Physics 12

2007/2008 Released Exam
January 2008 — 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	A, B	9 %
and Dynamics *and* Vector Dynamics	C, D	9 %
2. Work, Energy and Power	E	6 %
and Momentum	F, G	6 %
3. Equilibrium	H	12 %
4. Circular Motion	I	8 %
and Gravitation	J	8 %
5. Electrostatics	K, L	12 %
6. Electric Circuits	M, N	12 %
7. Electromagnetism	O, P	18 %

Question Number	Keyed Response	Cognitive Process	Mark	Topic	PLO	Question Type
1.	A	K	2	1	B1Ai1	MC
2.	A	U	2	1	B1Ai5	MC
3.	B	U	2	1	C2Ai6	MC
4.	D	K	2	1	D1Ai4	MC
5.	B	U	2	1	D1Ai6	MC
6.	A	U	2	1	D2Ai6	MC
7.	B	U	2	2	E1Ai3	MC
8.	D	U	2	2	E1Ai10	MC
9.	D	U	2	2	F2Ai3	MC
10.	D	U	2	2	F1Ai7	MC
11.	B	U	2	2	F2Ai3	MC
12.	B	U	2	2	G1Ai3	MC
13.	B	U	2	2	G1Ai3	MC
14.	A	U	2	2	G1Ai12	MC
15.	D	U	2	2	G1Ai12	MC

Question Number	Keyed Response	Cognitive Process	Mark	Topic	PLO	Question Type
16.	B	U	2	3	H1Ai6	MC
17.	C	K	2	3	H1Ai3	MC
18.	B	U	2	3	H1Ai6	MC
19.	C	U	2	4	I1Ai3	MC
20.	C	H	2	4	I1Ai7	MC
21.	C	U	2	4	I1Ai8	MC
22.	A	U	2	4	J1Ai3	MC
23.	D	U	2	4	J2Ai3	MC
24.	D	K	2	4	J2Ai2	MC
25.	D	U	2	4	J5Ai2	MC
26.	B	U	2	6	M7	MC
27.	C	U	2	6	M7	MC
28.	A	U	2	6	M11	MC
29.	A	U	2	6	N2; M7	MC
30.	B	U	2	5	L1Ai7	MC
31.	B	U	2	7	O2	MC
32.	D	K	2	7	P8	MC
33.	B	U	2	7	P5	MC
34.	C	U	2	7	P11	MC
35.	B	U	2	7	P6	MC

Question Number	Keyed Response	Cognitive Process	Mark	Topic	PLO	Question Type
1.	–	U	5	1	C2Ai6	WR
2.	–	U/H	6	2	G1Ai12	WR
3.	–	U	5	3	H1Ai6	WR
4.	–	U	5	5	L1Ai7	WR
5.	–	U/H	5	1	A2Ai1	WR
6.	–	H	4	2	E1Ai8	WR

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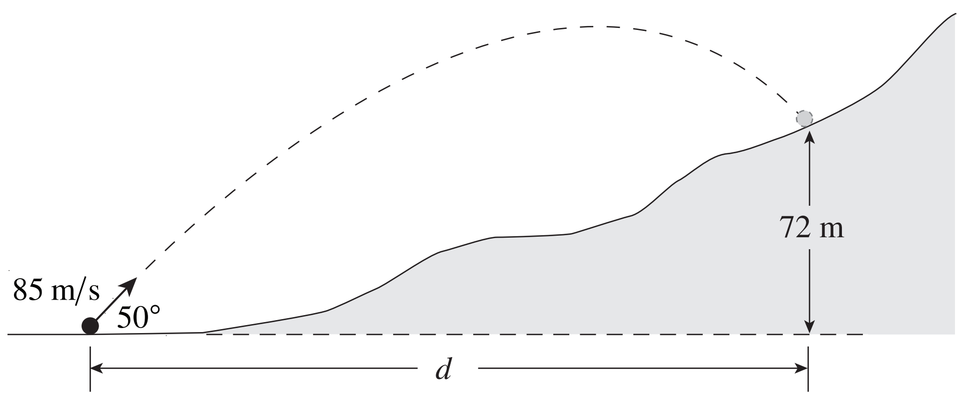
Provincial Examination — Scoring Guide

1. **(5 marks)**

   A cannon ball is launched at $85\ \text{m/s}$, $50°$ above the horizontal, towards a hill as shown.



   What horizontal distance d does the cannon ball travel before it impacts the hillside? (Ignore friction.)

Velocity components:

$v_x = v_0 \cos\theta = 85\cos 50° = 54.6\ \text{m/s}$

$v_y = v_0 \sin\theta = 85\sin 50° = 65.1\ \text{m/s}$ ← **1 mark**

Template set-up — components

$X - component$	$Y - component$
$d_x = ?$	$d_y = 72\ \text{m}$
$v_x = 54.6\ \text{m/s}$	$v_{0y} = 65.1\ \text{m/s}$
$t = ?$	$a_g = -9.8\ \text{m/s}^2$
	$t = ?$

Solution: Solve for time, so *y*-component:

$$d_y = v_0 t + \tfrac{1}{2}at^2$$

$$72 = (65.1)t + \tfrac{1}{2}(-9.8)t^2$$

solving for t,

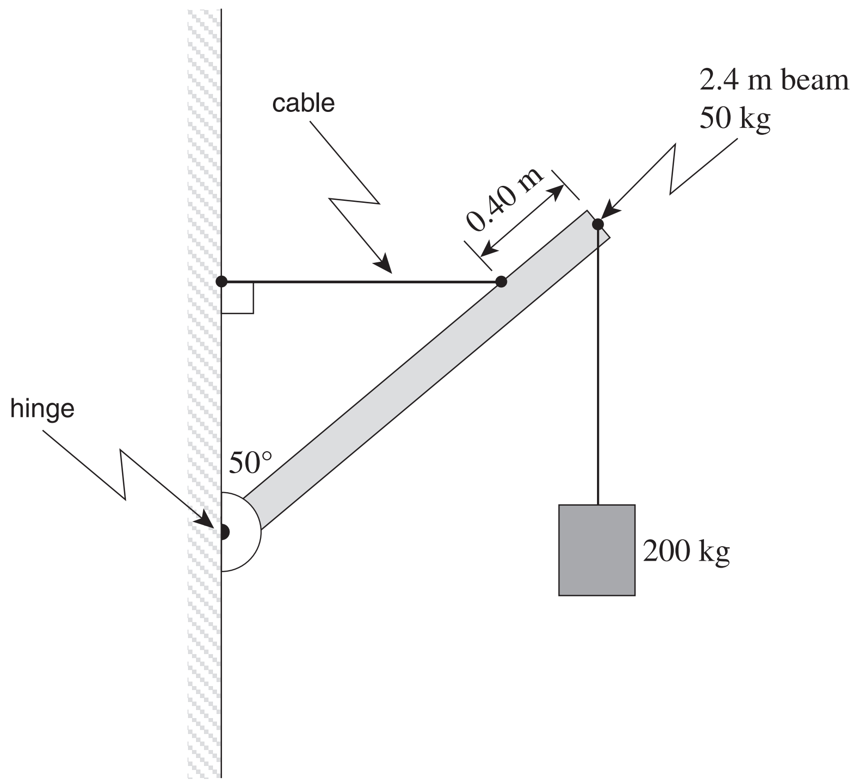
$t = 12.1\ \text{s}$ ← **3 marks**

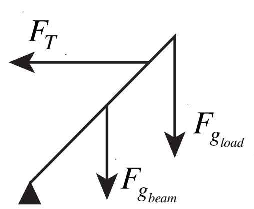
Solving for *d* (d_x)

$d_x = v_x t = 54.6(12.1) = 660\ \text{m}$ ← **1 mark**

2. **(6 marks)**

A uniform 50.0 kg beam with a length of 2.4 m supports a 200 kg load. What is the tension in the horizontal cable attached to the beam as shown below?





In equilibrium,

$$\Sigma\tau = 0$$

$$\tau_{clockwise} = \tau_{counterclockwise}$$

$$\tau_{beam} + \tau_{load} = \tau_{cable} \qquad \leftarrow \tfrac{1}{2} \textbf{ mark}$$

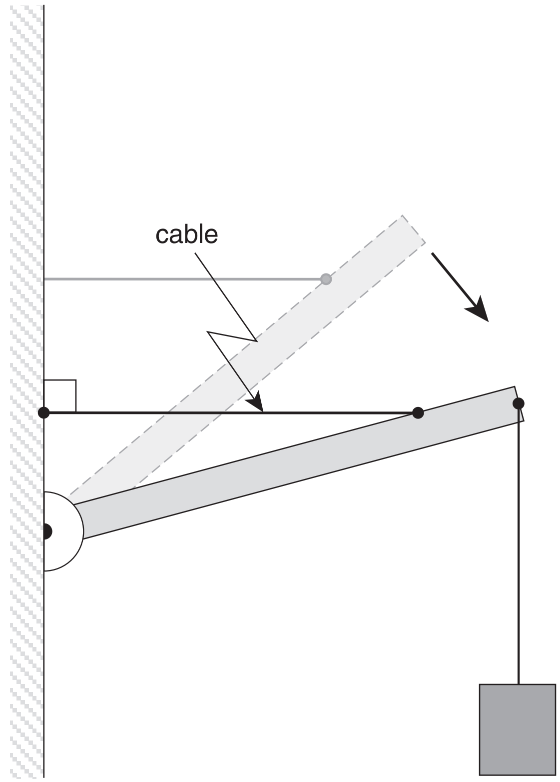
$$lF_{beam}\sin\theta + lF_{load}\sin\theta = lF_{cable}\sin\theta \qquad \leftarrow \textbf{1 mark}$$

$$1.2(50)(9.8)\sin 50° + 2.4(200)(9.8)\sin 50° = 2.0\left(F_T\right)\sin 40° \qquad \leftarrow \textbf{1 mark}$$

$$450 + 3600 = 1.29\ F_T \qquad \leftarrow \tfrac{1}{2} \textbf{ mark}$$

$$F_T = 3200 \text{ N} \qquad \leftarrow \textbf{1 mark}$$

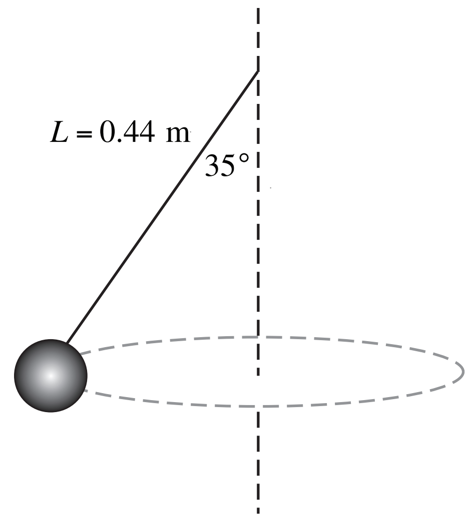
Using principles of physics, explain how this tension will change if the beam is lowered to a more horizontal orientation (i.e., greater angle) as shown below. The cable remains horizontal and connected to the same point on the beam.



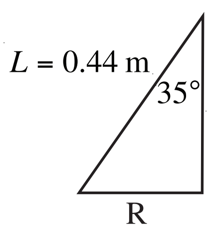
If the beam is moved to a lower, more horizontal orientation, the vertical forces remain the same but as the angle θ increases, the clockwise torques will increase. If the clockwise torques increase, then the counterclockwise torque due to the horizontal cable must increase. This means the tension in the cable must increase. (2 marks)

3. **(5 marks)**

A blue ball is swung in a horizontal circle and completes a single rotation in 1.2 s. The 0.44 m long cord makes an angle of $35°$ with the vertical during the ball's motion as shown.



What is the centripetal acceleration of the ball?



$$\sin\theta = \frac{R}{L}$$

$R = 0.44 \times \sin 35°$	$\leftarrow$ **1 mark**
$R = 0.252$ m	$\leftarrow$ **1 mark**
$a = 4\pi^2 R/T^2$	$\leftarrow$ **1 mark**
$a = 4\pi^2 \times 0.252/1.2^2$	$\leftarrow$ **1 mark**
$a = 6.9 \text{ m/s}^2$	$\leftarrow$ **1 mark**

4. **(5 marks)**

A proton enters a 0.65 T magnetic field. The velocity of the proton is perpendicular to the field causing the proton to travel in a circular arc of radius 1.1×10^{-2} m. What is the momentum of the proton?

$F_c = F_B$ ← **1 mark**

$\frac{mv^2}{R} = qvB$ ← **1 mark**

$mv = qBR$ ← **1 mark**

$p = 1.6\times 10^{-19}\times 0.65\times 1.1\times 10^{-2}$ ← **1 mark**

$p = 1.1\times 10^{-21}$ kg m/s ← **1 mark**

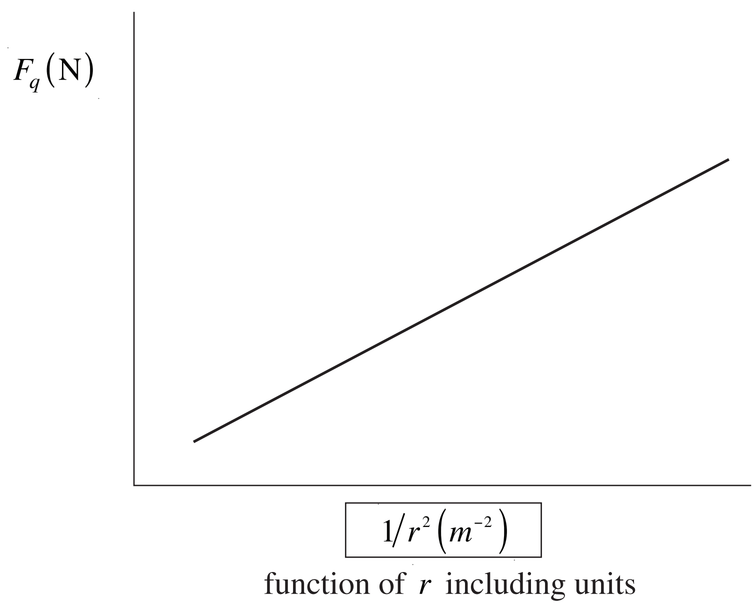
5. **(5 marks)**

During an electrostatics experiment to investigate Coulomb's Law, a positive point charge, q_1, is moved gradually closer to a $10\ \mu C$ charge that is fixed to a table top.

The electrostatic force, F_q, experienced by q_1 at several separation distances, r, from the $10\ \mu C$ fixed charge is recorded.

It is possible to use such data (F_q and r) to create a linear graph and obtain a slope.

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



The electrostatic force, F_q, experienced by the positive charge q_1 from the $10\ \mu C$ fixed charge is given by:

$$F_q = k \cdot q_1 \cdot 10\mu C / r^2$$

F_q varies as the inverse of the square of the separation distance, r.

Therefore $1/r^2$ (2 marks) must be used on the horizontal axis to produce a linear relation from the data.

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

Explain how you can use the slope of this graph to determine the unknown charge, q_1.

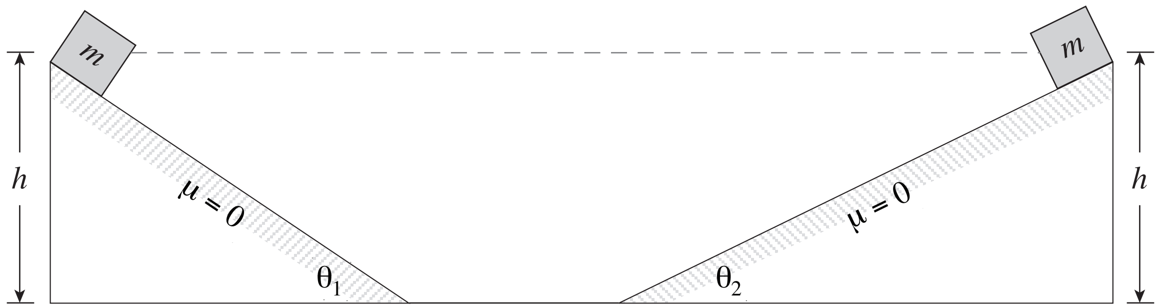
Since $F_q = k \cdot q_1 \cdot 10\mu C / r^2$ the slope of the graph must be equal to $k \cdot q_1 \cdot 10\mu C$. The charge, q_1, can be determined by equating the slope of the graph with $k \cdot q_1 \cdot 10\mu C$ and solving for q_1, the only unknown.

$slope = k \cdot q_1 \cdot 10\mu C$ $\leftarrow$ **2 marks**

$$q_1 = \frac{slope}{k \cdot 10\mu C}$$

6. **(4 marks)**

The two bricks shown have equal mass and are initially positioned at the same height, h, above the floor, at rest. The surfaces of both inclined planes are frictionless.



Using principles of physics, explain why both masses have the same speed when they reach the floor.

Both bricks have equal mass and begin at equal height at rest so they have the same initial E_{total} (all E_p). (2 marks)

Neither brick produces any heat energy through friction on the way down so all of their original E_{total} (E_p) is converted to E_k and they must therefore have the same E_k, and hence the same speed when they reach the floor. (2 marks)