

Physics 12
2008/09 Released Exam
June 2009 — Form A
 Provincial Examination — Answer Key

Cognitive Processes	Weightings	Question Types
K = Knowledge	10%	35 = Multiple Choice (MC)
U = Understanding	80%	6 = Written Response (WR)
H = Higher Mental Processes	10%	

Topics	Prescribed Learning Outcomes (PLOs)	Weightings
1. Vector Kinematics in Two Dimensions <i>and</i> Dynamics <i>and</i> Vector Dynamics	B, C, D	18%
2. Work, Energy and Power <i>and</i> Momentum	E	6 %
	F	6 %
3. Equilibrium	G	12 %
4. Circular Motion <i>and</i> Gravitation	H	8 %
	I	8 %
5. Electrostatics	J	12 %
6. Electric Circuits	K	12 %
7. Electromagnetism	L	18 %

Question Number	Keyed Response	Cognitive Process	Mark	Topic	PLO	Question Type	Question Source
1.	B	K	2	1	B1	MC	
2.	A	U	2	1	B1	MC	
3.	A	U	2	1	C2	MC	
4.	D	K	2	1	D1	MC	
5.	D	U	2	1	D1	MC	
6.	C	U	2	1	D2	MC	
7.	B	U	2	2	E1	MC	
8.	B	U	2	2	E1	MC	
9.	B	U	2	2	F2	MC	
10.	B	U	2	2	F1	MC	
11.	B	U	2	2	F2	MC	
12.	D	U	2	3	G1	MC	
13.	C	U	2	3	G1	MC	
14.	D	U	2	3	G1	MC	
15.	C	U	2	3	G1	MC	

Question Number	Keyed Response	Cognitive Process	Mark	Topic	PLO	Question Type	Question Source
16.	C	U	2	4	H1	MC	
17.	D	K	2	4	H1	MC	
18.	A	U	2	4	H1	MC	
19.	A	U	2	4	I1	MC	
20.	D	H	2	4	I1	MC	
21.	C	K	2	4	I1	MC	
22.	A	U	2	5	J1	MC	
23.	D	U	2	5	J2	MC	
24.	B	U	2	5	J3	MC	
25.	C	U	2	5	J5	MC	
26.	C	U	2	6	K1	MC	
27.	B	U	2	6	K1	MC	
28.	A	U	2	6	K2	MC	
29.	A	U	2	6	K1	MC	
30.	B	K	2	7	L2	MC	
31.	C	U	2	7	L1	MC	
32.	C	U	2	7	L1	MC	
33.	A	U	2	7	L2	MC	
34.	D	U	2	7	L2	MC	
35.	C	U	2	7	L2	MC	

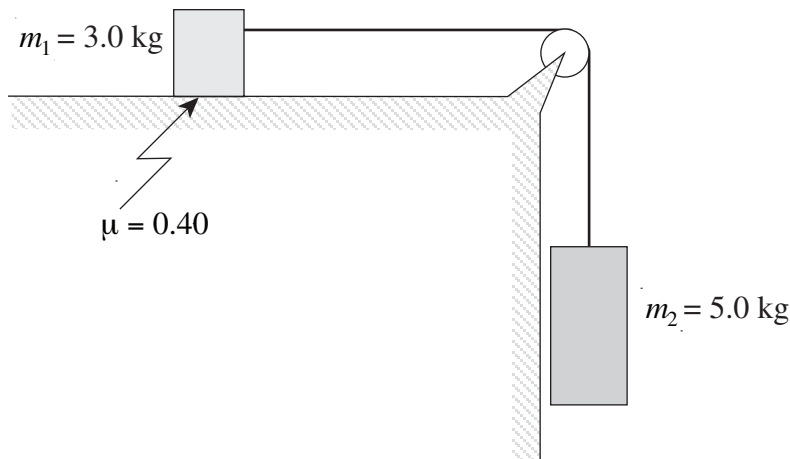
Question Number	Keyed Response	Cognitive Process	Mark	Topic	PLO	Question Type	Question Source
1.	–	U/H	6	1	D2	WR	
2.	–	U	5	3	G1	WR	
3.	–	U	5	5	J2	WR	
4.	–	U	5	7	L1	WR	
5.	–	U/H	5	1	A2	WR	
6.	–	H	4	4	I1	WR	

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Provincial Examination — Scoring Guide

1. (6 marks)

Two masses are connected by a light cord over a frictionless pulley as shown below. The masses are initially held at rest by students doing a dynamics lab.



Determine the acceleration of the system of masses when they are released.

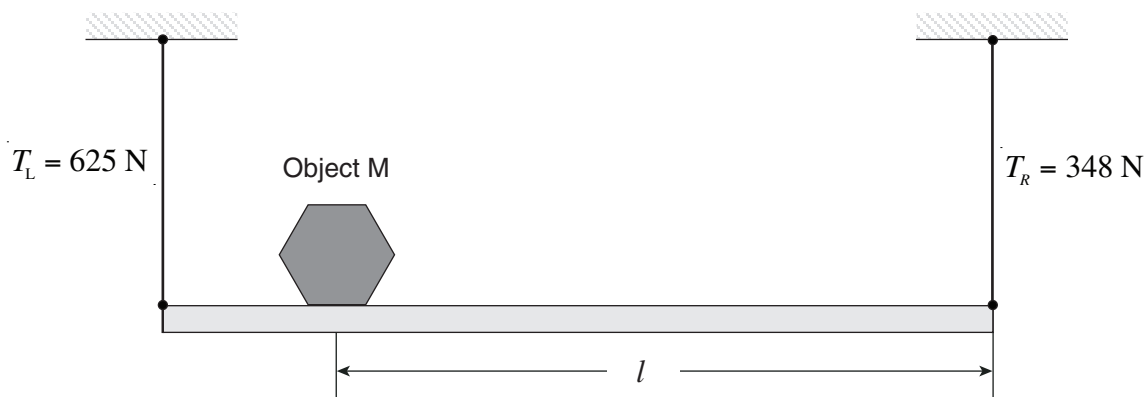
$$\begin{aligned} a &= F_{net}/m \\ &= \frac{F_{2g} - F_f}{m_1 + m_2} \\ &= \frac{5.0 \times 9.8 - 0.40 \times 3.0 \times 9.8}{3.0 + 5.0} \\ &= 4.7 \text{ m/s}^2 \end{aligned}$$

Student B tells Student A that mass m_2 must be greater than mass m_1 if this system is to accelerate. Explain why this need not be the case.

In order for the system of masses to accelerate, there must be a net force acting on the system of masses. ($\frac{1}{2}$ mark) The net force in this case is the difference between the weight of mass m_2 and the friction force acting on mass m_1 . ($\frac{1}{2}$ mark) This means that F_{g2} must be greater than F_f , which means F_{g2} must be greater than μF_{g1} . Therefore, as long as μ is less than one, F_{g2} can be less than F_{g1} . (1 mark)

2. (5 marks)

Two vertical wires with tensions as indicated support a uniform 14 kg, 3.0 m-long beam carrying an object of mass M as shown.



At what distance l from the right-hand wire is the object located?

$$\text{Forces}_{\text{up}} = \text{Forces}_{\text{down}}$$

$$T_L + T_R = Mg + mg \quad \leftarrow \text{1 mark}$$

$$Mg = T_L + T_R - mg$$

$$Mg = 625 + 348 - (14 \times 9.8)$$

$$Mg = 835.8 \text{ N} \quad \leftarrow \text{1 mark}$$

$$\tau_{cc} = \tau_c \quad \leftarrow \text{1 mark}$$

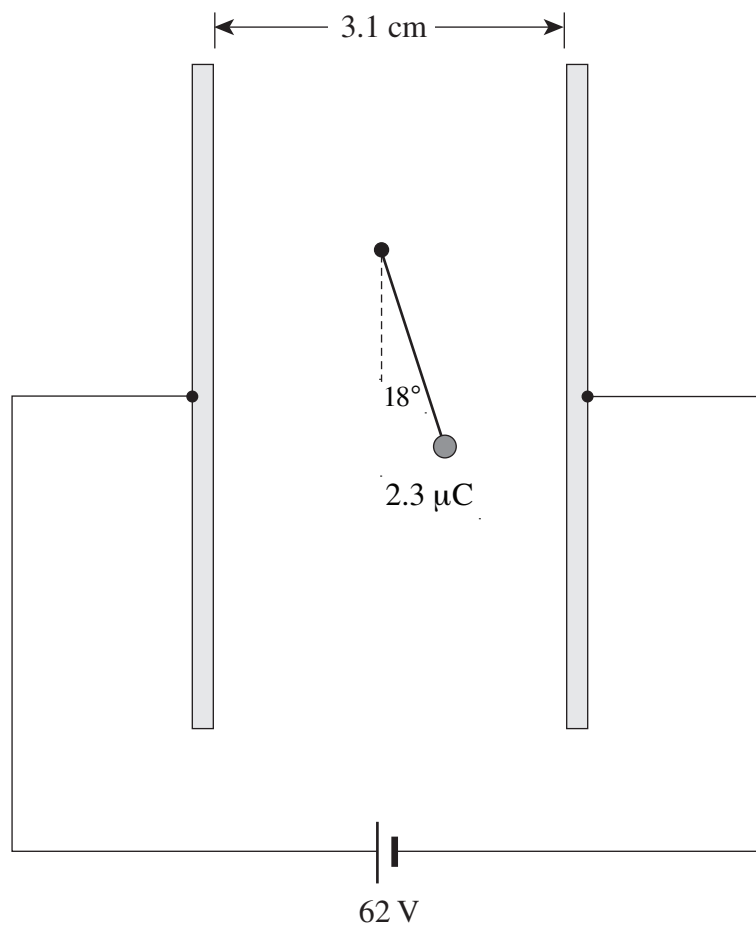
$$625 \times 3.0 = 835.8 \times l + 137.2 \times 1.5 \quad \leftarrow \text{1 mark}$$

$$l = \frac{1875 - 205.8}{835.8}$$

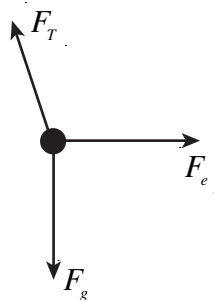
$$l = 2.0 \text{ m} \quad \leftarrow \text{1 mark}$$

3. (5 marks)

A small sphere having a charge of $2.3 \mu\text{C}$ is suspended from a thread hanging between two charged plates as shown.



What is the mass of the small sphere?



$$\tan \theta = F_e / F_g \quad \leftarrow 1 \text{ mark}$$

$$F_g = F_e / \tan \theta$$

$$mg = qE / \tan \theta \quad \leftarrow 1 \text{ mark}$$

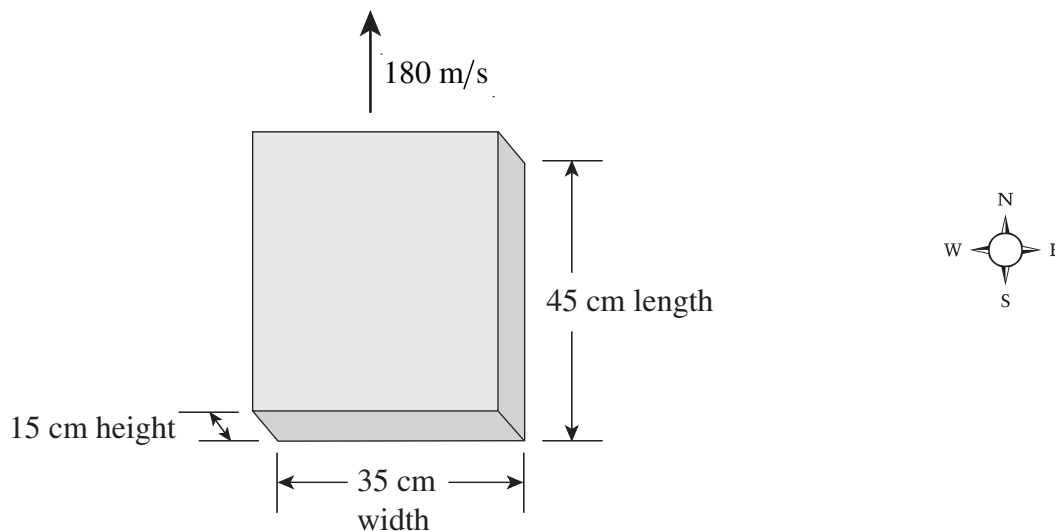
$$mg = \frac{q \times V / d}{\tan \theta} \quad \leftarrow 1 \text{ mark}$$

$$m = \frac{2.3 \times 10^{-6} \times (62 / 0.031)}{9.8 \times \tan 18^\circ} \quad \leftarrow 1 \text{ mark}$$

$$m = 1.4 \times 10^{-3} \text{ kg} \quad \leftarrow 1 \text{ mark}$$

4. (5 marks)

A block of metal moves north at 180 m/s, perpendicular to a magnetic field.



If an electron in the block experiences a force of 7.2×10^{-18} N vertically upwards out of the page, what are the magnetic field strength and direction?

$$F = qvB$$

$$B = \frac{F}{qv}$$

$$= \frac{7.2 \times 10^{-18}}{1.6 \times 10^{-19} (180)}$$

$$B = 0.25 \text{ T, eastward (to the right)} \leftarrow \mathbf{3 \text{ marks}}$$

What is the potential difference developed across this block?

$$\mathcal{E} = Blv$$

$$= 0.25(0.15)180$$

$$\mathcal{E} = 6.8 \text{ V} \quad \leftarrow \mathbf{2 \text{ marks}}$$

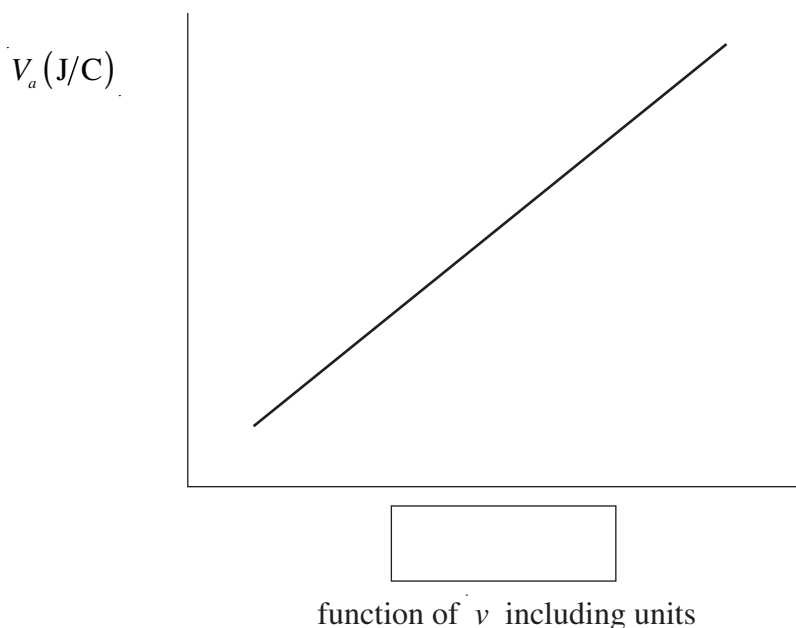
5. (5 marks)

During an electrostatics experiment a small positively charged plastic sphere is accelerated from rest through several different voltages, V_a .

The final velocity, v , of the sphere is recorded for each different accelerating voltage, V_a . The charge, q , on the sphere is the same in each case.

It is possible to use this data to create a linear graph and obtain a slope.

In the box on the graph below write the function (include units) of the velocity, v , that must be used on the horizontal axis to produce a linear relation from this data.



The kinetic energy of the sphere after exposure to the accelerating voltage is given by:

$$V_a \cdot q = \frac{1}{2} m \cdot v^2$$

$$V_a = \frac{m}{2q} \cdot v^2$$

V_a varies as the square of the final velocity, v , of the sphere. (m and q are constant)

Therefore v^2 (2 marks) must be used on the horizontal axis to produce a linear relation from the data.

The units are m^2s^{-2} . (1 mark)

Clearly explain how you can use the slope of this graph to determine the charge q on the plastic sphere if you are given its mass.

Since $V_a = \frac{m}{2q} \cdot v^2$ the slope of the graph must be equal to $m/2q$. The charge q on the plastic sphere can be determined by equating the slope of the graph with $m/2q$ and solving for q , the only unknown.

$$\text{slope} = m/2q$$

$$q = m/2 \cdot \text{slope} \quad \leftarrow 2 \text{ marks}$$

6. (4 marks)

Student A states that there is no force due to gravity acting on the International Space Station (ISS). He states this must be so as he has seen television coverage showing astronauts and equipment floating around in the spacecraft.

Student B states that this is a common misconception for orbiting spacecraft, such as the ISS.

Using principles of physics, help Student B convince Student A that there must be a force due to gravity acting on the ISS.

For a spacecraft to orbit the earth it must be in accelerated motion. Such motion requires a force on the spacecraft. This force is a gravitational force, produced by Earth's gravitational field. (4 marks)