1 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 $2\pi\sqrt{\frac{R}{GM}}$

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

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

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

(Total 1 mark)

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

A gravitational potential

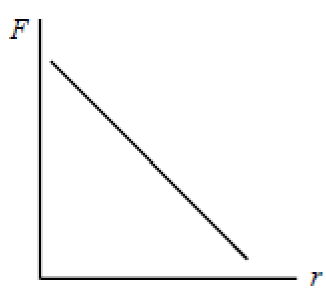
B gravitational field strength

C force per unit mass

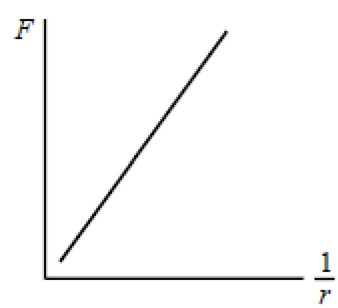
D gravitational potential gradient

(Total 1 mark)

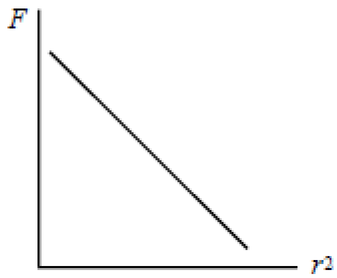
3 Which one of the following graphs correctly shows the relationship between the gravitational force, F, between two masses and the distance, r, between them?



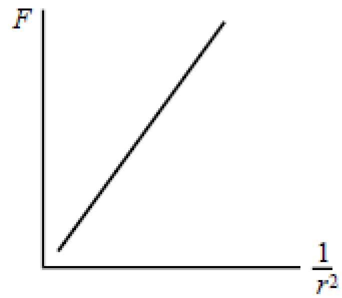
A



B



C



D

(Total 1 mark)

4 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 1 mark)

5 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)

6 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 1 mark)

7 Satellites N and F have the same mass and move in circular orbits about the same planet. N is the nearer satellite and F is the more distant. Which one of the following is smaller for N than for F?

A gravitational force on the satellite

B speed

C kinetic energy

D time for one orbit

(Total 1 mark)

8 A mass of 5 kg is moved in a gravitational field from a point **X** at which the gravitational potential is –20 J kg^{-1} to a point **Y** where it is –10 J kg^{-1}. The change in potential energy of the mass, in J, between **X** and **Y** is

A –50

B –10

C +10

D +50

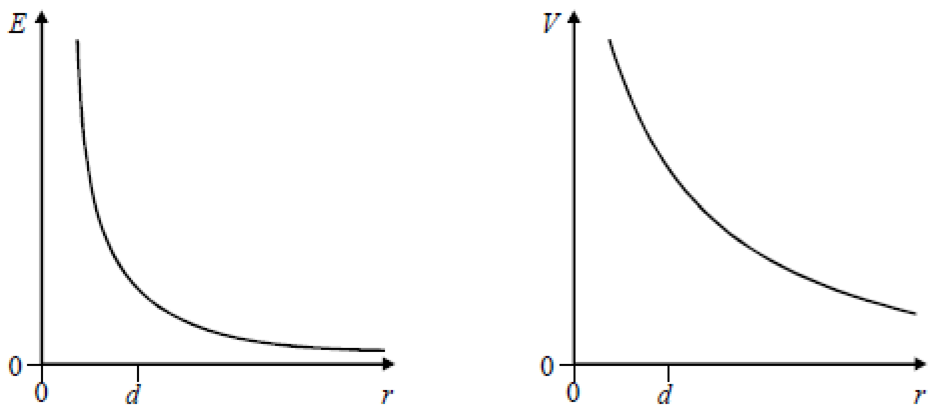
(Total 1 mark)

9 For which of the following relationships is the quantity y related to the quantity x by the relationship $x \propto \frac{1}{y}$?

	x	y
A	energy stored in a spring	extension of the spring
B	gravitational field strength	distance from a point mass
C	de Broglie wavelength of an electron	momentum of the electron
D	period of a mass-spring system	spring constant (stiffness) of the spring

(Total 1 mark)

10 **Graph 1** shows the variation of electric field strength E with separation r for two point charges. **Graph 2** shows the corresponding variation of electric potential V with separation.



Which line in the table correctly relates data for the two graphs?

	Magnitude of electric field strength at separation d	**Magnitude of electric potential at separation d**
A	Gradient of **graph** 2 at separation d	Area under **graph 1** from separation d to ∞
B	Area under **graph 2** from separation d to ∞	Area under **graph 1** from separation d to ∞
C	Gradient of **graph 2** at separation d	Gradient of **graph 1** at separation d
D	Area under **graph 2** from separation d to ∞	Gradient of **graph 1** at separation d

(Total 1 mark)

11 g is the strength of the gravitational field at the surface of the Earth; R is the radius of the Earth. The potential energy lost by a satellite of mass m falling to the Earth's surface from a height R above the surface is

A $4mgR$

B $2mgR$

C $\frac{mgR}{2}$

D $\frac{mgR}{4}$

(Total 1 mark)

12 When two similar spherical objects of radius R are touching, the gravitational force of attraction between them is F. When the gravitational force between them is $F/4$, the distance between the surfaces of the spheres is

A R

B $2R$

C $4R$

D $6R$

(Total 1 mark)

Mark schemes

1	D	**[1]**
2	A	**[1]**
3	D	**[1]**
4	C	**[1]**
5	B	**[1]**
6	A	**[1]**
7	D	**[1]**
8	D	**[1]**
9	C	**[1]**
10	A	**[1]**
11	C	**[1]**
12	B	**[1]**

Examiner reports

2

Gravitation was the subject being tested in this question. The fact that candidates for the examinations were not familiar with the units of field and potential became clear in the scripts for Unit 4 Section B, and so it is hardly surprising that the facility of this question was no higher than 54%.