PART A / *BAHAGIAN A*

(1). (a). Figure 1 shows a small bridge on a walking path that has a pin at one end and a roller at the other end. Separate the bridge from its supports and sketch a free body diagram. The center of gravity (cg) of the bridge is at its geometric center, midway between the supports.

Rajah 1 menunjukkan sebuah titi kecil di atas laluan berjalan kaki yang mempunyai satu pin di hujungnya dan satu roda di sebelah hujung bertentangan. Pisahkan titi tersebut daripada tanggungannya dan lakarkan gambarajah jasad bebas. Pusat graviti titi ini berada pada pusat geometrinya, di tengah-tengah kedua-dua kekangan tersebut.
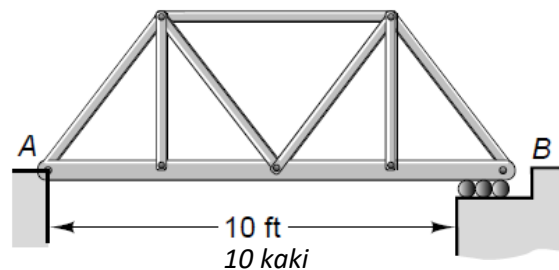

Figure 1 / *Rajah 1*

(5 marks/*markah)*

(b). Express the force **F** as a cartesian vector and calculate α, β, γ based on Figure 2.
Nyatakan daya F sebagai vektor kartesan dan kirakan α, β, γ berdasarkan Rajah 2.
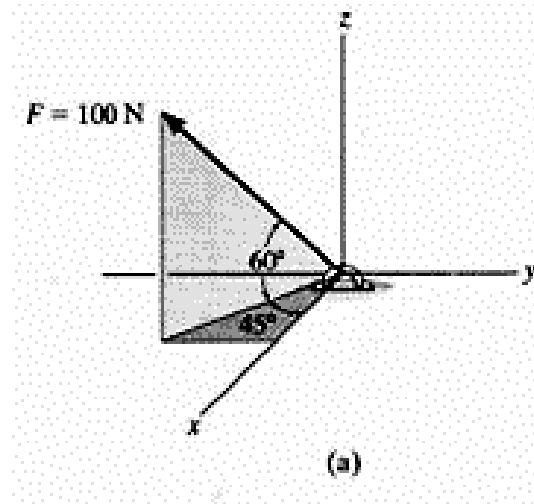
(20 marks/*markah)*

…3/-

Figure 2 / *Rajah 2*

(2). (a). A Material Engineering student travels from Bukit Mertajam (BM) to Nibong Tebal (NT) by commuter. At first, a commuter starts from rest at BM station and accelerates at 0.5 m/s^2 for 60 s. Afterward it travels at a constant velocity for 15 min. It then decelerates at 1 m/s^2 until it is brought to rest at NT station. Determine the distance between the stations.

Seorang pelajar Kejuruteraan Bahan bergerak dari Bukit Mertajam (BM) ke Nibong Tebal (NT) dengan menaiki komuter. Pada mulanya, komuter bermula dari keadaan pegun di stesen BM dan memecut pada 0.5 m/s^2 selama 60 s. Selepas itu ia bergerak dengan halaju malar selama 15 minit. Ia kemudian mengalami nyahpecutan pada 1 m/s^2 sehingga ia dibawa berhenti di stesen NT. Tentukan jarak antara stesen tersebut.

(15 marks/*markah*)

…4/-

(b). Figure 3 shows a diagram between conveyor belt system and loading car drawn by Mineral Engineer. It can be observed that several packages of mineral traveling on the conveyor belt fall off into a 1 m-long loading car. He wants to set the conveyor running at a constant speed of $v = 2$ m/s. However, he needs to determine the smallest and largest distance R at which the end A of the car may be placed from the conveyor so that the packages enter the car. Please assist him.

Rajah 3 menunjukkan diagram antara sistem tali sawat dan kereta muatan yang dilukis oleh Jurutera Mineral. Diperhatikan bahawa beberapa bungkusan mineral yang bergerak pada tali sawat penghantar jatuh ke dalam kereta muatan sepanjang 1 m. Dia ingin menetapkan penghantar tersebut bergerak pada kelajuan malar v = 2 m/s. Walau bagaimanapun, dia perlu menentukan jarak terkecil dan terbesar R di mana hujung A kereta boleh diletakkan dari penghantar supaya bungkusan memasuki kereta. Sila bantu beliau.
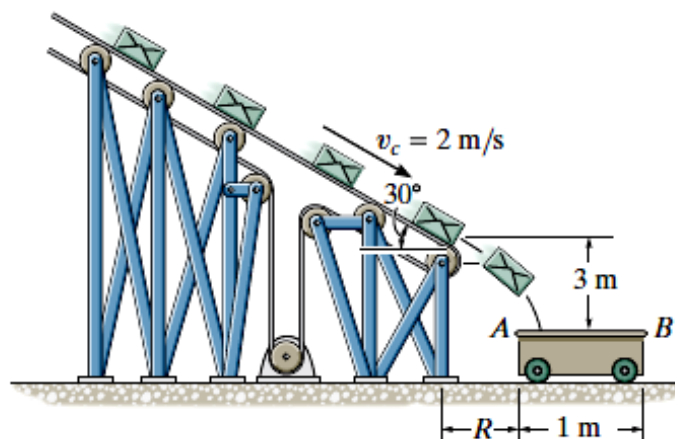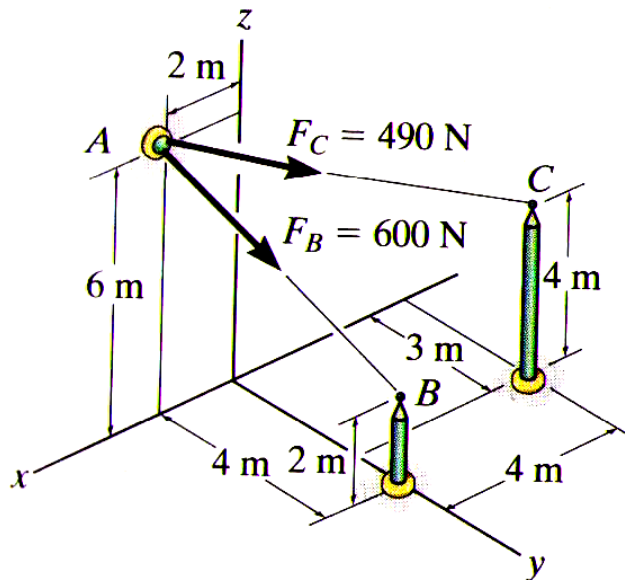

Figure 3 / *Rajah 3*

(10 marks/*markah*)

PART B / *BAHAGIAN B*

(3). (a). Determine the resultant force at A (Figure 4).

Tentukan daya paduan di A (Rajah 4).

Figure 4 / *Rajah 4*

(13 marks/*markah)*

(b). A bridge support structure has a mass of 101.94 kg with center of gravity located mid way between A and B. Calculate the reaction of the bridge supports if a 3 kN load is applied at the point indicated in the Figure 5.

Satu struktur penyokong jambatan mempunyai jisim 101.94 kg dengan pusat gravitynya berlokasi di tengah antara A dan B. Kirakan tindakbalas penyokong jambatan tersebut jika beban 3 kN dikenakan pada tempat ditunjukkan dalam Rajah 5.

(12 marks/*markah)*

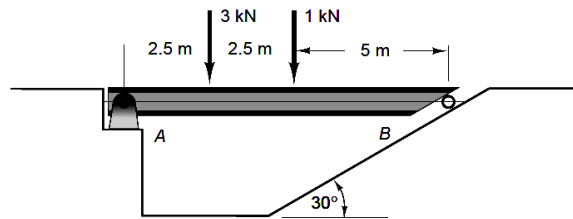**…6/-**

Figure 5 / *Rajah 5*

(4). (a). Identify the centroid ($\bar{x}, \bar{y}$) for the cross sectional area in Figure 6

Tentukan sentroid ($\bar{x}, \bar{y}$) bagi kawasan keratan rentas dalam Rajah 6.
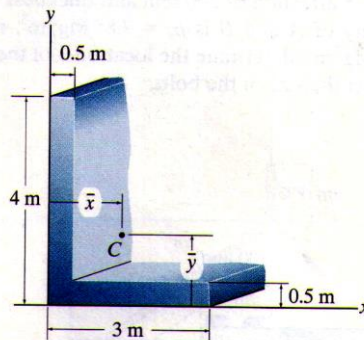
(8 marks/*markah*)

Figure 6 / *Rajah 6*

(b). Determine the resultant couple moment of the two couples that act on the pipe assembly (Figure 7). The distance from A to B is d = 400 mm. Express the result as a Cartesian vector.

Hitungkan momen berpasangan untuk dua pasangan yang bertindak di sambungan paip (Rajah 7). Jarak dari A ke B adalah d = 400 mm. Nyatakan sebagai jawapan vektor kartesan.
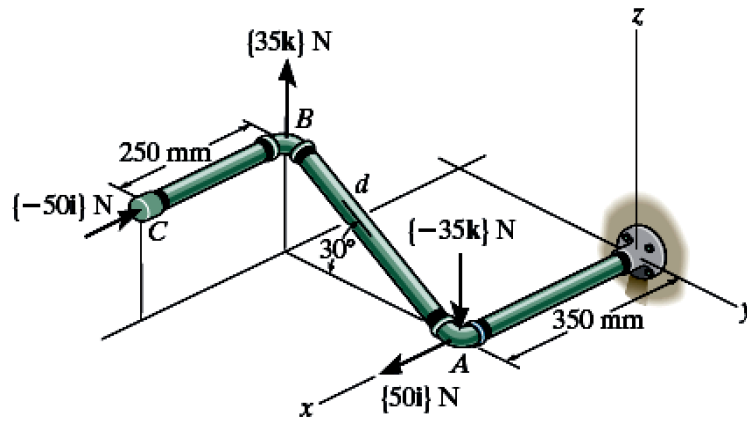
(17 marks/*markah*)

Figure 7 / *Rajah 7*

PART C / *BAHAGIAN C*

(5). (a). State the principles of work and energy and when they are useful to apply?

Nyatakan prinsip kerja dan tenaga dan bila mana ia sesuai digunakan?

(4 marks/*markah*)

(b). Maybe some of you have watched a Fast and Furious movie, where opponent vehicle has hit a road barrier. Actually, this barrier is made from plastic and filled with water. The barrel barrier is normally placed in front of the bridge pier. If the relation between the force and deflection of the barrier is $F = \left(800(10^3)x^{1/2}\right)N$, where x is in *m* as illustrated in Figure 8, determine the car's maximum penetration in to the barrier. The car has a weight of 20,000 N and it is traveling with a speed of 20 m/s just before it hits the barrier.

Mungkin sebahagian daripada anda telah menonton filem Fast and Furious, di mana kenderaan lawan telah melanggar penghadang jalan. Sebenarnya, penghadang ini diperbuat daripada plastik dan diisi dengan air. Penghalang tong biasanya diletakkan di hadapan jeti jambatan. Jika hubungan antara daya dan pesongan penghalang ialah $F = \left(800(10^3)x^{1/2}\right)N$, di mana x berada dalam m seperti yang digambarkan dalam Rajah 8, tentukan penembusan maksimum kereta dalam penghalang itu. Kereta itu mempunyai berat 20,000 N dan ia bergerak dengan kelajuan 20 m/s sejurus sebelum ia melanggar penghalang.

Figure 8/*Rajah 8*

(6 marks/*markah*)

(c).   An experiment on the nature of electrons is carried out in the
PPKBSM advanced materials laboratory. An electron of mass m is
discharged with an initial horizontal velocity of v_0 as shown in
Figure 9. If it is subjected to two fields of force for which $F_x = F_0$ and
$F_y = 0.3F_0$, where F_0 is constant, determine the equation of the path,
and the speed of the electron at any time t.

*Satu eksperimen sedang dijalankan di makmal bahan termaju
PPKBSM tentang sifat elektron. Elektron berjisim m dinyahcas
dengan halaju mendatar awal v_0 seperti yang ditunjukkan pada
Rajah 9. Jika ia tertakluk kepada dua medan daya yang $F_x = F_0$ dan
$F_y = 0.3F_0$, di mana F_0 adalah malar, tentukan persamaan laluan,
dan kelajuan elektron pada bila-bila masa t.*

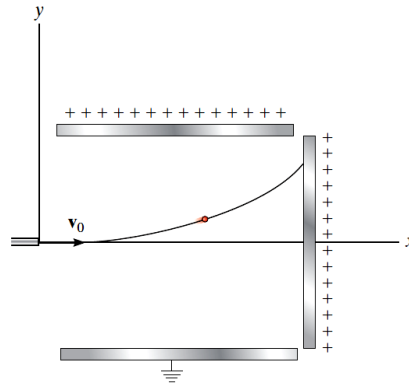Figure 9/*Rajah 9*

(15 marks/*markah*)

*(*6). (a). Differentiate impulse and impact and also state their respective equations.

Bezakan dorongan dan impak dan nyatakan juga persamaan mereka masing-masing.
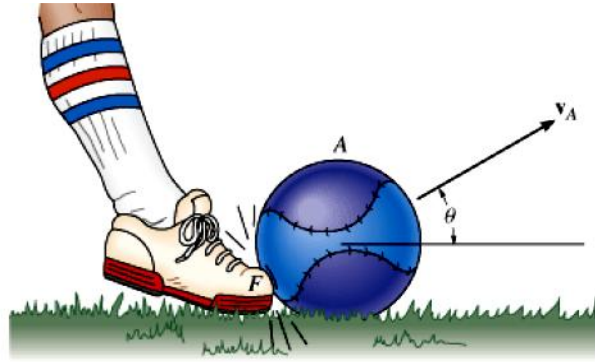
(6 marks/*markah*)

(b). Figure 10a shows Ronaldo once at Manchester United kicking the ball. Let say, he kicked the ball of mass 200 *g* and it left the ground at angle 30º and strikes the ground 15 *m* away (Figure 10b). Determine the impulse of his foot *F* on the ball. Neglect the impulse caused by the ball's weight while its being kicked.

Rajah 10a menunjukkan Ronaldo ketika beliau di Manchester United menendang bola. Dia menendang bola berjisim 200 g supaya ia meninggalkan tanah pada sudut 30º dan mengenai tanah pada jarak 15 m darinya (Rajah 10b). Tentukan impuls kakinya F pada bola itu. Abaikan impuls yang disebabkan oleh berat bola semasa ia ditendang.

(a) Ronaldo kicked the ball/*Ronaldo menendang bola*

(b) Free body diagram/*Rajah badan bebas*

Figure 10/*Rajah 10*

(9 marks/*markah*)

(C). Figure 11 portrayed a boy who want to hit the marble ball. Marble balls *A* and *B* each have a mass of 20 *g*. If *A* strikes *B* with a velocity $(v_A)_1 = 1.5\,m/s$, determine their final velocities after collision. Marble ball *B* is originally at rest and the coefficient of restitution is *e = 0.85*. Neglect the size of each marble ball and also assume the surface is smooth.

Rajah 11 menggambarkan seorang budak lelaki yang ingin memukul bola guli. Bola guli A dan B masing-masing mempunyai jisim 20 g. Jika bola guli A memukul B dengan halaju$(v_A)_1 = 1.5\,m/s$, tentukan halaju akhir mereka selepas perlanggaran. Bola guli B pada asalnya pegun dan pekali pengembalian ialah e = 0.85. Abaikan saiz setiap bola guli dan juga anggap permukaannya licin.

Figure 11/*Rajah 11*

(10 marks/*markah*)

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