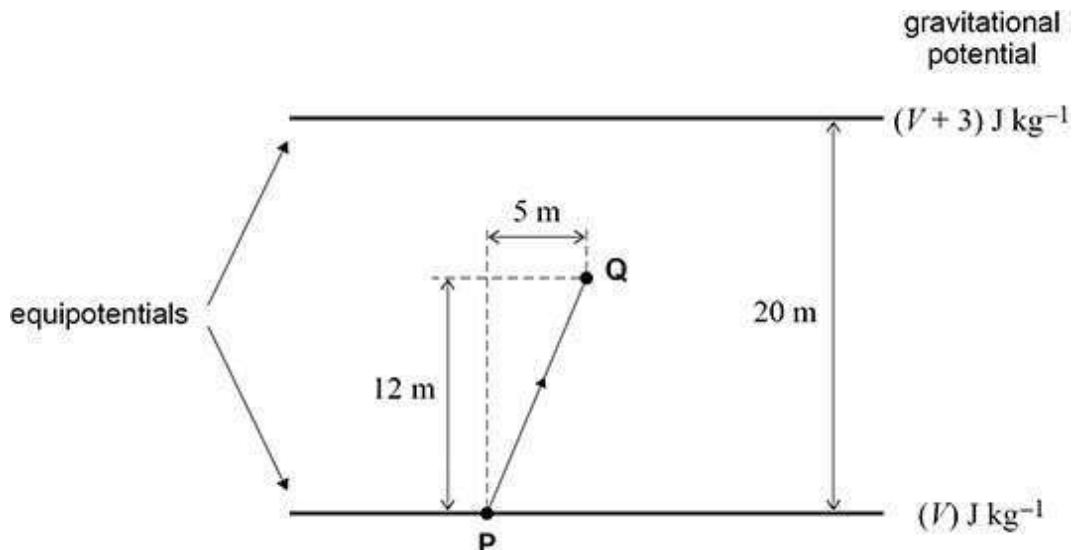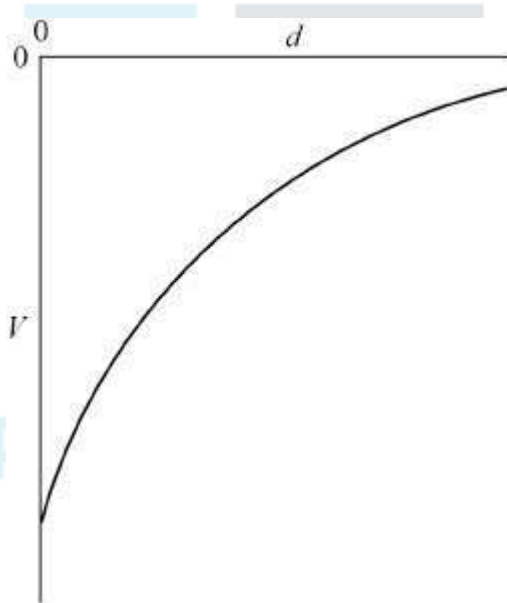
An object of mass 4 kg is moved from **P** to **Q**.

What is the work done against gravity to move the object?

   A   7.2 J

   B   7.8 J

   C   10.2 J

   D   36 J

20. The graph shows how the gravitational potential V varies with the vertical distance d from thesurface of the Earth.

What does the gradient of the graph represent at the surface of the Earth?

  A   potential energy

  B   mass of the Earth

  C   magnitude of the gravitational constant

  D   magnitude of the gravitational field strength