JAMES RUSE AGRICULTURAL HIGH SCHOOL

HIGHER SCHOOL CERTIFICATE EXAMINATION

ASSESSMENT TASK 2: **THEORY**

TERM 1, 2019

Physics

General Instructions

- Reading time – 3 minutes
- Working time – 55 minutes
- Write using black pen
- Draw diagrams using pencil
- NESA approved calculators may be used
- A data sheet, formulae sheet and Periodic Table are provided
- For questions in Section II, show all relevant working in questions involving calculations
- Total marks 36

Section I – 10 marks (pages 2–8)

- Attempt Questions 1–10
- Allow about 15 minutes for this section

Section II – 26 marks (pages 9–17)

- Attempt Questions 11–15
- Allow about 40 minutes for this section

Write your student number on page 9.

Use the multiple-choice answer sheet.

Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

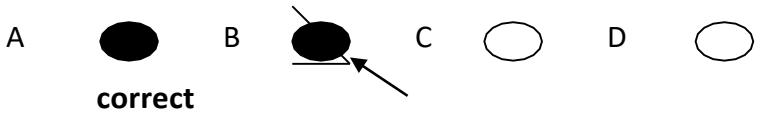
Sample: 2 + 4 = (A) 2 (B) 6 (C) 8 (D) 9



If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.



If you change your mind and have crossed out what you consider to be the correct answer, then indicate the correct answer by writing the word **correct** and drawing an arrow as follows.

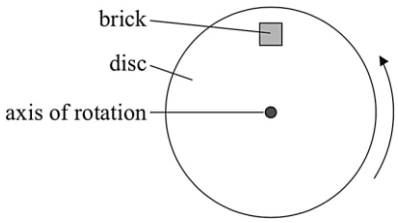


Section I

10 marks
Attempt Questions 1–10
Allow about 15 minutes for this section

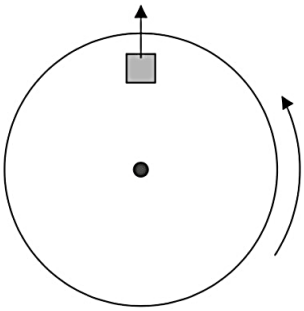
Use the multiple-choice answer sheet for Questions 1–10.

1 A brick is placed on the surface of a flat horizontal disc as shown in the diagram below. The disc is rotating at constant speed about a vertical axis through its centre. The brick does not move relative to the disc.

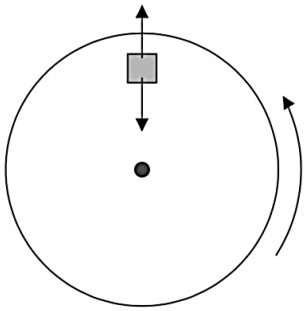


Which of the diagrams below correctly represents the horizontal force or forces acting on the brick?

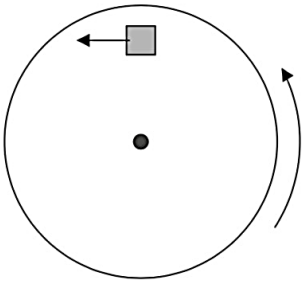
A.



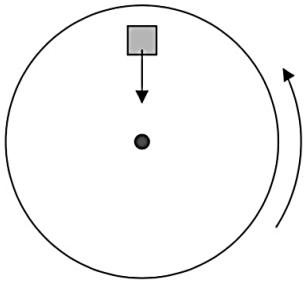
B.



C.



D.

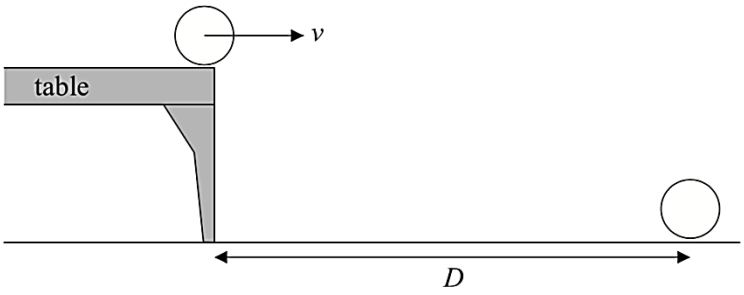


2 A satellite is in a circular orbit around the Earth. The satellite now is moved to a circular orbit closer to the Earth.

Which one of the following correctly describes the changes in the gravitational potential energy and kinetic energy of the satellite?

	Gravitational potential energy	*Kinetic energy*
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

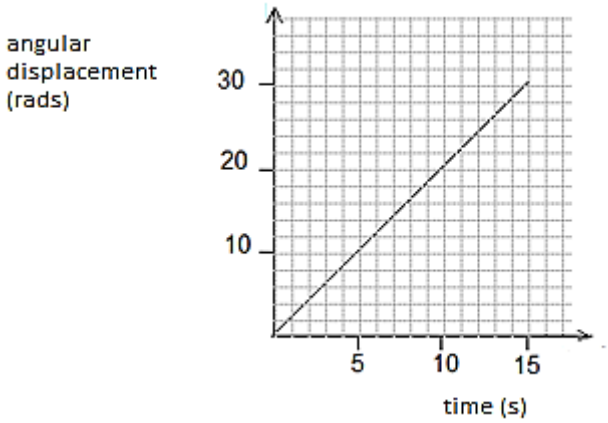
3 A ball rolls off a horizontal table with velocity *v*. It lands on the ground a time *T* later at a distance *D* from the foot of the table as shown in the diagram below. Air resistance is negligible.



A second heavier ball rolls off the table with velocity *v*. Which of the following is correct for the heavier ball?

	Time to land	*Distance from table*
A	T	D
B	T	less than D
C	less than T	D
D	less than T	less than D

The graph below represents the angular motion of a body.



4 What is the number of revolutions made in 10 s?

A. 40 π

B. 20 / π

C. 10 π

D. 10 / π

5 Two identical cars, one on the moon and one on Earth, are rounding curves at the same, constant speed with the same radius and banked at different angles. The acceleration due to gravity on the moon is 1/6 that of Earth.

How do the centripetal accelerations of each car compare?

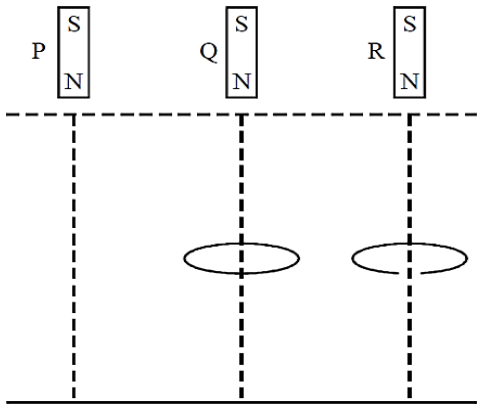
A. The centripetal acceleration of the car on Earth is less than that on the moon.

B. The centripetal acceleration of the car on Earth is greater than that on the moon.

C. The centripetal accelerations are the same for both cars.

D. This cannot be determined without knowing the radius and the angle.

6 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 thin 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?

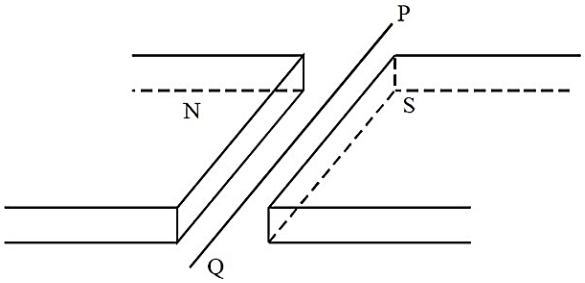
A. P and R arrive together followed by Q.

B. P and Q arrive together followed by R.

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

D. All magnets arrive simultaneously.

7 A wire carrying a current experiences a force of 3.0 $\times 10^{-3}$ N downward when it lies perpendicularly across a horizontal uniform magnetic field of flux density 2.0 $\times$ 10^{-2} T. The length of wire that is effectively subjected to the magnetic field is 0.30 m.



What is the size and direction of current in the wire?

A. 0.45 A from P to Q

B. 0.45 A from Q to P

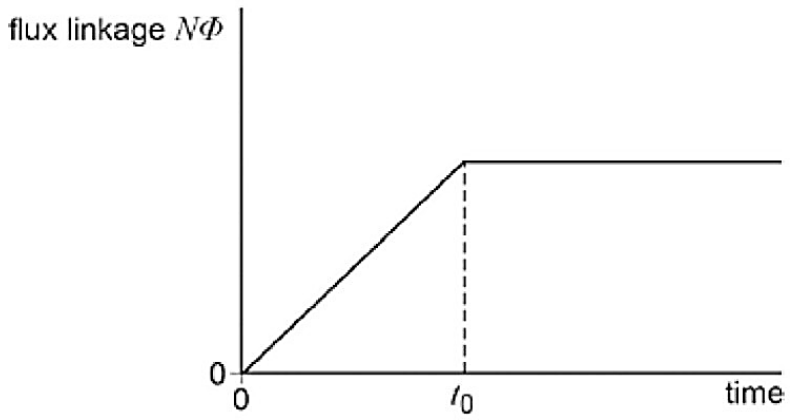
C. 5.0 A from P to Q

D. 5.0 A from Q to P

8 Which row correctly describes the trajectory of charged particles which enter, at right angles a uniform electric field and a uniform magnetic field?

	Uniform electric field	*Uniform magnetic field*
A	circular	circular
B	circular	parabolic
C	parabolic	circular
D	parabolic	parabolic

9 The graph shows how the flux linkage, $N\Phi$, through a coil changes when the coil is moved into a magnetic field.



The emf induced in the coil

A. decreases then becomes zero after time t_0

B. increases then becomes constant after time t_0

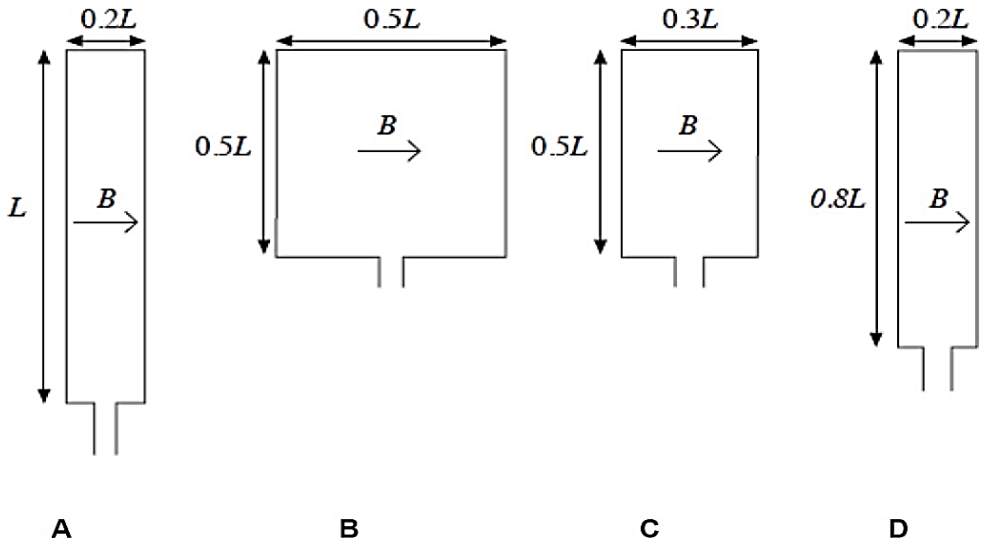
C. is constant then becomes zero after time t_0

D. is zero then increases after time t_0

10 Four rectangular loops of wire A, B, C and D are each placed in a uniform magnetic field of the same flux density *B*. The direction of the magnetic field is parallel to the plane of the loops as shown.

When a current of 1 A is passed through each of the loops, magnetic forces act on them. The lengths of the sides of the loops are as shown.

Which loop experiences the largest torque?



Student Number	
Theory Mark / 36	

Section I

Answer grid for multiple choice questions.

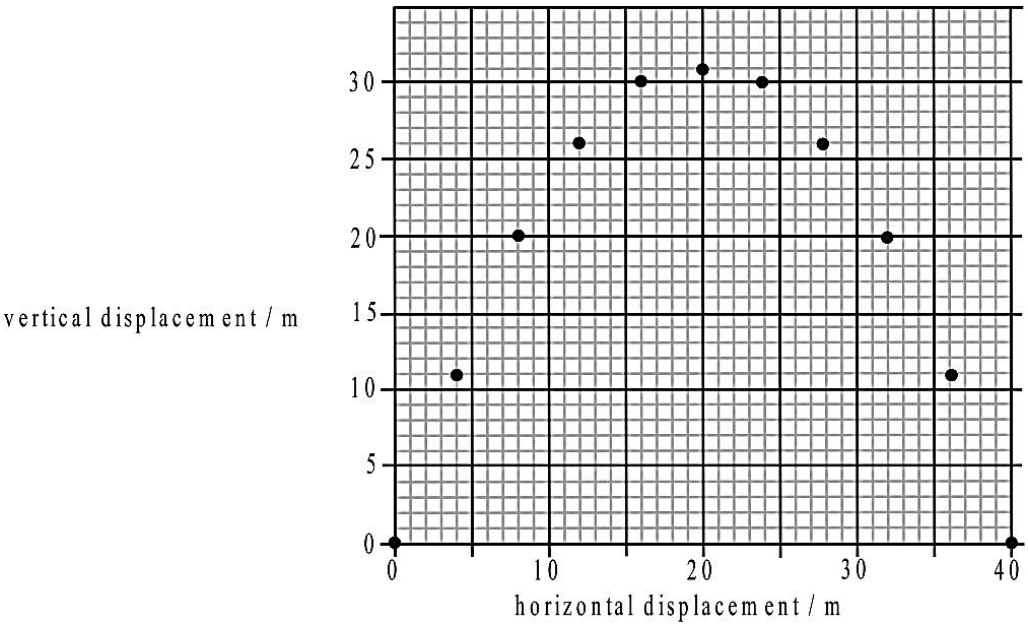
1.	A O	B O	C O	D O
2.	A O	B O	C O	D O
3.	A O	B O	C O	D O
4.	A O	B O	C O	D O
5.	A O	B O	C O	D O
6.	A O	B O	C O	D O
7.	A O	B O	C O	D O
8.	A O	B O	C O	D O
9.	A O	B O	C O	D O
10.	A O	B O	C O	D O

Section II

26 marks
Attempt Questions 11–15
Allow about 40 minutes for this section

Question 11 (5 Marks)

A ball is kicked at an angle to the horizontal. The diagram below shows the position of the ball every 0.50 s.



The acceleration of free fall is g = 9.8 m s^{-2}. Air resistance may be neglected.

(a) Using the diagram determine, for the ball

(i) the horizontal component of the initial velocity. **1**

.....

.....

(ii) the vertical component of the initial velocity. **2**

.....

.....

.....

Question 11 continued on next page

(iii) the magnitude of the displacement after 3.0 s. **1**

.....

.....

.....

(b) On the diagram on page 10 draw a line to indicate a possible path for the ball if air resistance were NOT negligible. **1**

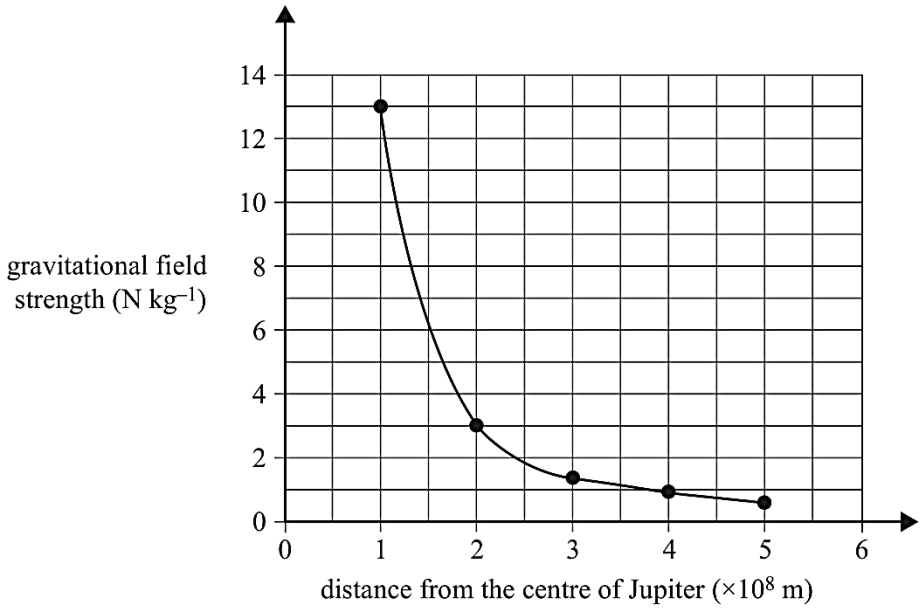
Question 12 (5 marks)

The spacecraft *Juno* has been put into orbit around Jupiter. The table below contains information about the planet Jupiter and the spacecraft *Juno*.

Data

mass of Jupiter	1.90×10^{27} kg
radius of Jupiter	7.00×10^{7} m
mass of spacecraft *Juno*	1500 kg

The figure below shows gravitational field strength (N kg^{-1}) as a function of distance from the centre of Jupiter.



(a) Calculate the gravitational force acting on *Juno* by Jupiter when *Juno* is at a distance of 2.0×10^{8} m from the centre of Jupiter. Show your working. **2**

.....

.....

.....

.....

Question 12 continued on next page

(b) Use the graph in the Figure on the previous page to estimate the magnitude of the change in gravitational potential energy of the spacecraft *Juno* as it moves from a distance of 2.0×10^{8} m to a distance of 1.0×10^{8} m from the centre of Jupiter. Show your working. **3**

.....

.....

.....

.....

.....

.....

Question 13 (7 marks)

The strength of the magnetic field surrounding a current-carrying wire can be found by using the formula $B = \frac{\mu_0 I}{2\pi r}$, where μ_0 is the magnetic permeability constant, in $\mathrm{N.A^{-2}}$.

An experiment is performed to establish the value of the constant μ_0. The current was constant at 5.0 A and the strength of the magnetic field was measured at various distances from the wire.

The data recorded are given in the table below.

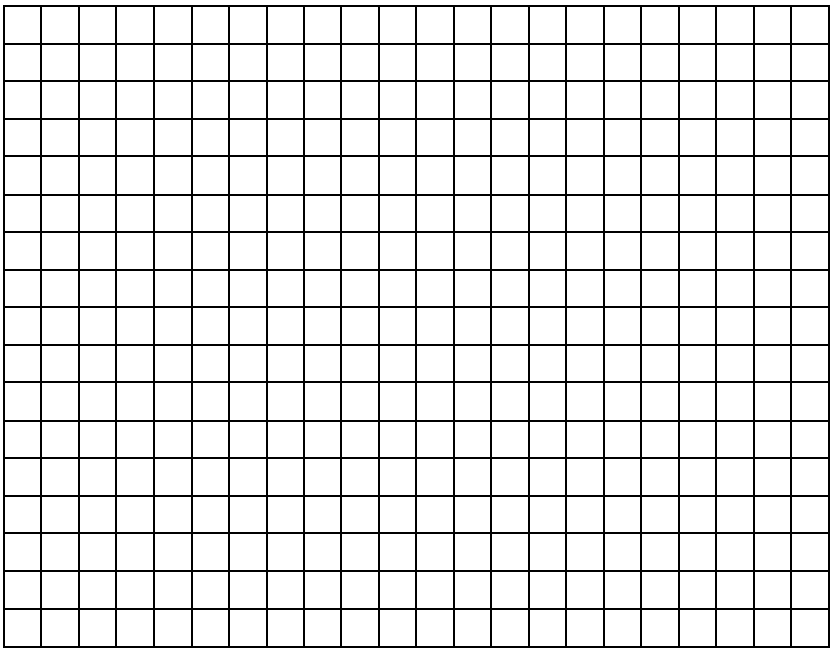
Distance from the wire $r\ (m)$	*Magnitude of the magnetic field* $B(\times 10^{-6}\ \mathrm{T})$	
0.1	6.28	
0.2	3.14	
0.3	2.09	
0.4	1.57	
0.5	1.26	

(a) According to the table of data, what is the relationship between B and r? **1**

.....

.....

(b) Complete the above table, draw a graph, using the grid below, to show that B is directly proportional to $\frac{1}{r}$. **2**



(c) Hence, by finding the slope of the trend line, determine the value of μ_0 . **1**

.....

.....

.....

.....

(d) If this experiment was performed on the Moon, would μ_0 be any different? **1**

Justify your prediction.

.....

.....

.....

(e) How does your calculated value of μ_0 compare with the true value of μ_0 ? **2**

.....

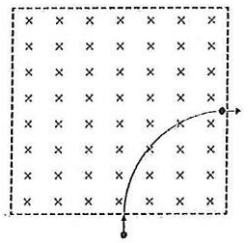
.....

.....

.....

Question 14 (5 marks)

An electron that has been accelerated from rest by a potential difference of 250 V, enters a region of magnetic field of strength 0.12 T that is directed into the plane of the page, as shown below.



The electron's path while in the region of magnetic field is a quarter circle.

(a) Show that the speed of the electron after acceleration is 9.4×10^6 m s^{-1}. **2**

.....

.....

.....

.....

.....

(b) Show that the radius of the path is 4.5×10^{-4} m. **2**

.....

.....

.....

.....

(c) Show that the time the electron spends in the region of the magnetic field is 7.5×10^{-11}s. **1**

.....

.....

.....

.....

Question 15 (4 marks)

How does the force of gravity determine the motion of planets and satellites? **4**

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

END OF TASK