SP015 ASSIGNMENT
WITH SOLUTION

SARAWAK MATRICULATION COLLEGE
SCIENCE DEPARTMENT
PHYSICS UNIT

SP015 INDIVIDUAL ASSIGNMENT

SEMESTER 1, SESSION 2022/2023

SUBMISSION DATE : 17.10.2022

NAME :

MATRICULATION NO. :

TUTORIAL CLASS :

LECTURER'S NAME :

DATE SUBMITTED :

QUESTION NO.	FULL MARKS	MARKS OBTAINED	MODERATOR
1	15		
2	16		
3	14		
4	15		
TOTAL	60		

SARAWAK MATRICULATION COLLEGE
PHYSICS SP015 SEMESTER 1, SESSION 2022/23

INDIVIDUAL ASSIGNMENT RUBRIC

Name :

Matriculation Number :

Tutorial Class :

Subattribute	1	2	3	4	5	**SCORE**
Allocated mark	$\left(\frac{Mark\ Earned}{Total\ Marks}\right) \times 80$					
Originality	Student's solution has 76% to 99% similarity with other students.	Student's solution has 51% to 75% similarity with other students.	Student's solution has 26% to 50% similarity with other students.	Student's solution has 25% or less similarity with other students.	All the solutions is written in student's own word.	
Solution methods	Less than 25% solutions are written in correct sequence.	25% to 49% solutions are written in correct sequence.	50% to 74% solutions are written in correct sequence.	75% to 99% solutions are written in correct sequence.	All solutions are written in the correct sequence (1a,1b, 1c, 2a, 2b, 2c).	
	Solutions for 3 different questions is written on the same page.	Solution for 1 out of 4 questions are written on a new page.	Solutions for 2 out of 4 questions are written on a new page.	Solutions for 3 out of 4 questions are written on a new page.	The solutions for all 4 questions are written on a new page.	
	Less than 20% of the solution method contains formulas and diagrams.	20% of the solution method contains formulas and diagrams.	40% of the solution method contains formulas and diagrams.	60% of the solution method contains formulas and diagrams.	80% of the solution method contains formulas and diagrams.	
TOTAL MARKS (100)						
CONTINUOUS ASSESSMENT (PB 10 %)						

Evaluated by;

…….

STUDENT'S DECLARATION
MATRICULATION PROGRAMME, MINISTRY OF EDUCATION MALAYSIA

Student's Name :	Course : Code :	Matric No. :
Assignment Title :		

Student's Declaration

I hereby declare that this task is my original work except for the citations and summaries of which I acknowledged the source.

Signature : _____ Date : _____
( )

Note: This form needs to be attached together with written/printed/model assignment and submitted to the respective lecturer for evaluation.

KOLEJ MATRIKULASI SARAWAK
PHYSICS SP015
SEMESTER 1 SESI 2022/2023
ASSIGNMENT

Name: _____ **Tutorial Group:** _____

Instruction:

1. **Answer all questions below.**
2. **Assignment must be submitted by hand latest by 4.30p.m. on the 17th November 2022.**

1. (a)

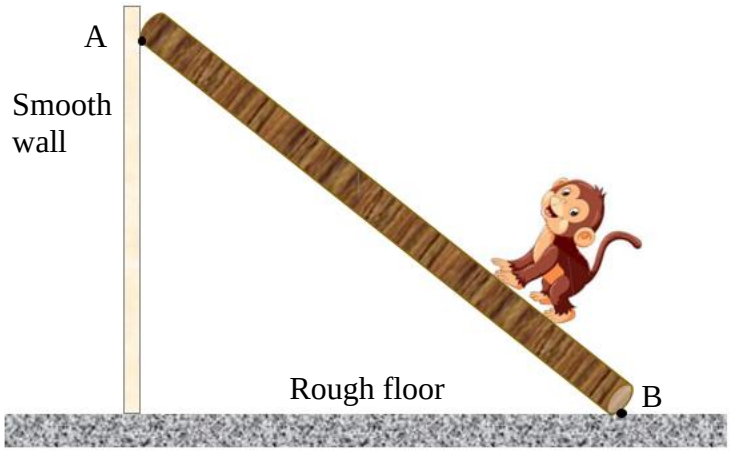


FIGURE 1

FIGURE 1 shows a coconut tree trunk of length 17 m and mass 40 kg leans against a smooth wall. The height of the end A of the coconut tree is 8.0 m from the rough floor.

(i) Determine the horizontal and vertical forces the floor exerts on the end B of the coconut tree when a monkey of mass 7 kg stands $\frac{1}{3}$ of the way from B.

[6 *marks*]

(ii) If the coconut tree is just on the verge of slipping when the monkey climbs further until it reaches 15.0 m up the trunk, calculate the coefficient of static friction between coconut tree and floor.

[6 *marks*]

(b) On a rotating carousel or merry-go-round, Shafiq sits on a horse near the outer edge and Mary sits on a lion halfway out from the center.

(i) Which one has the greater linear velocity? Explain.

[2 *marks*]

(ii) Which one has the greater angular velocity? Explain.

[2 *marks*]

2. (a)

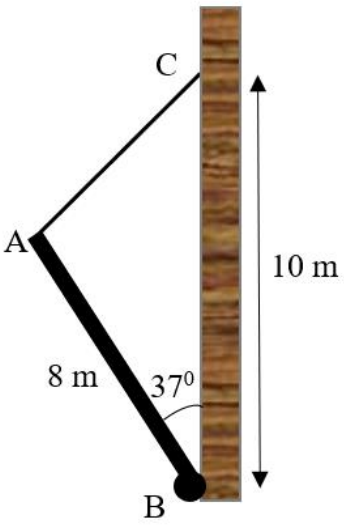


FIGURE 2

FIGURE 2 shows an 8 m uniform metal rod AB of weight 400 N is hinged to a wall at point B. The end A of the rod is connected with a string of length 6 m to the wall at point C.
Calculate:

(i) the tension of the string T.

[2 *marks*]

(ii) the reaction force and its direction at the end B.

[6 *marks*]

(b)

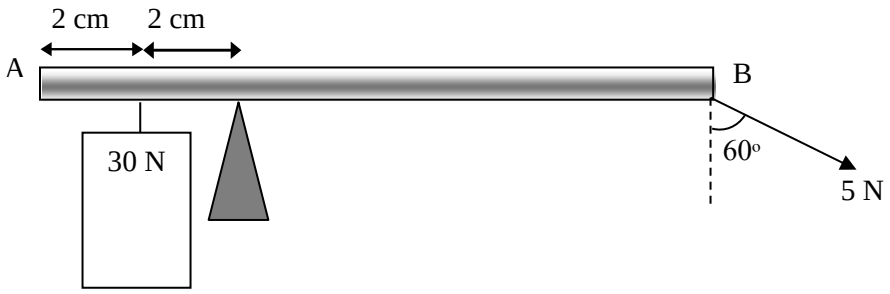


FIGURE 3

A uniform rod AB of length 24 cm is hinged smoothly at a point 4.0 cm from end A. it is maintained in a horizontal position by a 30 N weight suspended 2.0 cm from A and a 5.0 N force applied at B, as shown in **FIGURE 3**. Determine

(i) the weight of the rod

[3 *marks*]

(ii) the reaction force at the hinge.

[4 *marks*]

3.

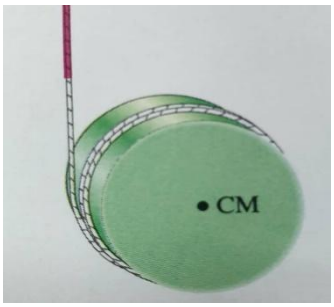


FIGURE 4

(a) A string is wound around a uniform solid cylinder like a yo-yo of mass 3.0 kg, radius 40 cm, and moment of inertia 0.10 kg m^2 about the axis of rotation. The cylinder starts falling from rest in **FIGURE 4**. As the cylinder falls, find

(i) its linear acceleration of the cylinder

[5 *marks*]

(ii) the tension in the string.

[2 *marks*]

(b)

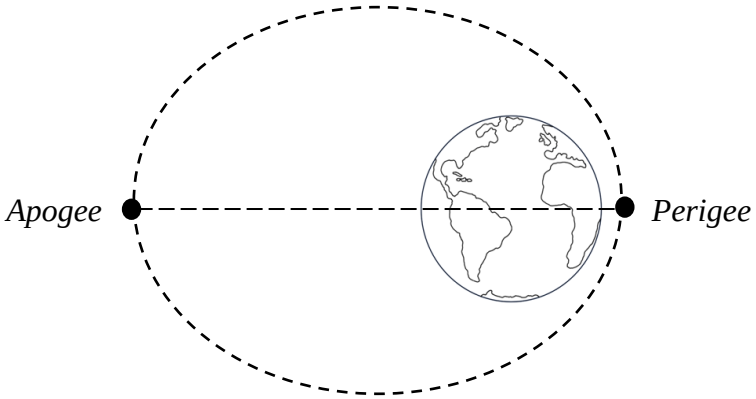


FIGURE 5

An artificial satellite is placed into an elliptical orbit about the earth, in **FIGURE 5**. Telemetry data indicate that its point of closest approach (called the *perigee*) is $r_P = 8.37 \times 10^6$ m from the center of the earth, and its point of greatest distance (called the *apogee*) is $r_A = 25.1 \times 10^6$ m from the center of earth. The speed of the satellite at the perigee is $v_P = 8450$ m s^{-1}. Find its speed v_A at the apogee.

[3 *marks*]

(c)

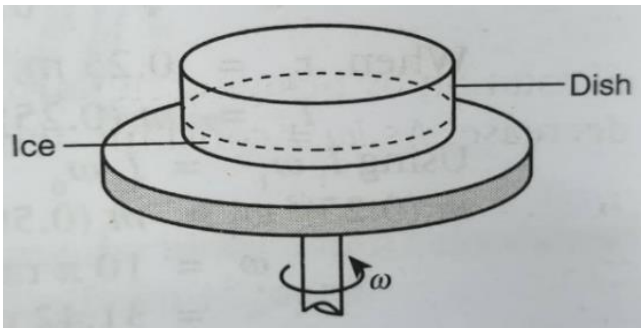


FIGURE 6

(i) **FIGURE 6** shows a thin layer of ice in a dish placed on top of a rotating table. As the table rotates freely, ice in the dish starts to melt. Describe and explain any changes to the rotational motion of the table.

[3 *marks*]

(ii) Misinah is sitting on the spinning seat of a piano stool with her arms folded. Ignore any friction in the spinning stool. What happens to her angular velocity and angular momentum when she extends her arms outward?

[2 *marks*]

4. (a)

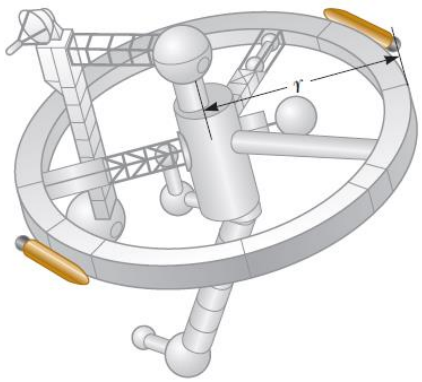


FIGURE 7

FIGURE 7 shows a space station that is constructed in the shape of a hollow ring of mass 5.0×10^4 kg. Members of the crew walk on a deck formed by the inner surface of the outer cylindrical wall of the ring, with radius r = 100 m. At rest when constructed, the ring is set rotating about its axis so that the people inside experience an effective free-fall acceleration equal to g. The rotation is achieved by firing two small rockets attached tangentially to opposite points on the rim of the ring.

(i) What angular momentum does the space station acquire?

[2 *marks*]

(ii) For what time interval must the rockets be fired if each exerts a thrust of 125 N?

[3 *marks*]

(b)

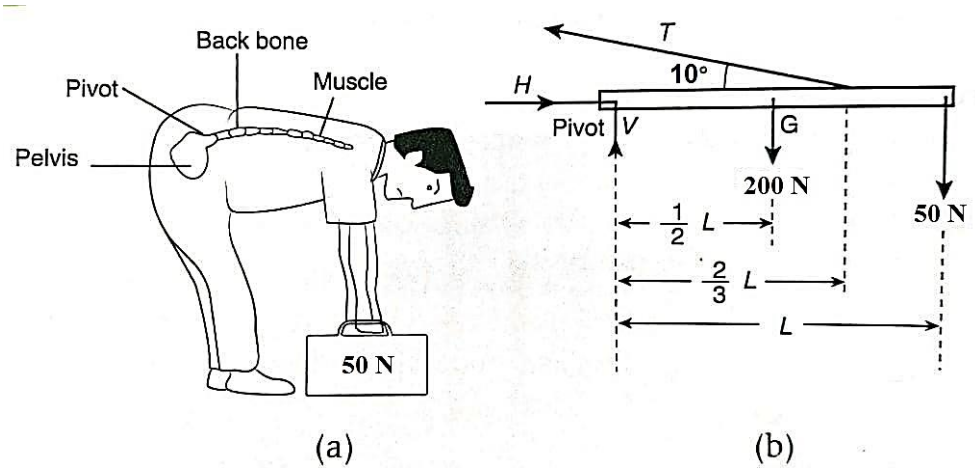


FIGURE 8

FIGURE 8(a) shows Aiman bending to lift a load of 50 N. His backbone may be considered as a rod pivoted at the end as shown in **FIGURE 8(b)**. The weight of the upper torso of Aiman is 200 N and acts through the point G. Calculate

(i) The tension *T* in the back muscle.

[2 *marks*]

(ii) The compression *H* on the backbone.

[2 *marks*]

(iii) The vertical reaction *V* on the pivot.

[2 *marks*]

(iv) Suggest a proper body posture or the correct technique for Aiman to lift the load. Describe and explain you answer clearly.

[3 *marks*]

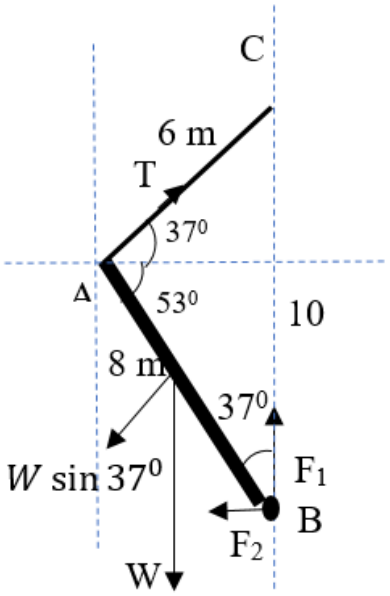
END OF QUESTION

KOLEJ MATRIKULASI SARAWAK
PHYSICS SP015 ASSIGNMENT
SESSION 2022/2023
MARKING SCHEME

No	Answer	Mark(s)
1(a)(i)	$\Sigma\tau_B = 0$ $\tau_m + \tau_t + (-\tau_A) = 0$ $m_m g\left(\frac{L}{3}\right) sin\frac{15}{17} + m_t g\left(\frac{L}{2}\right) sin\frac{15}{17} - N_A L sin\frac{8}{17} = 0$ $(7)(9.81)\left(\frac{17}{3}\right) sin\frac{15}{17} + (40)(9.81)\left(\frac{17}{2}\right) sin\frac{15}{17} - N_A(17) sin\frac{8}{17} = 0$ $N_A = 410.78\ N$ **Horizontal force** $\Sigma F_x = 0$ $N_A + (-f_s) = 0$ $N_A = f_s$ $f_s = 410.78\ N$ **Vertical force** $\Sigma F_y = 0$ $N_B + (-W_m) + (-W_t) = 0$ $N_B = W_m + W_t$ $N_B = g(m_m + m_t)$ $N_B = 9.81(7 + 40)$ $N_B = 461.07\ N$	K1 G1 K1 JU1 G1 JU1
1(a)(ii)	$\Sigma\tau_B = 0$ $\tau_m + \tau_t + (-\tau_A) = 0$ $m_m g(L_m) sin\frac{15}{17} + m_t g\left(\frac{L}{2}\right) sin\frac{15}{17} - N_A L sin\frac{8}{17} = 0$ $(7)(9.81)(m) sin\frac{15}{17} + (40)(9.81)\left(\frac{17}{2}\right) sin\frac{15}{17} - N_A(17) sin\frac{8}{17} = 0$ $N_A = 481.47\ N$ **Vertical force** $\Sigma F_y = 0$ $N_B + (-W_m) + (-W_t) = 0$ $N_B = W_m + W_t$ $N_B = g(m_m + m_t)$ $N_B = 9.81(7 + 40)$ $N_B = 461.07$ **Horizontal force** $\Sigma F_x = 0$	K1 G1 G1

	$N_A + (-f_s) = 0$ $N_A + \mu_s N_B = 0$ $\mu_s = \frac{N_A}{N_B}$ $\mu_s = \frac{481.47}{461.07}$ $\mu_s = 1.044$	K1 G1 JU1
1(b)(i)	The linear velocity is the distance travelled divided by the time interval. In one rotation Shafiq on the outer edge travels a longer distance than Irfan near the center, but the time interval is the same for both. Hence Shafiq will have greater linear velocity. ***or*** From the equation $v = r\omega$, if the ω is constant the velocity is directly proportional to the radius or distance from axis of rotation. Shafiq will have greater linear velocity because his distance from the center of carousel is greater than Mary.	J1 J1 J1 J1
1(b)(ii)	Both Shafiq and Mary has the same angular velocity because both are rotating with the carousel angular velocity. They both covered the same angle of rotation in the same period of time	J1 J1
	TOTAL	**16**

No	Answer	Mark(s)

2(a)(i)	 Let F1 and F2 are the horizontal and vertical forces exerted on the rod at B. Taking torque at point B, $\Sigma\tau_B = 0$ $\tau_1 + (-\tau_2) = 0$ $F_1 d_1 - F_2 d_2 = 0$ $W\ sin\ sin\ 37^0(4) - T(8) = 0$ $T = \frac{(4)(400)37^0}{8}$ $T = 120.4\ N$	G1 JU1
2(a)(ii)	$\Sigma F_y = 0$ $T_y + F_{1y} + (-W) = 0$ $T(37^0) + F_1 - W = 0$ $(120.4)(37^0) + F_1 - 400 = 0$ $F_1 = 327.6\ N$ $\Sigma F_x = 0$ $T_x + (-F_{2x}) = 0$ $T(37^0) - F_2 = 0$ $(120.4)\ cos\ cos\ (37^0) - F_2 = 0$ $F_2 = 96.2\ N$ Hence the reaction force, $F = \sqrt{F_1^2 + F_2^2}$ $F = \sqrt{327.6^2 + 96.2^2}$	K1 G1 G1

	$F = 341.4\ N$ Direction, $\theta = tan^{-1}(\frac{F_1}{F_2})$ $\theta = tan^{-1}(\frac{327.6}{96.2})$ $\theta = 73.6^0$	G1 JU1 G1 JU1

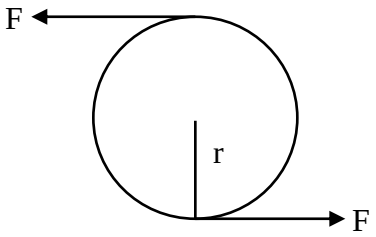
No.	Answer	Mark(s)
2(b)(i)	$\Sigma\tau = 0$ $\tau_b + (-\tau_r) + (-\tau_F) = 0$ $W_b(r_b)sin90 - W_r(r_r)sin90 - F(r_F)sin30 = 0$ $(30)(0.02)sin90 - W_r(0.08)sin90 - 5(0.2)sin30 = 0$ $W_r = 1.25\ N$	K1 G1 JU1
2(b)(ii)	$\Sigma F_y = 0$ $R + (-W_b) + (-W_r) + (-F_y) = 0$ $R = 30 + 1.25 + 5cos60$ $R = 33.75\ N$	K1 G1 JU1
	TOTAL	**15**

No.	Answer	Mark(s)
3(a)(i)	$\Sigma\tau = I\alpha$ $Tr = I\alpha$ $Tr = I\left(\frac{a}{r}\right)$	K1

	$T = \frac{Ia}{r^2}$ --- 1 $\Sigma F_y = ma$ $W + (-T) = ma$ $mg - T = ma$ $T = mg - ma$ --- 2 $1 = 2$ $a = \frac{mg}{\left(\frac{I}{r^2}\right) + m}$ $a = \frac{(3)(9.81)}{\left(\frac{0.1}{0.4^2}\right) + 3}$ $a = 8.12\ ms^{-2}$	K1 K1 G1 JU1

No.	Answer	Mark(s)
3(a)(ii)	$T = \frac{Ia}{r^2}$ $T = \frac{(0.10)(8.12)}{(0.4)^2}$ $T = 5.08\ N$	G1 JU1
3(b)	$L_A = L_P$ $I_A\omega_A = I_P\omega_P$ $(mr_A{}^2)\left(\frac{v_A}{r_A}\right) = (mr_P{}^2)\left(\frac{v_P}{r_P}\right)$ $r_A v_A = r_P v_P$ $v_A = \frac{r_P v_P}{r_A}$ $v_A = \frac{(8.37 \times 10^6)(8450)}{25.1 \times 10^6}$ $v_A = 2817.79\ ms^{-1}$	K1 G1 JU1

3(c)(i)	Water from the melted ice moves to the side of the dish as the table rotates. The moment of inertia I increases. Since $I\omega$ = constant, the angular velocity ω decreases.	J1 J1 J1
3(c)(ii)	Angular velocity decreases. Angular momentum remains the same.	J1 J1
	TOTAL	**15**

No	Answer	Mark(s)
4(a)(i)	$a_c = g = \frac{v^2}{r} = r\omega^2$ $\omega = \sqrt{\frac{g}{r}}$ $I = Mr^2$ $L = I\omega$ $L = (Mr^2)\left(\sqrt{\frac{g}{r}}\right)$ $L = (5 \times 10^4)(100^2)\left(\sqrt{\frac{9.81}{100}}\right)$ $L = 1.566 \times 10^8\ kgm^2s^{-1}$	G1 JU1
4(a)(ii)	 $\Sigma\tau = I\alpha$ $2Fr = I\alpha$ $\alpha = \frac{2Fr}{I}$ ---1 $\alpha = \frac{\omega_f - \omega_i}{\Delta t}$ $as\ \omega_i = 0, \quad \alpha = \frac{\omega}{\Delta t}$ ---2	

	$1 = 2$ $\frac{2Fr}{I} = \frac{\omega}{\Delta t}$ $\Delta t = \frac{I\omega}{2Fr}$ $\Delta t = \frac{L}{2Fr}$ $\Delta t = \frac{1.566 \times 10^8}{2(125)(100)}$ $\Delta t = 6264\ s$	K1 G1 JU1
4(b)(i)	$\Sigma\tau = 0$ $\tau_T + (-\tau_L) + (-\tau_G) = 0$ $T\left(\frac{2}{3}L\right)sin10 - W_L(L)sin90 - W_G\left(\frac{L}{2}\right)sin90 = 0$ $T\left(\frac{2}{3}L\right)sin10 - 50(L) - 200\left(\frac{L}{2}\right) = 0$ $T = \frac{(3)150}{(2)sin10}$ $T = 1295.72\ N$	G1 JU1
4(b)(ii)	$\Sigma F_x = 0$ $H + (-T_x) = 0$ $H = 1295.72\ cos10$ $H = 1276.04\ N$	G1 JU1
4(b)(iii)	$\Sigma F_y = 0$ $V + T_y + (-W_L) + (-W_G) = 0$ $V = -1295.72\ sin10 + 50 + 200$ $V = 25\ N$	G1 JU1
4(b)(iv)	Aiman should bend his knees when lifting a heavy load. When bending and lifting our backs becomes a lever system. The spine is the lever, the hips are the anchor point, and the muscles of the back are the supporting rope. When correctly bending the knees and lifting with the legs we keep our shoulders over our hips creating a short lever. As a result a small force is created on the lever	J1 J1

	(spine) and the weight of the object travels safely down our back and hips. Additionally the muscles are kept in their shortest and safest position When lifting only with the back the shoulders are positioned forward relative to the hips. With the shoulders forward the weight of the object is further away from the hips and creates an increased force on the lever (spine). Additionally the muscles are stretched longer and have to contract with a greater force. This combination of a stressed spine and increased muscle contraction can cause the back to fail.	J1
	TOTAL	**14**

SP025 ASSIGNMENT
WITH SOLUTION

KOLEJ MATRIKULASI SARAWAK
JABATAN SAINS
UNIT FIZIK
SEMESTER 2, SESI 2022/2023

NAMA :
NO. MATRIK :
KELAS :
PENSYARAH KULIAH :
TARIKH TUGASAN DIHANTAR :

SECTION A: TUGASAN INDIVIDU

NO. SOALAN	MARKAH PENUH	MARKAH DIPEROLEHI	MARKAH MODERATOR	MARKAH KETUA MODERATOR
1	**15**			
2	**16**			
3	**17**			
4	**12**			
5	**10**			
JUMLAH	**70**			

SECTION B: TUGASAN NUMERASI

MARKAH PENUH	MARKAH DIPEROLEHI	MARKAH MODERATOR	MARKAH KETUA MODERATOR
20			

PB/PTP

STUDENT'S DECLARATION
MATRICULATION PROGRAMME, MINISTRY OF EDUCATION MALAYSIA

Student's Name :	Course : Code :	Matric No. :
Assignment Title :		

Student's Declaration

I hereby declare that this task is my original work except for the citations and summaries of which I acknowledged the source.

Signature :

Nama :

Date :

Note: This form needs to be attached together with written/printed/model assignment and submitted to the respective lecturer for evaluation.

SARAWAK MATRICULATION COLLEGE
PHYSICS SP025
SEMESTER 2, SESSION 2022/2023

INDIVIDUAL ASSIGNMENT RUBRIC

Name :

Matriculation Number :

Tutorial Class :

Subattribute	1	2	3	4	5	**SCORE**
Allocated mark	$\left(\frac{\text{Mark earned}}{\text{Total marks}}\right) \times 80$					
Originality	Student's solution have 76% to 99% similarity with other students.	Student's solution have 51% to 75% similarity with other students.	Student's solution have 26% to 50% similarity with other students.	Student's solution have 25% or less similarity with other students.	All the solutions is written in student's own word.	
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	Less than 20% of the solution method contains formulas and diagrams.	20% of the solution method contains formulas and diagrams.	40% of the solution method contains formulas and diagrams.	60% of the solution method contains formulas and diagrams.	80% of the solution method contains formulas and diagrams.	
TOTAL MARKS (100)						
TOTAL PERCENTAGE (10 %)						

Evaluated by;

…….

SARAWAK MATRICULATION COLLEGE
PHYSICS SP025
SEMESTER 2, SESSION 2022/2023

SECTION A : INDIVIDUAL ASSIGNMENT

Instructions: This assignment has 2 sections A and B. Answer all questions.

1

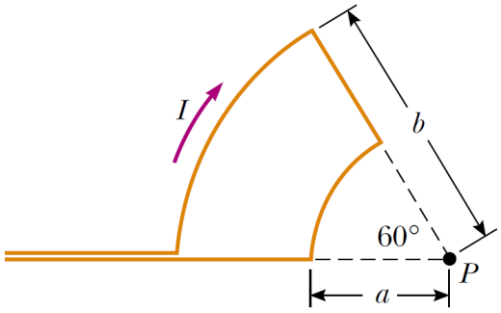


FIGURE 1.1

(a) Consider the current-carrying loop shown in **FIGURE 1.1**, formed of radial lines and segments of circles whose centers are at point P. Find the magnitude and direction of the magnetic field at ***P***.

[4 *marks*]

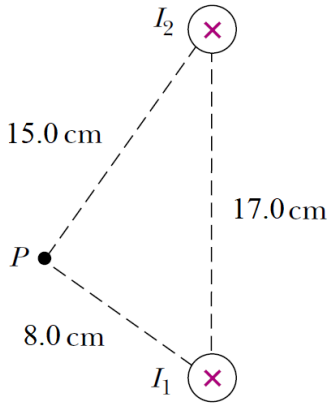


FIGURE 1.2

(b) Two long, parallel conductors both carrying currents of 2.50 A directed into the page as in **FIGURE 1.2**. Determine the magnitude and direction of the resultant magnetic field at ***P***.

[5 marks]

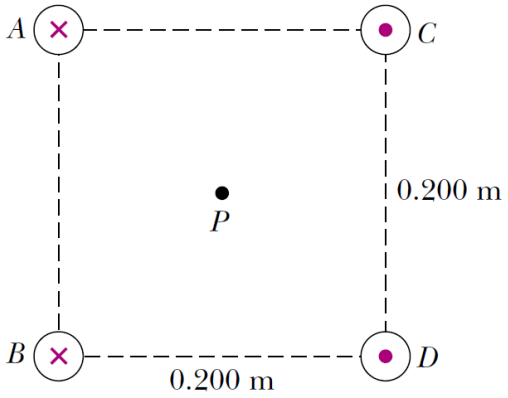


FIGURE 1.3

(c) Four long, parallel conductors can carry equal currents of I = 5.00 A. **FIGURE 1.3** is and end view of the conductors. The current direction is into the page at points A and B and out of the page at C and D. Calculate the magnitude and direction of the magnetic field at point ***P***, located at the center of the square of edge length 0.20 m.

[6 *marks*]

2 (a)

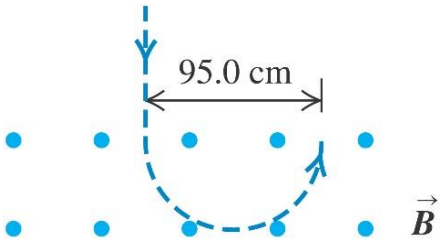


FIGURE 2.1

In an experiment with cosmic rays, a vertical beam of particles that have charge of magnitude 3e and mass 12 times the proton mass enters a uniform horizontal magnetic field of 0.250 T and is bent in a semicircle of diameter 95.0 cm as shown in **FIGURE 2.1**.

(i) Find the speed of the particles and the sign of their charge.

[4 *marks*]

(ii) Is it reasonable to ignore the gravity force on the particles? Explain your answer.

[3 *marks*]

(iii) How does the speed of the particles as they enter the field compare to their speed as they exit the field?

[1 *mark*]

(b)

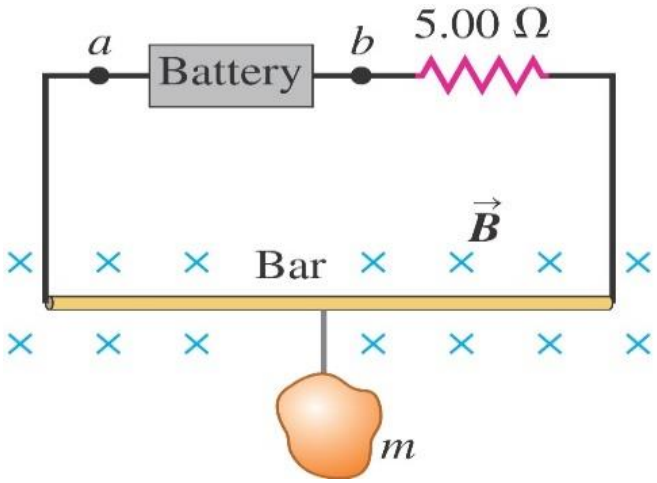


FIGURE 2.2

The circuit shown in **FIGURE 2.2** is used to make a magnetic balance to weigh objects. The mass *m* to be measure is hung from the center of the bar that is in a uniform magnetic field of 1.50 T directed into the plane of the figure. The battery voltage can be adjusted to vary the current in the circuit. The horizontal bar is 60.0 cm long and is made of extremely light weight material. It is connected to the battery by thin vertical wires that can support no appreciable tension; all the weight of the suspended mass *m* is supported by the magnetic force on the bar. A resistor with R=5.00 Ω is in series with the bar; the resistance of the rest of the circuit is much less than this.

(i) Which point *a* or *b* should be the positive terminal of the battery? Explain your answer.

[4 *marks*]

(ii) If the maximum voltage of the battery is 175 V, what is the greatest mass *m* that this instrument can measure?

[4 *marks*]

3 (a) The **FIGURE 3.1** shows two parallel straight wires are placed 42 cm apart carry currents I_1 = 2.5 A and I_2 = 3.2 A in opposite directions.

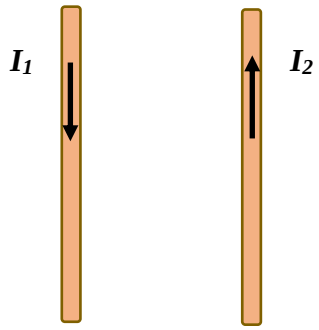


FIGURE 3.1

(i) Copy **FIGURE 3.1** and draw the direction of the magnetic force and magnetic field on each wire.

[2 *marks*]

(ii) Calculate the force per unit length between the wires.

[2 *marks*]

(iii) If the current I_1 is increased to 3.0 A, calculate the current needed in the second wire to maintain the same force per unit length between the wires as in (ii). (Given $\mu_0 = 4\pi \times 10^{-7}$ T m A^{-1})

[2 *marks*]

(b)

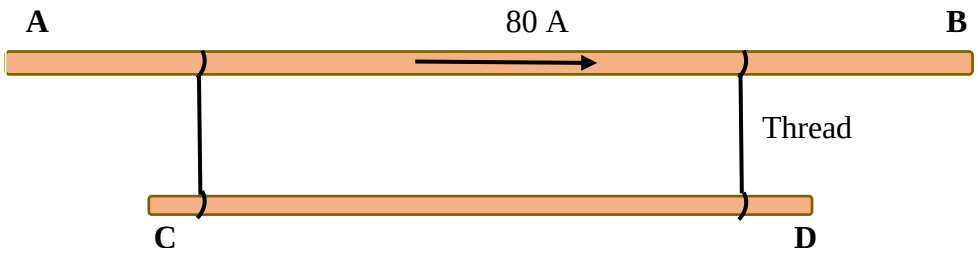


FIGURE 3.2

A horizontal wire AB in **FIGURE 3.2** carries a current of 80 A in the direction AB. A lower wire CD has a mass of 0.12 g per meter of length hangs horizontally from threads of length 20 cm. Determine the direction and magnitude of the current in the wire CD required for the tensions in the threads to become zero.

[4 *marks*]

(c)

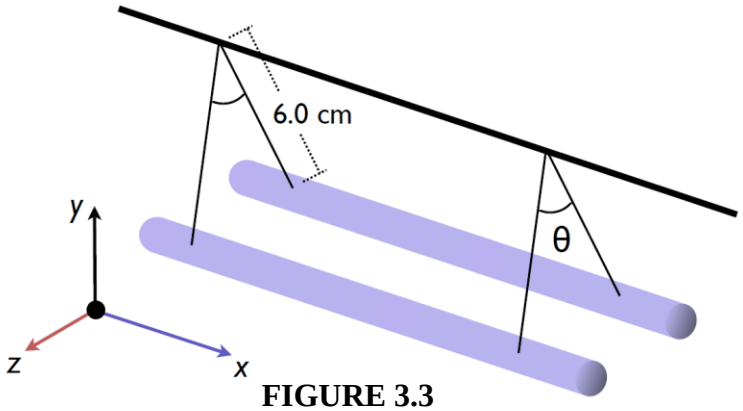


FIGURE 3.3

Two long parallel wires, each with a mass per unit length of $\lambda = m/l = 0.040$ kg/m, are supported in a horizontal plane by 6.0 cm strings, as shown in **FIGURE 3.3**. Each wire carries the same current I, causing the wires to repel one another, which causes the supporting strings to make an angle $\theta = 16°$ with one another.

(i) Are the currents in the wires in the same or opposite direction? Explain.

[2 *marks*]

(ii) Find the magnitude of the current in the wire.

[5 *marks*]

4 (a)

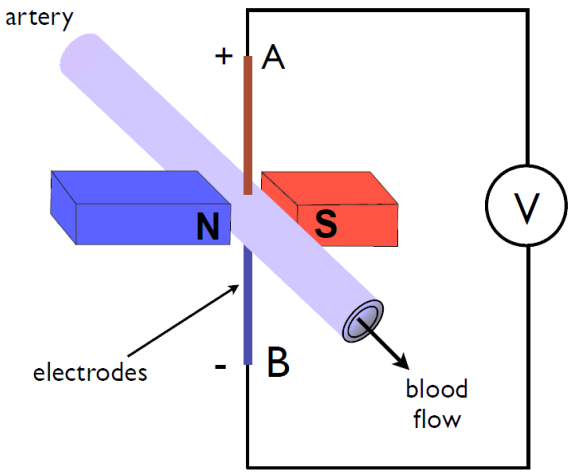


FIGURE 4.1

Using an electromagnetic flowmeter as in **FIGURE 4.1**, a heart surgeon monitors the flow rate of blood through an artery. Electrodes A and B make contact with the outer surface of the blood vessel, which has inside diameter 3.2 mm. Permanent magnets outside the blood vessel create a magnetic field perpendicular to the blood flow direction. For a magnetic field strength of $\boldsymbol{B} = 0.037$ T, a potential difference of $\Delta V = 160\ \mu V$ appears between the electrodes.

(i) Calculate the speed of the blood.

[3 *marks*]

(ii) Does the sign of the potential difference (electrodes) depend on whether the mobile ions in the blood are predominantly positively or negatively charged?

[2 *marks*]

(b)

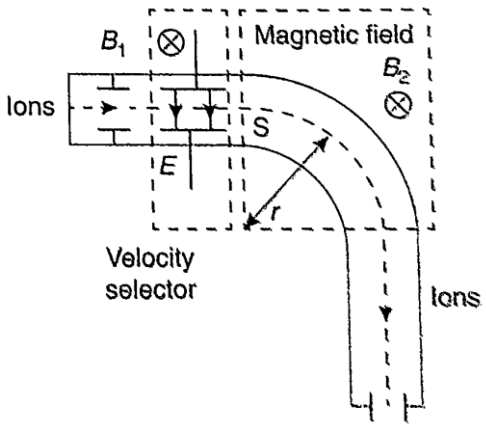


FIGURE 4.2

FIGURE 4.2 shows a schematic model of a mass spectrometer. An ion of charge q enters the velocity selector with electric field E and magnetic field B_1. The velocity of the ion at slit S is v. The ion then enters the region of the magnetic field B_2 where it is deflected in a circular path of radius r.

(i) Express v in terms of E and B_1

[1 *mark*]

(ii) Derive an expression for the mass m of the ion in terms of E, B_1, B_2, r and q.

[2 *marks*]

(iii) If $B_1 = B_2 = 0.01$ T and $r = 20.0$ cm, calculate two different electric fields that enable the spectrometer to differentiate singly charged copper isotopes ${}^{63}_{29}Cu$ and ${}^{65}_{29}Cu$.

[4 *marks*]

[Atomic mass of isotope ${}^{63}_{29}Cu = 62.929601\ u$, isotope ${}^{65}_{29}Cu = 64.927794\ u$]

5 (a) Briefly describe the workings of Magnetic Resonance Imaging (MRI).

[5 *marks*]

(b) Explain the phenomenon of Hall Effect.

[5 *marks*]

SARAWAK MATRICULATION COLLEGE
PHYSICS SP025
SEMESTER 2, SESSION 2022/2023

SECTION B : NUMERACY ASSIGNMENT

An electrical engineer is designing a DC electric motor. The DC electric motor required a circular coil with the range of diameter between 4.0 cm to 7.0 cm. **TABLE 1** and **TABLE 2** show a set of data for two circular coils, coil A and coil B. Based on the data given, use a suitable method to identify which coil is the most suitable for the DC electric motor.

[20 *marks*]

TABLE 1: Coil A

B ($\times 10^{-8}$ T)	**6.28**	**9.42**	**12.57**	**15.71**	**18.84**
I (mA)	**2.0**	**3.0**	**4.0**	**5.0**	**6.0**

TABLE 2: Coil B

B ($\times 10^{-8}$ T)	**2.51**	**3.77**	**5.03**	**6.28**	**7.54**
I (mA)	**2.0**	**3.0**	**4.0**	**5.0**	**6.0**

END OF QUESTION

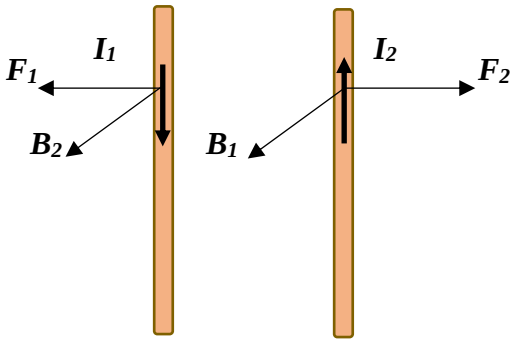
PHYSICS SP025 ASSIGNMENT
SEMESTER 2 SESI 2022/2023
INDIVIDUAL ASSIGNMENT MARKING SCHEME

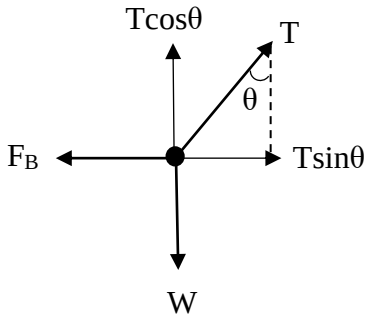
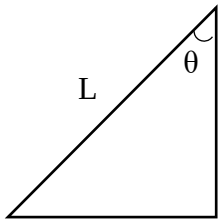
<table>
<tr><th>No</th><th>Suggested answer</th><th>Mark/s</th></tr>
<tr><td>1(a)</td><td>$$\Sigma B_P = B_1 + B_2$$
$$\Sigma B_P = \frac{1}{6}\left[\frac{\mu_o I}{2a} + \left(-\frac{\mu_o I}{2b}\right)\right]$$
$$\Sigma B_P = \frac{\mu_o I}{12}\left(\frac{1}{a} - \frac{1}{b}\right)$$
direction: out of the page</td><td>K1
G1
J1
J1</td></tr>
<tr><td>1(b)</td><td>$$B_1 = \frac{\mu_o I_1}{2\pi r_1}$$
$$B_1 = \frac{(4\pi \times 10^{-7})(2.5)}{2\pi(0.08)}$$
$$B_1 = 6.25 \times 10^{-6}\ T$$
using the same method as above,
$$B_2 = 3.33 \times 10^{-6}\ T$$
<table>
<tr><th></th><th>$x - component$</th><th>$y - component$</th></tr>
<tr><td>B_1</td><td>$B_1 cos\theta_1$
$=(6.25 \times 10^{-6})cos61.93$
$= + 2.94 \times 10^{-6}\ T$</td><td>$B_1 sin\theta_1$
$=(6.25 \times 10^{-6})sin61.93$
$= + 5.51 \times 10^{-6}\ T$</td></tr>
<tr><td>B_2</td><td>$B_2 cos\theta_2$
$=(3.33 \times 10^{-6})cos28.07$
$= - 2.94 \times 10^{-6}\ T$</td><td>$B_2 sin\theta_2$
$=(3.33 \times 10^{-6})sin28.07$
$= + 1.57 \times 10^{-6}\ T$</td></tr>
<tr><td>Σ</td><td>$\Sigma B_x = 0$</td><td>$\Sigma B_y = 7.08 \times 10^{-6}\ T$</td></tr>
</table>
$$B_P = \sqrt{\Sigma B_x{}^2 + \Sigma B_y{}^2}$$
$$B_P = \sqrt{0^2 + (7.08 \times 10^{-6})^2}$$
$$B_P = 7.08 \times 10^{-6}\ T$$
direction: upward at point P @ in +y direction at point P</td><td>G1
G1
G1
JU1
J1</td></tr>
</table>

1(c)	$\lvert B_A\rvert = \lvert B_B\rvert = \lvert B_C\rvert = \lvert B_D\rvert = B$ $B = \frac{\mu_o I}{2\pi r}$ $B = \frac{(4\pi \times 10^{-7})(5.00)}{2\pi(0.141)}$ $B = 7.09 \times 10^{-6}\ T$ $B_A + B_D = 1.42 \times 10^{-5}\ T$ $B_c + B_B = 1.42 \times 10^{-5}\ T$ As $B_A + B_D$ is perpendicular to $B_B + B_C$,we can consider them as horizontal and vertical component $B_P = \sqrt{(B_A + B_D)^2 + (B_c + B_B)^2}$ $B_P = \sqrt{(1.42 \times 10^{-5})^2 + (1.42 \times 10^{-5})^2}$ $B_P = 2.01 \times 10^{-5}\ T$ direction: downward at point P @ in -y direction at point P	K1 G1 G1 G1 JU1 J1
	TOTAL	**15**

No	Answer	Mark/s
2(a)(i)	r = 47 .5 cm q = 3e = $3 \times 1.6 \times 10^{-19}\ C$ m = $12 \times 1.67 \times 10^{-27}\ kg$ B = 0.25 T $F_c = F_B$ $\frac{mv^2}{r} = qvB$ $v = \frac{qBr}{m}$ $= \frac{(3)(1.6 \times 10^{-19})(0.25)(0.475)}{12 \times 1.67 \times 10^{-27}}$ $= 2.84 \times 10^6\ ms^{-1}$ Sign of the charge = negative	K1 G1 JU1 J1

2(a)(ii)	Yes. $F_B = 3 \times 1.6 \times 10^{-19} \times\ 2.84 \times 10^{6} \times 0.25$ $= 3.4 \times 10^{-13}\ N$ $W = 12 \times 1.67 \times 10^{-27} \times 9.81$ $= 1.97 \times 10^{-25}$ $\frac{F_B}{W} = 1.7 \times 10^{12}$ Since F_B is 10^{12} greater than the weight, therefore force of gravity can be ignored.	J1 K1 K1
2(a)(iii)	The speed does not change since the force is perpendicular to the velocity. No change in kinetic energy implies that the work done is zero.	J1
2(b)(i)	Point a. F_B should be upward to balance the weight. Therefore, by using right hand rule, the direction of current is to the right. Since the direction of current is from positive terminal to negative terminal, hence the point a is the positive terminal.	J1 K1 K1 K1
2(b)(ii)	$I = \frac{V}{R}$ $= \frac{175}{5}$ $= 35\ A$ $F_B \geq mg$ $ILB \geq mg$ $m \leq \frac{35 \times 0.6 \times 1.5}{9.81}$ $m \leq 3.21\ kg$ The maximum mass that the bar can support is 3.21 kg.	 G1 K1 G1 JU1
	TOTAL	**16**

No.	Answer	Mark/s
3(a)(i)		D1 – both B correct with label. D1 – both F correct with label.
3(a)(ii)	$\frac{F}{l} = \frac{\mu_0 I_1 I_2}{2\pi d}$ $\frac{F}{l} = \frac{(4\pi \times 10^{-7})(2.5)(3.2)}{2\pi(0.42)}$ $\frac{F}{l}$ = 3.81×10^{-6} N m^{-1}	G1 JU1
3(a)(iii)	$\frac{F}{l} = \frac{\mu_0 I_1 I_2}{2\pi d}$ $3.81 \times 10^{-6} = \frac{(4\pi \times 10^{-7})(3.0) I_2}{2\pi(0.42)}$ I_2= 2.67 A	G1 JU1
3(b)	$F_B = F_g$ $\frac{\mu_0 I_1 I_2 l}{2\pi d} = mg$ $\frac{\mu_0 I_1 I_2}{2\pi d} = \left(\frac{m}{l}\right) g$ $I_2 = \frac{(2\pi d)\left(\frac{m}{l}\right) g}{\mu_0 I_1}$ $I_2 = \frac{2\pi(0.2)(0.12 \times 10^{-3})(9.81)}{(4\pi \times 10^{-7})(80)}$ I_2= 14.7 A Magnetic force on the wire must be upward, this means that the current in two wires must be in the same direction, **to the right.**	K1 G1 JU1 J1

3(c)(i)	The two wires in the figure are hanging without being in contact with each other. This is only possible because both wires are exerting a **repulsive force** on each other. For the force between the wires to be repulsive, using Fleming Left Hand rule, the direction of current flowing in the wires is determined to be in **opposite direction.**	K1 K1
3(c)(ii)	  d/2 $\frac{F_B}{L} = \frac{\mu_o I^2}{2\pi d} \quad ---1$ $\Sigma F_x = 0$ $Tsin\theta + (-F_B) = 0$ $Tsin\theta = F_B \quad ---2$ $\Sigma F_y = 0$ $Tcos\theta + (-W) = 0$ $Tcos\theta = W \quad ---3$ $\frac{2}{3} = \frac{Tsin\theta}{Tcos\theta} = \frac{F_B}{mg}$ $F_B = mgtan\theta \quad ---4$ $sub\ 4\ into\ 1 \qquad \frac{mgtan\theta}{L} = \frac{\mu_o I^2}{2\pi d}$ $as\ \lambda = \frac{m}{L}\ , \qquad \lambda gtan\theta = \frac{\mu_o I^2}{2\pi d}$ $I = \sqrt{\frac{\lambda gtan\theta(2\pi d)}{\mu_o}}$ $I = \sqrt{\frac{(0.04)(9.81)(tan8)2\pi(0.0167)}{4\pi \times 10^{-7}}}$ $I = 67.84\ A$	K1 K1 K1 R1 JU1
	TOTAL	**17**

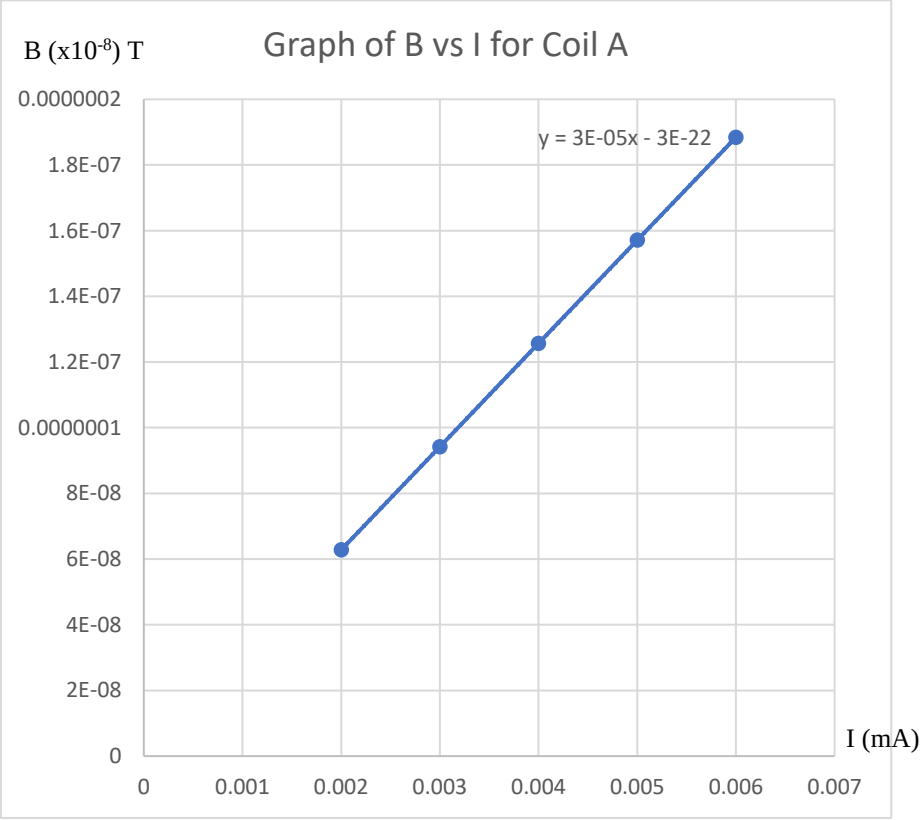
No.	Answer	Mark/s
4(a)(i)	$F_E = F_B$ $qE = qvB$ $v = \frac{E}{B} \quad ---1$ $as\ V = Ed \quad rearrange \quad E = \frac{V}{d} \quad ---2$ $sub\ 2\ into\ 1\ we\ get \quad v = \frac{V}{Bd}$ $v = \frac{(60 \times 10^{-6})}{(0.04)(3 \times 10^{-3})}$ $v = 1.33\ ms^{-1}$	K1 G1 JU1
4(a)(ii)	**No.** The sign of the potential difference (electrodes) **does not** depend on whether the mobile ions in the blood are predominantly positively or negatively charged. The direction of magnetic field on all the ions is from left to right and the direction of blood flow is out of the page causing the direction of the **magnetic force** acting on the **positively charged ion** is always **pointing up** while for **negatively charged ion** always **pointing down**. Positive ions will accumulate at electrode A making the electrode positive and the negative ions that accumulate at electrode B making the electrode negative.	K1 K1

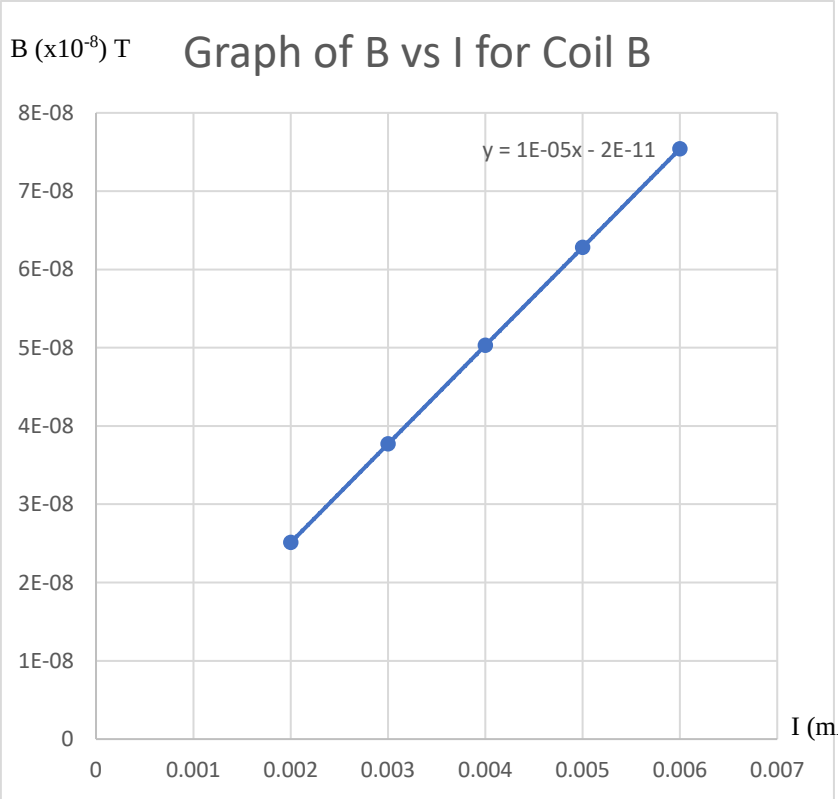
No.	Answer	Mark/s
4(b)(i)	$v = \frac{E}{B_1}$ where $v = velocity\ of\ the\ ion\ at\ slit\ S$ $E = Electric\ field$ $B_1 = magnetic\ field\ in\ velocity\ selector$	R1
4(b)(ii)	In the magnetic field B_2, $qvB_2 = \frac{mv^2}{r}$ $m = \frac{qrB_2}{v}$ $m = \frac{qrB_1B_2}{E}$	K1 J1

4(b)(iii)	$$E = \frac{qrB_1B_2}{m}$$ $$For\ {}^{63}_{29}Cu,\ \ E = \frac{(1.60 \times 10^{-19})(0.2)(0.01)(0.01)}{(62.929601)(1.66 \times 10^{-27})}$$ $$E = 30.6\ Vm^{-1}$$ $$For\ {}^{65}_{29}Cu,\ \ E = \frac{(1.60 \times 10^{-19})(0.2)(0.01)(0.01)}{(64.927794)(1.66 \times 10^{-27})}$$ $$E = 29.7\ Vm^{-1}$$	G1 JU1 G1 JU1
	TOTAL	**12**

No.	Answer	Mark/s
5(a)	1) In MRI (Magnetic Resonance Imaging) machines, a strong magnetic field is used to align the magnetic moments of hydrogen atomic nuclei in body's tissues. 2) The body is then exposed to radio waves, which causes the nuclei to change their direction slightly. 3) When the body is no longer exposed to the radio waves, the nuclei reverts back to its original position and the nucleus gives off energy in form of radio waves. 4) Coils of varying magnetic field strength pointed at different parts of the body means that each hydrogen nucleus experiences slightly different magnetic fields. 5) Radio waves given off from the nuclei allows scanner to work out what tissues in what locations.	K1 K1 K1 K1 K1
5(b)	1) The Hall Effect is a phenomenon that occurs when an electric current flows through a conductor placed in a magnetic field. 2) When a current-carrying conductor is held fixed in a magnetic field, the field exerts a sideways force on the charges moving in the conductor. 3) The Hall Effect refers to the creation of a measurable electric field perpendicular to the direction of an electric current flowing through a conductor and the magnetic field. 4) It results in the creation of a measurable voltage perpendicular to both the direction of the current and the magnetic field. 5) The magnitude of the electric field is proportional to the strength of the magnetic field and the current density.	K1 K1 K1 K1 K1
	TOTAL	**10**
	GRAND TOTAL	**70**

PHYSICS SP025 ASSIGNMENT
SEMESTER 2 SESI 2022/2023
NUMERICAL ASSIGNMENT MARKING SCHEME

Suggested answer	Mark/s
Coil A Formulating the question, *Magnetic field produced by circular coil,* $B = \frac{\mu_o I}{2r}$ *By comparing with linear graph equation* $B = (\frac{\mu_o}{2r})\ (I)$ $y = mx + c$ $y = B$ $x = I$ $m = \frac{\mu_o}{2r}$	K1 J1 J1 J1
	x-axis and y-axis with correct unit – 1m 5 correct plotted points – 2 m 4 correct plotted points – 1 m 3 correct plotted points – 0 m
$m = \frac{\mu_o}{2r}$ $r_A = \frac{\mu_o}{2m}$ $r_A = 0.021\ m$	K1 JU1

Suggested answer	Mark/s
Coil B Formulating the question, $Magnetic\ field\ produced\ by\ circular\ coil,\ B = \frac{\mu_o I}{2r}$ *By comparing with linear graph equation* $B = (\frac{\mu_o}{2r})\ (I)$ $y = mx + c$ $y = B$ $x = I$ $m = \frac{\mu_o}{2r}$	K1 J1 J1 J1
	x-axis and y-axis with correct unit – 1m 5 correct plotted points – 2 m 4 correct plotted points – 1 m 3 correct plotted points – 0 m
$m = \frac{\mu_o}{2r}$ $r_A = \frac{\mu_o}{2m}$ $r_A = 0.063\ m$	K1 JU1
$r_A = 0.021\ m,\ d_A = 0.042\ m$ $r_B = 0.063\ m,\ d_B = 0.126\ m$ **d_A is in the range of diameter between 4.0 cm to 7.0 cm, coil A is the most suitable for the DC electric motor.**	determine the diameter – JU1 decision making – JU1
TOTAL	**20 MARKS**