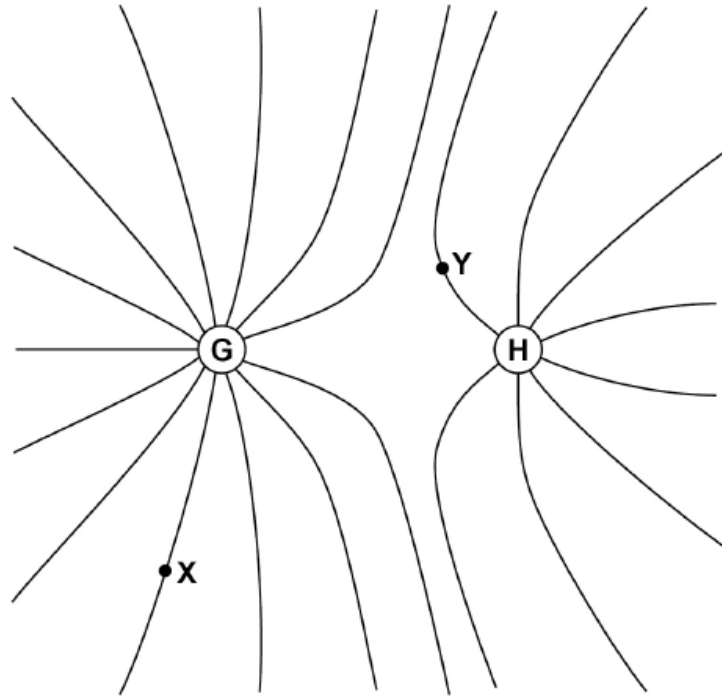## AQA – Gravitational fields – 2022 A2 Physics P2

1. June /2022/Paper_ 7408/2/No.4

| 0 | 4 |

The lines in **Figure 4** show the shape of the gravitational field around two stars **G** and **H**.

Figure 4

| 0 | 4 |.| 1 | Compare, with reference to **Figure 4**, the masses of **G** and **H**.

[2 marks]

_____

_____

_____

_____

| 0 | 4 |.| 2 | **X** and **Y** are two points in the field.

Annotate **Figure 4** to show the field direction at **X** and the field direction at **Y**.

[1 mark]

0 4 . 3 A spherical asteroid **P** has a mass of 2.0×10^{20} kg.

The gravitational field strength at its surface is 0.40 N kg^{-1}.
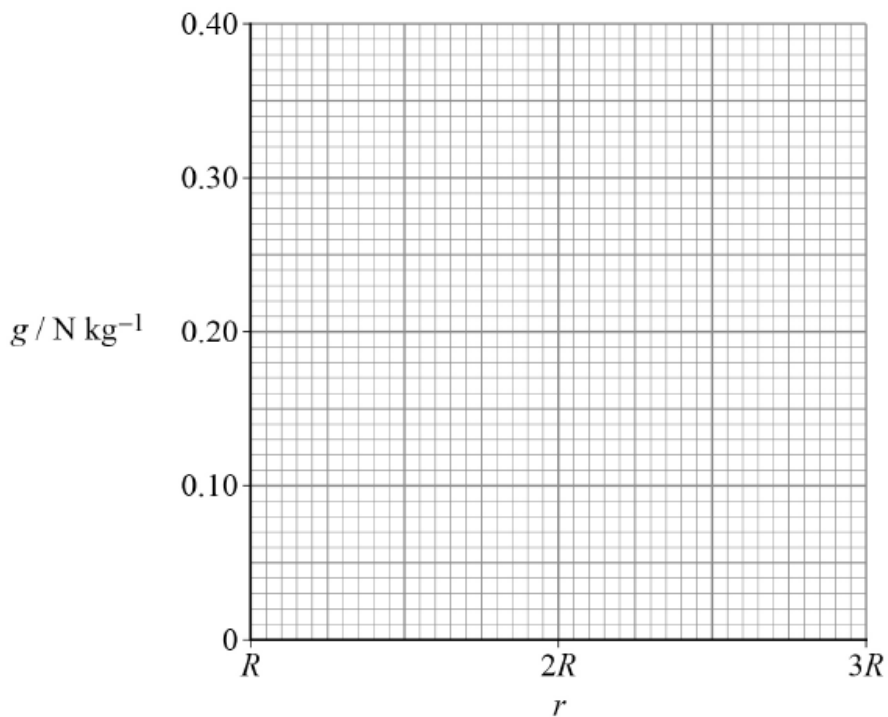
Calculate the radius R of **P**.

[1 mark]

$R =$ _____ m

0 4 . 4   Sketch, on **Figure 5**, the variation of the gravitational field strength g with distance r. The distance r is measured from the centre of **P**.
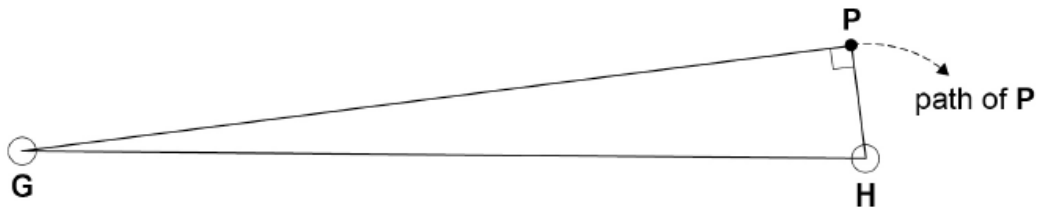
[1 mark]

Figure 5

0 4 . 5   Explain what is represented by the area under the graph between $r = R$ and $r = 2R$ on **Figure 5**.

[2 marks]

_____

_____

_____

_____

_____

_____

3

Asteroid **P** approaches the two stars **G** and **H**.
Figure 6 shows one position of **P** close to **H**.

Figure 6

| 0 4 | . | 6 | The gravitational force on **P** from **G** is 6.38×10^{12} N.

The mass of **H** is 3.00×10^{25} kg and the mass of **P** is 2.00×10^{20} kg.
The distance **HP** is 1.50×10^{11} m.

Calculate the magnitude of the acceleration of **P**.

[4 marks]

magnitude of acceleration = _____ m s^{-2}

| 0 | 4 |.| 7 | Explain why **P** cannot have a circular orbit around **H**.

[1 mark]

_____

_____

_____

2. June /2022/Paper_ 7408/2/No.9

A planet of radius R and mass M has a gravitational field strength of g at its surface.

Which row describes a planet with a gravitational field strength of $4g$ at its surface?

[1 mark]

	Radius of planet	Mass of planet	
A	$2R$	$2M$	○
B	$R\sqrt{2}$	$\dfrac{M}{2}$	○
C	$\dfrac{R}{\sqrt{2}}$	$\dfrac{M}{2}$	○
D	$\dfrac{R}{\sqrt{2}}$	$2M$	○

3. June /2022/Paper_ 7408/2/No.10

The Moon orbits the Earth in 27 days.

What is the angular speed of the Moon's orbit?

[1 mark]

A 4.3×10^{-7} rad s^{-1} ☐

B 2.7×10^{-6} rad s^{-1} ☐

C 3.7×10^{-2} rad s^{-1} ☐

D 2.3×10^{-1} rad s^{-1} ☐

4. June /2022/Paper_ 7408/2/No.11

The radius of the Earth is R and the acceleration due to gravity at the surface of the Earth is g.

What is the escape velocity for a mass m at the surface of the Earth?

[1 mark]

A $\sqrt{gR}$ ☐

B $\sqrt{2gR}$ ☐

C $\sqrt{2mgR}$ ☐

D $\sqrt{\dfrac{2gR}{m}}$ ☐

5. June /2022/Paper_ 7408/2/No.12

A planet has a mass M and a radius R.
Loose material at the equator only just remains in contact with the surface of the planet.
This is because the speed at which the planet rotates is very large.

What is the period of rotation of the planet?

[1 mark]

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

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

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

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

6. June /2022/Paper_ 7408/2/No.13

Satellites **N** and **F** have the same mass and move in circular orbits about the same planet.
The orbital radius of **N** is less than that of **F**.

Which is smaller for **N** than for **F**?

[1 mark]

A the gravitational force on the satellite

B the speed of the satellite

C the kinetic energy of the satellite

D the orbital period of the satellite